

APPENDIX

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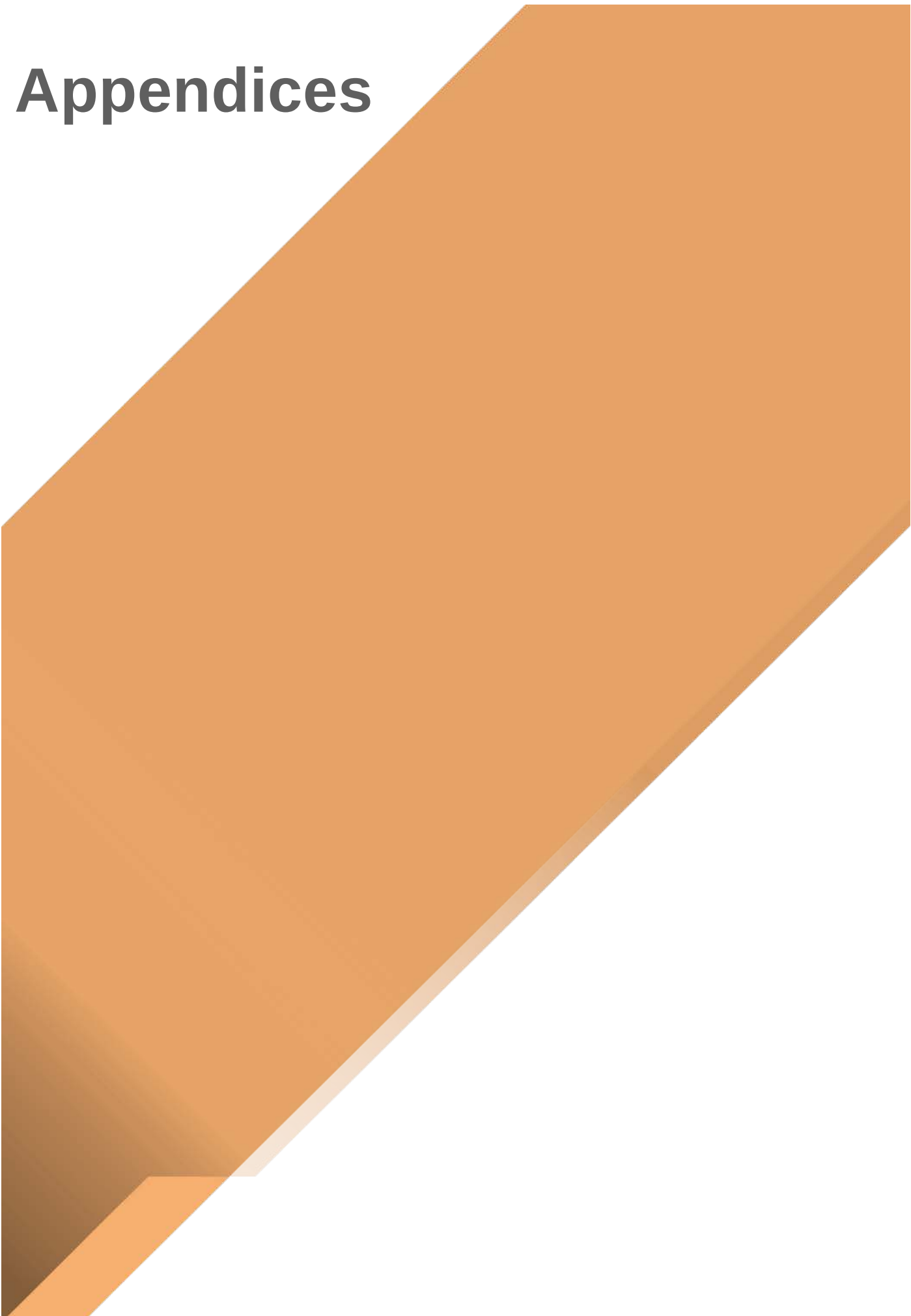
INLAND
RAIL 

Groundwater Technical Report

Part 2 of 2

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

Appendices



APPENDIX

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Groundwater Technical Report

Appendix A Registered Bores within the Project Footprint

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

Appendix A

Registered bores within the Project footprint

Registered bore RN	Bore depth	Reported aquifer	Easting	Northing	Lat	Long
71611	85.3	Kumbarilla Beds	261004	6832198	-28.6152	150.5556
41620041	28.8	Kumbarilla Beds	262066	6832209	-28.6153	150.5665
77068	96.0	Kumbarilla Beds	260728	6832238	-28.6148	150.5528
77347	20.0	Alluvium - Border Rivers (Macintyre River)	280255	6837431	-28.5715	150.7534
56880	29.0	Hutton Sandstone	315970	6860422	-28.3696	151.122
18790	100.6	Walloon Coal Measures	325745	6904659	-27.9718	151.2283
48317	36.3	Alluvium - Condamine	343406	6924792	-27.7923	151.4105
42230034	0.0	Alluvium - Condamine	343040	6924795	-27.7922	151.4068
42231415	52.0	Alluvium - Condamine	343763	6925098	-27.7896	151.4142
42230038	13.3	Alluvium - Condamine	344623	6925917	-27.7823	151.423
42231160	11.3	Alluvium - Condamine	344623	6925917	-27.7823	151.423
42230040	11.5	Alluvium - Condamine	344623	6925917	-27.7823	151.423
42230039	12.1	Alluvium - Condamine	344623	6925917	-27.7823	151.423
56586	38.1	Alluvium - Condamine	344659	6925957	-27.7819	151.4234
42230043	30.6	Alluvium - Condamine	348392	6928800	-27.7567	151.4616
42231378	76.0	Alluvium - Condamine	348392	6928800	-27.7567	151.4616
42231378	119.0	Alluvium - Condamine	348392	6928800	-27.7567	151.4616
32163	31.7	Main Range Volcanics	360800	6933647	-27.7143	151.588
64493	66.0	Main Range Volcanics	364827	6934713	-27.7051	151.629
119211	78.0	Main Range Volcanics	365749	6935428	-27.6987	151.6384
94532	43.0	Main Range Volcanics	368745	6936071	-27.6932	151.6689
61628	6.2	Main Range Volcanics	372728	6940243	-27.656	151.7097
66261	31.0	Main Range Volcanics	374393	6941342	-27.6462	151.7267
107025	98.0	Main Range Volcanics	375923	6942517	-27.6357	151.7423
52509	43.3	Main Range Volcanics	378064	6946048	-27.6041	151.7644
30052	198.0	Walloon Coal Measures	378797	6952008	-27.5503	151.7724
66652	89.0	Walloon Coal Measures	378887	6952048	-27.55	151.7733
35241	45.7	Main Range Volcanics	380259	6954642	-27.5267	151.7875
83537	109.0	Main Range Volcanics	385995	6958407	-27.4932	151.8459
64284	79.2	Hutton Sandstone	385604	6958441	-27.4929	151.8419

APPENDIX

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Groundwater Technical Report

Appendix B Border to Gowrie: Hydrogeological Design Report—Golder Associates

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

Appendix B

Border to Gowrie: Hydrogeological Design Report – Golder Associates



REPORT

Inland Rail - Border to Gowrie

100% Feasibility Design Scope of Works- Hydrogeology

Submitted to:

Alice Clark- Geotechnical Discipline Leader

Future Freight Joint Venture

Submitted by:

Golder Associates Pty Ltd

147 Coronation Drive, Milton, Queensland 4064, Australia

+61 7 3721 5400

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Important Information Relating to this Report

1.0 INTRODUCTION

1.1 Background

Inland Rail is a freight transport scheme connecting Melbourne with Brisbane along a rail route west of the mountainous Great Dividing Range via regional Victoria, New South Wales and Queensland. The scheme has been divided into 13 sections to facilitate delivery of the 1 700-kilometre rail line by 2024/2025. Future Freight Joint Venture (FFJV), the AECOM/Aurecon consortium, is delivering works associated with five sections including the Border to Gowrie section (the Project).

1.2 Objective

This report provides 100% Feasibility Design advice regarding estimated groundwater levels and inflows to cut sections. It also provides an assessment of groundwater quality parameters to inform feasibility design for earthworks, bridges and cuts along the Project alignment. This version of the report supersedes Golder Technical Memoranda (Golder, 2018a).

1.3 Alignment

The Project extends approximately 210 km, commencing from a proposed tie in point along the existing Queensland Rail (QR) South Western Line (southern terminus), approximately 26 km west of Yelarbon. It will extend to Gowrie Junction (northern terminus), that is immediately west of Toowoomba. It is planned to construct the southern portion of the alignment along the existing QR railway to Whetstone (Kilometrage 30.200). At that point, it will leave the existing rail alignment and by-pass to the north of Inglewood (Kilometrage 68.800). This part of the alignment primarily passes through privately owned farmland, prior to it re-joining an existing QR railway between Millmerran and Yandilla (Kilometrage 137.200). At Yandilla the railway crosses the Condamine River Valley (Kilometrage 142.600) heading towards Yarranlea (Kilometrage 162.200). Beyond Yarranlea the planned alignment diverts away from the existing railway, and it will remain within a greenfield (farmland) area for the remainder of its length as far as Gowrie Junction (Kilometrage 206.400) where it will join up with the QR Western System line.

1.4 Assumptions

This report is based upon the following information supplied by FFJV including:

- geological sections and accompanying geotechnical interpretive information for critical cuts
- critical cuts¹
- cut and fill details²
- design flood levels³
- bridge register⁴.

¹ Updated digital information supplied on 18 December 2018

² Updated digital information supplied on 18 December 2018

³ Derivation of design flood levels detailed elsewhere. Information supplied to Golder as digital surfaces on 4th December 2018.

⁴ Updated bridge register supplied 19 December 2018 with clarification that unique bridge identifiers are the kilometrage and bridge name.

2.0 REVIEWED INFORMATION

Completed scope from the Phase 2 Feasibility Design geotechnical investigation⁵ at the time of this report includes:

- Rotary and core drilling at documented positions associated with:
- 29 bridge locations,
 - 26 rail bridges, and
 - 3 road bridges.
- 48 cut locations.
- 77 embankment locations.
- Installation of 22 groundwater monitoring bores equipped with standpipe piezometers and automatic water level probes recording groundwater level at half hourly intervals.
- Borehole permeability testing including:
 - slug testing in 12 monitoring bores.
- Groundwater sampling for water chemistry analysis
- Groundwater modelling⁶.

Data records and information gained from the investigation were used to inform the hydrogeological assessment. Selected results from the site investigation are presented in this report.

There are a limited number of publicly available data sources to assess the hydrogeology and groundwater conditions, including the following maps and publications:

- 1) Conceptual modelling for the Clarence-Moreton bioregion, Product 2.3 from the Clarence-Moreton Bioregional Assessment, 19 January 2017 (Raiber *et. al.*, 2016).⁷
- 2) Observations analysis, statistical analysis and interpolation for the Clarence-Moreton bioregion, Product 2.1 – 2.2 from the Clarence-Moreton Bioregional Assessment, 6 October 2016 (Australian Government, 2018).
- 3) Conceptual modelling of the Maranoa-Balonne-Condamine subregion, Product 2.3 from Maranoa-Moreton Bioregional Assessment, 26 May 2016 (Holland, *et. al.*, 2016).
- 4) Australian Government Bureau of Meteorology (BoM) Climate statistics for Australian locations.
- 5) Geology of the Ipswich and Stanthorpe 1:250 000 Sheet Areas (Geological Survey of Queensland & Cranfield and Schwarzbock 1973).
- 6) Water bore data with stratigraphic descriptions and groundwater quality data (DNRM, 2018).

⁵ Refer Condamine Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

⁶ #1897791-014-V-Rev0 Scope Change Request Additional Hydrogeological Scope B2G

⁷ Information from the Basin bioregion assessments were used to develop characteristics for the Inland Rail Project and are included in similar geological units and limited information available in the Maranoa-Balonne Bioregion Assessment for the area.

3.0 PHYSIOGRAPHIC SETTING

3.1 Climate and Rainfall

The Bureau of Meteorology weather station at Warwick (Station Number 041525) is the nearest weather station, less than 100 km to the east of the alignment on the west side of the Great Dividing Range, with evaporation data available near Project alignment in Queensland. Rainfall from the following stations have been reported on Figure 1 to compare rainfall and evaporation along the project alignment which covers approximately 210 km. Rainfall along the alignment is generally uniform (temporally) with minor variations from October through December. Rainfall stations include:

- Warwick (Station Number 041525),
- Glen Royal (Station Number 041504), and
- Inglewood Bridge TM (Station Number 041123).

The Glen Royal BoM weather station (041504) is south-west of Toowoomba near the locality of Brookstead and has long term climate data (1943 to 2018). Table 1 provides long-term monthly rainfall (summary) statistics for the Glen Royal BoM station. Statistical results from this station indicate an annual rainfall range from 368.5 mm to 1077.5 mm, a mean annual rainfall of 648.6 mm and a median annual rainfall of 652.4 mm (BoM, 2018). Records from the Glen Royal BoM weather station has been used to develop a Cumulative Rainfall Deficit (CRD) dataset.

Table 1: Long-term Mean Monthly Rainfall Summary Statistics for Glen Royal Australian Bureau of Meteorology station number 041504 for between 1943 and 2018

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	85.8	75.3	59.2	36.1	41.4	32.0	34.8	30.1	30.7	62.4	69.8	99.7
Lowest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.0
10th %ile	22.5	24.9	3.4	0.1	4.4	4.8	2.9	0.8	4.6	16.5	16.8	28.5
Median	78.2	63.0	40.6	25.4	27.2	25.6	28.9	24.2	23.4	54.7	63.0	91.
90th %ile	152.9	146.1	137.8	72.7	82.5	75.4	70.6	67.9	72.3	115.9	121.3	175.7
Highest	285.7	194.0	329.4	253.0	289.6	121.5	140.5	104.7	109.4	210.9	240.7	385.6

Notes: Source – Bureau of Meteorology (2018). Lowest and highest monthly values are in blue and red, respectively.

Despite the large area covered by the Project alignment, rainfall distribution does not differ greatly between weather stations which is likely the result of the alignment lying to the west of the Great Dividing Range (Figure 1). Throughout the year, monthly evaporation is greater than monthly rainfall, which indicates a net deficit of water on a monthly basis. Direct infiltration of rainfall to groundwater is unlikely during dry periods, when light rainfall events will be mostly absorbed by soil moisture only to be subsequently lost to evapotranspiration. Recharge is likely to occur in response to more intense or continuous rainfall events, and overall net recharge rates at the site are expected to be low.

Annual rainfall records were used to calculate rainfall residuals and the CRD, for the 'Glen Royal' BoM station (Figure 1). The CRD shows the long-term trends in rainfall patterns. A rising trend in slope in the CRD plot indicates periods of above average rainfall, whilst a declining slope indicates periods when rainfall is below average. CRD and groundwater levels are generally well correlated, with groundwater levels expected to rise during periods of rising CRD (regional scale groundwater recharge) while those recorded during periods of declining CRD expected to decline (drought conditions).

Some long-term trends occur at Glen Royal that likely extend throughout the project alignment. The CRD residual underwent multiple cycles, with trends generally decreasing from 1942 to 1952, increases from 1952 to 1964, decreases again from 1964 to 1968, increasing from 1968 until 1989, decreasing again from 1989 to 2008 before increasing from 2008 to 2017. There were wetter than average periods from the 1970s to the 1980s which were followed by dryer periods from the 1990s to 2010s. In recent years between 2010 and 2017, there were wetter than average periods.

3.2 Topography and Drainage

The project alignment begins from a proposed tie in point along the existing Queensland Rail (QR) South Western Line (southern terminus), approximately 26 km west of Yelarbon at about 230 m AHD, extending to about 3 km east of Gowrie Junction at approximately 450 m above sea level. West of the Toowoomba Range the section is located within a relatively flat plateau with localised slopes, gradually decreases in elevation to the south-west along gradually undulating terrain. The project alignment falls within the following drainage basins:

- Between Kilometrage 0.000 to 117.200 km, surface water in the Border Rivers basin regionally flows to the west. The Border Rivers basin is divided into the Macintyre Brook sub-basin and the Macintyre & Weir Rivers sub-basin.
 - The Macintyre Brook sub-basin drains to the south-west near Yelarbon, and
 - The Macintyre & Weir Rivers sub-basin drains to the west.
- Between Kilometrage 117.200 and 209.400 km, surface water in the Balonne-Condamine basin regionally flows to the north-west.

The approximate locations where the project alignment intersects a watercourse are presented in Table 2. These locations are based on a spatial assessment of intersections between the project alignment and water course spatial layers (DNRM, 2018).

Table 2: Watercourses Intersected by the Project Alignment

Watercourse Crossed	Approximate Kilometrage (km)
5 Ephemeral tributaries of Macintyre Brook	48.400 to 82.600
2 Pariagara Creek	66.200 and 67.400
6 Ephemeral tributaries of Canning Creek	74.200 to 85.000
Ephemeral tributary of Cattle Creek	87.200
Cattle Creek	88.100
6 Ephemeral tributaries of Canning Creek	91.800 to 97.400
Boola Creek	100.300
Nicol Creek	104.200
4 Ephemeral tributaries of Nicol Creek	109.200 to 115.600
9 ephemeral tributaries of Leonard (Back Creek) Gulley	117.300 to 124.400
Leonard (Back Creek) Gulley	126.800 to 127.600
Grass Tree Creek	138.000

Watercourse Crossed	Approximate Kilometrage (km)
Ephemeral tributary of Grass Tree Creek	139.200
Condamine River	142.400
Condamine River (North Branch)	148.200
3 ephemeral tributaries of Fourteen Mile Creek	168.000 to 170.600
4 Ephemeral tributaries of Umbiram Creek	181.200 to 185.400
6 Ephemeral tributaries of Westbrook Creek	188.200 to 195.600
Westbrook Creek	196.800
Dry Creek	197.300
Ephemeral tributary of Dry Creek	201.000
3 Ephemeral tributaries of Gowrie Creek	204.300 to 206.300

3.3 Land Use and Cover

The Project extends south-west to north-east through the eastern portion of the Inland Catchments Bioregion (Maranoa-Balonne-Condamine subregion). Land cover in the Maranoa-Balonne-Condamine subregion has undergone significant modification, with approximately 75% of the subregion currently used for agricultural purposes, including predominantly grazing.

The project alignment is traversed by a number of ephemeral river systems (e.g. Canning Creek and the Condamine River). The data that define the primary land uses within a 5 km corridor of the rail alignment are based on spatial land use GIS data from the State of Queensland, 2016. Primary land uses comprise the following:

- Grazing native vegetation (46.25%), which is prevalent throughout the entire alignment.
- Cropping (30.29%) occurring primarily in the north-eastern portion of the alignment, west of Toowoomba and north of Inglewood.
- Production Forestry (10.18%) associated with the Bringilily and Whetstone State Forests.
- Irrigated land (including irrigated cropping, irrigated cotton cropping, irrigated perennial horticulture and irrigated modified pastures) occurs proximal to river systems and comprises approximately 8.5% of the total area. Irrigated areas may contribute to excess groundwater discharge into river systems.

Land use types within a 5 km corridor are listed in Table 3 and displayed on Figure 3.

Table 3: Percent Land Use by Area (within 5 km corridor of the Project Alignment)

Land Use Type (Secondary)	Sum Area (m ²)	% of Total Area
Grazing Native Vegetation	995 287 495	46.25
Cropping	651 787 044	30.29
Production Forestry	219 122 973	10.18
Irrigated Cropping	101 874 512	4.73
Irrigated Cropping – Cotton	80 440 237	3.74
Residential	31 470 786	1.46
Water (Including Reservoir/Dam, River, Marsh/Wetland, Lake)	21 574 690	1.00
Irrigated Perennial Horticulture	6 362 452	0.30
Irrigated Modified Pastures	1 812 347	0.08

Land Use Type (Secondary)	Sum Area (m ²)	% of Total Area
Others (Intensive animal production, transport and communication, services, mining, other minimal use, grazing modified pastures, nature conservation, manufacturing and industrial, land in transition, plantation forestry, perennial horticulture, utilities and waste treatment, and disposal)	42 073 540	1.96

3.4 Regional Flooding

A separate design flood assessment has been commissioned to support this Project.

Surface water levels provided for the 1% Annual Exceedance Probability (AEP) indicate that about half of the Project route has the potential to be directly impacted as indicated by the plan in APPENDIX A.

Potential hydrogeological impacts associated with regional flooding events are discussed in later sections.

4.0 REGIONAL HYDROGEOLOGY

Between Kilometrage 0.000 to 117.200 km, the Project alignment is located within the Border Rivers Basin, which is divided into the Macintyre Brook sub-basin and the Macintyre & Weir Rivers sub-basin. The remaining portion of the Project alignment, between kilometrage 117.200 and 209.400 km, is located within the Condamine Valley.

In the Border Rivers Basin, groundwater is associated with alluvial sediments found along the Dumaresq and Macintyre rivers and Macintyre Brook. Much of the region is characterised by an upper and lower alluvial system containing groundwater. East of the Macintyre Brook and Dumaresq rivers, alluvial sediments are largely confined to narrow valleys (Welsh et al, 2014).

The Condamine Valley is characterised by superficial high plasticity soils overlying a deep alluvium profile, with an intensely weathered bedrock profile beneath. Based on published geological maps, the bedrock in the Condamine Valley includes the Jurassic age Pilliga Sandstone and the Walloon Coal Measures (WCM), and the late Jurassic to Cretaceous age Kumbarilla beds. The Tertiary aged Main Range Volcanics (MRV) overlies the WCM east of kilometrage 163.800 km. Additionally, there are up to 100 m of alluvial deposits underlying the alluvial plains in the region, which are reported by Exon et al (1981) as Tertiary and Quaternary. Surficial Quaternary sand deposits are also present, which generally comprise a thin veneer of sand and red sandy soils which are developed from the breakdown of outcropping geological units (Senior, 1973).

Bedrock geology expected to be intercepted by cuts between Kilometrage 5.600 and 24.400 km is thought to consist of the Kumbarilla beds of the Surat Basin. The Kumbarilla beds are the outcrop equivalent of the sequence from the Springbok Sandstone to the Bungil Formation, which overlies the WCM with a contact that is a disconformity. The lithology of the Kumbarilla beds comprises sandstone, siltstone, mudstone and some conglomerate.

The Pilliga Sandstone is interbedded with the Springbok Sandstone and consists of quartzose sandstone and conglomerate with minor interbeds of siltstone and coal. The Pilliga Sandstone conformably overlies the WCM. The Eurombah Formation is a lithic conglomeratic sandstone with mudstone and siltstone beds. The Eurombah Formation conformably underlies the WCM and conformably overlies the Marburg Subgroup.

In the northern part of the project alignment, between Kilometrage 165.000 and 208.000 km, the MRV is present, which comprises a Tertiary basalt aquifer composed of weathered and fresh basalt ranging in thickness from 1 m up to approximately 90 m. The basalt aquifer may be compartmentalised into units with variable permeability such as low permeable units of claystone that weathers to a low permeability clay, weathering horizons developed between basalt flows, or units with high permeability such as honeycombed basalts. Low permeable massive basalts may exist in the centre of a basalt flow, separating the highly permeable vesicular and honeycomb basalts typically developed at the bottom and top of basalt flows. It is understood that the groundwater in the MRV is typically fresh and becomes brackish in the underlying Surat Basin formations. Total dissolved solids range between 194 to 2730 mg/L based on 114 samples from the Queensland Groundwater database (DNRM, 2018).

The alluvial deposits in the region largely consist of the Condamine Alluvium Unit, which occurs throughout the project alignment. The unit comprises fine to coarse-grained gravels and channel sands interbedded with clays (DNR, 2016). Additionally, the Project crosses the Macintyre Brook, which is associated with an alluvial aquifer unit characterised by infilled paleochannels and broad alluvial cover (Welsh et al, 2014).

The WCM make up the dominant basement geology throughout the central alluvial plain associated with the Condamine River, however there are localised outcrops of the Marburg Subgroup and Texas beds between kilometrage 75.000 and 77.000 km (near Inglewood, QLD). The WCM is not considered a major aquifer on a regional scale as the unit predominantly consists of low permeability sandstone, siltstone, shales and carbonaceous mudstones with minor sandstones and coal seams. However, local coal seams and geological structures, such as faulting, may increase the potential for groundwater movement and storage. Studies (QWC, 2012; GCQ, 2014) of the Condamine Alluvium show that groundwater flow in the alluvium and the seams (WCM) is primarily horizontal, as vertical flow and interaction between the units is impeded by the low permeable mudstone/siltstone beds of the WCM. The WCM is considered a Great Artesian Basin (GAB) aquifer in the Water Resource GAB Plan (State of Queensland, 2017) despite generally low permeabilities, due to the existence of localised aquifers within the formation.

The geological units of the project alignment have been divided into the following hydrostratigraphic units:

- Quaternary alluvium aquifer,
- Tertiary Sediments (aquitard),
- Fractured basalt aquifer (MRV), and
- Sedimentary rock aquifer(s)
 - Including the WCM, Pilliga Sandstone, Springbok Sandstone, Eurombah Formation, Kumbarilla Beds, Hutton Sandstone and Marburg Subgroup

4.1 Groundwater Levels

Automated water level probes were installed in 22 standpipe piezometers as part of the Phase 2 Feasibility Design Geotechnical Investigation⁸ for long-term groundwater level monitoring. Groundwater level information is currently available for 17 of these groundwater bores and is presented in Figure B1 to Figure B17 of APPENDIX B. Daily rainfall data was obtained from the BoM weather station at Inglewood Bridge TM (Station 041123). Groundwater level statistics are summarised in Table C1 of APPENDIX C. No responses to rainfall events were observed during the monitoring period in these bores.

⁸ Refer Condamine Geotechnical Factual Report 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

The results of a review of the QLD Registered Groundwater Database (DNRM, 2018) indicate that a total of 129 bores exist within 500 m of the Project alignment. Of the registered bores, nine contained water levels after 2005 while only six of these (including one nested piezometer) contained long-term groundwater monitoring data. The number of bores screened within the various formations is presented in APPENDIX B with groundwater level hydrographs, according to formations, presented in Figure B18, Figure B19 and Figure B20.

Basic groundwater level statistics from available groundwater bores are reported in Table C1 of APPENDIX C. The location of registered bores containing water levels within 500 m of the alignment, registered bores with water quality sampling within 5 km of the alignment and Phase 2 Feasibility Design Geotechnical Investigation locations are reported on APPENDIX C.

Table 4: Long-term Groundwater Monitoring by Formation for the Project Alignment

Monitored Formation	Monitored Aquifer	No. Phase 2 Feasibility Design Geotechnical Investigation Bores	No. Registered Bores
Condamine River Alluvium	Quaternary aquifer	-	5*
Undifferentiated Alluvium	Quaternary aquifer	1	1
Tertiary Sediments	Tertiary Sediment	4	-
Eurombah Formation	Sedimentary rock aquifer	2	-
Springbok Sandstone	Sedimentary rock aquifer	1	-
MRV	Fractured basalt aquifer	2	-
WCM	Sedimentary rock aquifer	12	2

Note: * two boreholes (RN42231378 and RN42231379) are nested and contain two monitoring bores at each location

4.1.1 Quaternary Alluvium Aquifer(S)

Multiple alluvium sequences are encountered along the Project alignment and are divided into named sequences where possible or into undifferentiated alluvium where no information is available.

Undifferentiated Alluvium

One Phase 2 Feasibility Design Geotechnical Investigation⁹ groundwater monitoring bore is located within Undifferentiated Alluvium close to the McIntyre River.

- Groundwater bore 310-01-BH2617 located at Kilometrage 95.500 km was dry or became dry when the groundwater level declined below the bottom of the screened interval (318.2 m AHD) during the monitoring period.

⁹ Refer Condamine Geotechnical Factual Report 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

Condamine River Alluvium

Seven registered groundwater monitoring bores are located within the Condamine River Alluvium within 500 m of the Project alignment. Groundwater levels in the Condamine River Alluvium remain relatively constant throughout the monitored period. An increase in groundwater levels of about 1.2 m was observed in RN42231415 which is the largest increase in groundwater level observed within this alluvial unit.

- RN42231378 is a nested bore screened at the base and middle of the Condamine River Alluvium. Groundwater levels show greater variation in the deep bore (RN42231378_A); however, groundwater levels in both bores exhibit similar trends, with the deep nested bore (RN42231378_A) generally containing groundwater levels that are about 1.5 to 2.0 m higher than those in the shallow nested bore (RN42231378_B).
 - RN42231378A is about 355.2 m AHD, and
 - RN42231378B is about 354.9 m AHD.
- RN42231379 is a nested bore screened at the base of the Condamine River Alluvium and WCM (RN42231379_A) and the middle of the Condamine River Alluvium (RN42231379_B). Groundwater levels show more variation in the deep bores (RN42231379_A); however, groundwater levels in both the bores exhibit similar trends, with the deep nested bore (RN42231379_A) generally containing groundwater levels that are about 2 to 4 m higher than those the shallow nest bore (RN42231379_B).
 - RN42231379A is about 354.9 m AHD, and
 - RN42231379B is about 354.4 m AHD.
- Registered bores RN42230035, RN42231415 and RN42231725 are completed within 3 km of one another in the Condamine River Alluvium and report similar groundwater levels of about 358 to 360 m AHD and similar groundwater trends.

4.1.2 Tertiary Sediments (Aquitard)

Four Phase 2 Feasibility Design Geotechnical Investigation¹⁰ groundwater monitoring bores are located within the Tertiary Sediments along the Project alignment, with groundwater levels typically as follows:

- 310-01-BH2231 (Tertiary Sediments) at about 364.9 m AHD.
- 310-01-BH2233 (Alluvium/Tertiary Sediments) at about 364.9 m AHD.
- 310-01-BH2234 (Alluvium/Tertiary Sediments) 363.2 m AHD.
- 310-01-BH2235 (Tertiary Sediments/WCM) at about 358.8 m AHD.

4.1.3 Fractured Basalt Aquifer (MRV)

Two Phase 2 Feasibility Design Geotechnical Investigation groundwater monitoring bores are located within the MRV along the project alignment.

- Groundwater bore 310-01-BH2344 (Kilometrage 187.500 km) was dry or became dry when the groundwater level decreased below the screened interval during the monitoring period.
- Groundwater levels in 310-01-BH2347 (Kilometrage 193.500 km) have stabilised above the screened interval at about 453.8 m AHD.

¹⁰ Refer Condamine Geotechnical Factual Report 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

4.1.4 Sedimentary Rock Aquifer (Springbok Sandstone)

One Phase 2 Feasibility Design Geotechnical Investigation groundwater monitoring bore is located within the Pilliga Sandstone/Springbok Sandstone along the project alignment.

- Groundwater levels in 310-01-BH2201 have stabilised above the screened interval at about 248.6 m AHD.

4.1.5 Sedimentary Rock Aquifer (Kumbarilla Beds)

One registered groundwater monitoring bore is inferred to be located within the Kumbarilla beds.

RN41620041 located at Kilometrage 7.200 km, is installed to a depth of 204.14 m AHD in undifferentiated alluvium near the NSW border and Yelarbon and reporting a relatively stable groundwater level of about 210.3 m AHD from 2006 until 2016 before decreasing to a relatively stable level of about 209.8 m AHD in 2017 until present. This location reported a variation of about 0.5 m in groundwater level during the monitoring period.

4.1.6 Sedimentary Rock Aquifer (Marburg Formation or Walloon Coal Measure)

Two Phase 2 Feasibility Design Geotechnical Investigation groundwater monitoring bores are located within an area that is reported by the Queensland Department of Natural Resources, Mining and Energy (digital surface geological 1:100000 map layer accessed through QLD Globe on 7 February 2019) as underlain by Marburg Formation or Walloon Coal Measure.

- Groundwater bore 310-01-BH2311 was dry or became dry when the groundwater level decreased below the screened interval during the monitoring period.
- Groundwater level was measured within the screened interval of 310-01-BH2323 at about 446.7 m AHD.

4.1.7 Sedimentary Rock Aquifer (WCM)

Eight Phase 2 Feasibility Design Geotechnical Investigation groundwater monitoring bores and one registered groundwater bore are located within the WCM and within 500 m of the project alignment. Typical groundwater levels are as follows:

- 310-01-BH2203 (WCM) at about 259.3 m AHD; however, became dry when the groundwater level decreased below the screened interval during the monitoring period.
- Groundwater levels in 310-01-BH2206 has stabilised above the screened interval at about 263.5 m AHD.
- 310-01-BH2308 (WCM) at about 289.1 m AHD.
- 310-01-BH2309 (WCM) at about 265.9 m AHD.
- 310-01-BH2210 (WCM) at about 274.0 m AHD.
- No information is currently available for 310-01-BH2214 or 310-01-BH2215.
- 310-01-BH2216 (WCM/Eurombah Formation) at about 307.4 m AHD.
- 310-01-BH2326 (WCM) – groundwater level is still decreasing following bore installation and has not yet stabilised; currently at about 466.9 m AHD.
- RN42231135 is installed in the WCM and reports a groundwater level that is relatively stable around 402 m AHD until 2012 and dropping through multiple steps to about 372 m AHD in August 2016. The final measurement shows a recovery of about 15 m from August 2016 to December 2017 to about 387.5 m AHD.

4.2 Wetland Springs

Table 5 summarises the key details for five registered wetland springs located within 10 km of the Project alignment, which are typically located near existing water courses and associated with the MRV. The locations of the springs are shown on Figure 5.

Table 5: Wetland Springs

Wetland Spring ID	Easting	Northing	Surface Elevation (m AHD)	Distance from Alignment (km)
Wellcamp Spring	386238	6949894	483 [^]	7.4
Jimna Spring	374334	6934190	484 [*]	5.0
Leigh Spring	363918	6943993	507 [*]	9.1
Springside	359443	6939086	466 [*]	5.5
Stone Spring	364262	6936890	477 [^]	2.1

Notes: [^] – Elevation obtained from the Project LiDAR; ^{*} – Elevation obtained from Google Earth because outside of the Project LiDAR.

4.3 Groundwater Recharge

In areas with alluvial materials present, recharge is anticipated to occur by direct infiltration of rainfall, and by seepage from ephemeral watercourses during periods of flow following rainfall, or where connected to perennial watercourses. Recharge to the Condamine Alluvium is primarily from the Condamine River and to a lesser extent, via direct infiltration from rainfall and lateral connectivity to surrounding bedrock and alluvium. Sub-cropping rock below permeable alluvium may also act as a source of recharge due to upward discharge of groundwater.

Preferential recharge to the bedrock aquifers (basalt aquifer and sedimentary rock aquifers) occurs where these aquifers outcrop at surface or subcrop below alluvium. Where the bedrock aquifers outcrop, recharge likely occurs via direct infiltration of rainfall where the formations are exposed at the surface or blanketed by a thin layer of soil. Recharge may also happen where alluvium is connected to bedrock aquifers. Locally perched groundwater may exist where more permeable weathered rock or soils are underlain by low permeability rocks.

Direct infiltration of rainfall to groundwater is unlikely during dry periods, when light rainfall (events) are more likely to be absorbed by unsaturated – partially saturated soils only to be subsequently lost to evapotranspiration. Recharge is likely to occur in response to more intense or more continuous rainfall events, and overall net recharge rates at the site are expected to be low.

4.4 Groundwater Chemistry

There was a total of 831 samples collected from 378 groundwater monitoring bores within 5 km of the proposed alignment. Collected samples span a range of 73 years, with the earliest samples collected in 1946 and the most recent collected as part of the Phase 2 Feasibility Design Geotechnical Investigations. The groundwater chemistry data has been obtained from the QLD registered bores database and the Phase 2 Feasibility Design geotechnical investigation¹¹. The locations of registered boreholes with relevant water chemistry data that are located within 5 km of the project are displayed in Figure 4. This figure also displays the Phase 2 Feasibility Design Geotechnical Investigations, including those with water chemistry data. Location information, aquifer data and key groundwater chemistry data for all registered boreholes and Phase 2 Feasibility Design Geotechnical Investigations groundwater bores are contained in the tables presented in APPENDIX D.

Of the above samples, 532 contain a complete set of cation and anion analytical records; 182 of which are screened the Quaternary alluvium, five screened the Tertiary sediments, 32 screened the WCM, 244 screened the MRV, four screened the Hutton Sandstone, 29 screened the Kumbarella Beds, 33 screened the Marburg Subgroup, two screened the Pilliga Sandstone, and one screened the Springbok Sandstone. Piper Diagrams were generated to support hydrogeochemical classification of the tested formations. The Piper Diagrams for groundwater sampled from the Quaternary alluvium and Main Range Volcanics are shown in Figure 6 and Figure 7, respectively, while samples from the remaining formations are shown in Figure 8. The milliequivalents percentage of major cations and anions are shown by separate ternary plots to the lower left and right of the diagram. The apexes of the cation plot are calcium, magnesium and sodium plus potassium cations. The apexes of the anion plot are sulphate, chloride and carbonate plus bicarbonate anions. The two ternary plots are then projected onto the central diamond field, which provides overall character of the water.

Regional groundwater chemistry has been summarised in Table 6. Variation of water types may be attributed to water bores screened across formations, geological structures separating formations or general variability over time.

Table 6: Summary of Groundwater Chemistry

Formation	Dominant Cation	Dominant Anion	Dominant Water Type
Quaternary (Alluvium)	No dominant cations or some samples with magnesium	Bicarbonate	Ca(Mg)HCO ₃ type with some Ca+Mg type
MRV (Tertiary Sediments)	No dominant cations or some samples with magnesium	Bicarbonate	Ca(Mg)HCO ₃ type with some Ca+Mg type
MRV (Basalt)	No dominant cations or some samples with magnesium	Bicarbonate	Ca(Mg)HCO ₃ type with some Ca+Mg type
Walloon Coal Measure	Magnesium or some samples with no dominant cations	Bicarbonate and Chloride	Ca(Mg)HCO ₃ type with some Ca+Mg type and some Ca(Mg)Cl(SO ₄) type

¹¹ Refer Condamine Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

Formation	Dominant Cation	Dominant Anion	Dominant Water Type
Marburg Subgroup	Magnesium or some samples with no dominant cations	Bicarbonate and Chloride	Ca+Mg type and with some Ca(Mg)HCO ₃ type
Kumbarilla Beds	Magnesium	Bicarbonate	Ca+Mg type
Pilliga Sandstone	Magnesium	Chloride	Ca+Mg type
Springbok Sandstone	Magnesium	Bicarbonate	Ca+Mg type
Hutton Sandstone	Magnesium	Chlorine	Ca+Mg type

Notes: Ca – Calcium; Mg – Magnesium; HCO₃ – bicarbonate; Cl – Chlorine; SO₄ – Sulphate

4.5 Groundwater Use

Reflecting the land use and cover discussed in Section 3.3 and reported on Figure 3, the groundwater use in the area is primarily to support pastoral and intense agricultural uses such as irrigation or water supply. Large areas used for cropping and grazing land typically occur along the flat river valley with water supply generally obtained from shallow alluvial aquifers near watercourses. Groundwater supply to wetland, marsh areas and springs utilise groundwater in the natural environment. Groundwater use in the region is understood to be extensive.

The Condamine Alluvium is heavily utilised for water supply purposes, including irrigation and town water supply as well as domestic, stock watering, industrial, stock intensive and commercial supplies (DNRM, 2016). Water is actively extracted by the city of Toowoomba from the MRV for water supply.

5.0 CONCEPTUAL HYDROGEOLOGY

Conceptualisations for the proposed slope cuts, embankment and bridge locations are presented in this section.

5.1 Hydrogeological Parameters

Hydraulic conductivity test data have been compiled from various sources including the Phase 2 Feasibility Design Geotechnical Investigation¹² along the proposed Project alignment and the Clarence-Moreton Bioregional Assessment database (Australian Government, 2018a and 2018b) as this data has been integrated into the Inland Rail data sets. Limited data was available for the Project alignment in the Maranoa-Balonne Bioregion assessment (Holland, *et. al.*, 2016). Hydraulic conductivity values were compared to values adopted for similar units in previous modelling studies conducted in the Surat Basin by the University of Southern Queensland (2011) and from the New Acland EIS for the Walloon Coal Measures in 2013 (Barnett, 2013). Statistical analysis has been carried out to derive hydraulic conductivity values for the Sedimentary rock aquifers of the Main Range Volcanics, Walloon Coal Measures, and Quaternary aquifers.

Estimates for hydraulic conductivity values contained in Clarence-Moreton Bioregional Assessment database were derived from specific capacity (air lift yield) data and information of the geological formation in which the test bore is screened. The records likely represent horizontal hydraulic conductivity of the tested formation accurate to within an order of magnitude.

¹² Refer Condamine Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

Where not explicitly stated otherwise, hydraulic conductivity refers to the saturated hydraulic conductivity in this report. Hydraulic parameters derived from site specific testing and the results of relevant other studies as listed above are summarised in Table 7. The “typical” values provided in this table may not be representative of conditions at specific locations along the Project alignment considering the limited data available and large value range. Further assessment may be required after results of further testing become available.

Slug tests were scheduled to be conducted in all groundwater bores installed as part of the Phase 2 Feasibility Geotechnical Investigation. At the time of this report, slug test results were available for 16 of the 22 groundwater monitoring bores.

Table 7: Summary of Hydraulic Test Results of the Project

Standpipe Piezometer ID	Date Tested	Test Interval (m)	Lithology Tested	Test Method	Test Mode	Analysis Method	Hydraulic Conductivity (m/s) ¹³
310-01-BH2201	1/11/2018	20.2 to 29.2	Silty Sand/Sandy Gravel	Variable Head Test	Falling Head	Hvorslev	3.3×10^{-6}
						KGS Model	3.2×10^{-6}
310-01-BH2203	10/10/2018	16.0 to 25.0	Sandstone	Variable Head Test	Falling Head	Hvorslev	6.3×10^{-9}
						KGS Model	1.1×10^{-9}
310-01-BH2206	6/10/2018	16.5 to 25.5	Sand/Clay/Sandy Clay	Slug Test	Falling Head	Hvorslev	6.0×10^{-7}
						KGS Model	5.1×10^{-7}
				Slug Test	Rising Head	Hvorslev	6.3×10^{-7}
						KGS Model	4.8×10^{-7}

¹³ Source Golder 2018c, Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002 Table 9

Standpipe Piezometer ID	Date Tested	Test Interval (m)	Lithology Tested	Test Method	Test Mode	Analysis Method	Hydraulic Conductivity (m/s) ¹³
10-01-BH2210	31/10/2018	21.0 to 30	Siltstone/ Sandy Clay/Sandstone/Sandy Gravel	Slug Test	Falling Head	Hvorslev	2.3×10^{-9}
						KGS Model	7.0×10^{-10}
310-01-BH2216	31/10/2018	12.5 to 18.5	Clay/Sandy Clay	Slug Test	Falling Head	Hvorslev	1.3×10^{-8}
						KGS Model	6.3×10^{-9}
310-01-BH2308	9/10/2018	9 to 15	Clayey Sand	Variable Head Test	Falling Head	Hvorslev	1.5×10^{-8}
						KGS Model	6.3×10^{-9}
310-01-BH2309	31/10/2018	9 to 15	Sandy Silt/Clayey Sand	Variable Head test	Rising Head	Hvorslev	9.0×10^{-9}
						KGS Model	6.6×10^{-8}
310-01-BH2323	11/10/2018	9 to 15	Silt (extremely weathered sandstone)	Variable Head Test	Falling Head	Hvorslev	1.1×10^{-5}
						KGS Model	5.7×10^{-6}
310-01-BH2326	11/10/2018	9 to 15	Clay/Sandy Clay	Variable Head Test	Falling Head	Hvorslev	6.3×10^{-9}
						KGS Model	6.3×10^{-9}
310-01-BH2344	11/10/2018	9 to 15	Sandy Gravel/Basalt	Slug Test	Falling Head	Hvorslev	1.2×10^{-6}
						KGS Model	1.6×10^{-7}
310-01-BH2347	11/10/2018	17 to 20	Silt/Gravelly Silt	Slug Test	Falling Head	Hvorslev	4.1×10^{-6}
						KGS Model	3.9×10^{-6}
					Rising Head	Hvorslev	4.3×10^{-6}
						KGS Model	4.0×10^{-6}
310-01-BH2617	10/10/2018	2 to 5	Sand	Variable Head Test	Falling Head	Hvorslev	4.1×10^{-6}
						KGS Model	2.9×10^{-7}

Standpipe Piezometer ID	Date Tested	Test Interval (m)	Lithology Tested	Test Method	Test Mode	Analysis Method	Hydraulic Conductivity (m/s) ¹³
310-01-BH2231	2/11/2018	11.4 to 17.4	Sandy Gravel/Gravelly Sand/Clayey Sand/Sandy Clay	Variable Head Test	Falling Head	Hvorslev	1.9×10^{-07}
						KGS Model	1.3×10^{-07}
310-01-BH2233	30/10/2018	9.5 to 24.5	Gravel/ Clayey Sand/ Clay/Sand	Slug Test	Falling Head	Hvorslev	1.4×10^{-06}
						KGS Model	6.7×10^{-07}
310-01-BH2234	2/11/2018	16.4 to 22.4	Sandy Clay/Clayey Sand	Slug Test	Falling Head	Hvorslev	3.4×10^{-06}
						KGS Model	1.0×10^{-07}
310-01-BH2235	29/10/2018	31 to 40	Clay/Clayey Sand/Gravelly Sand	Variable Head Test	Falling Head	Hvorslev	2.1×10^{-07}
						KGS Model	2.0×10^{-07}

Sedimentary Rock Aquifer (Eurombah Formation, Springbok Sandstone, and Pilliga Sandstone)

One test (310-01-BH2323) was conducted within the units identified as the Eurombah Formation and one test was conducted within units identified as Springbok Sandstone/Pilliga Sandstone (310-01-BH2201) during the Phase 2 Feasibility Design Geotechnical Investigation¹⁴. Hydraulic conductivity of the Eurombah Formation was reported as 8.4×10^{-6} m/s based on the results of one falling head test. Hydraulic conductivity of the Springbok Sandstone/Pilliga Sandstone was reported as 3.3×10^{-6} m/s based on the results of one falling head test.

Based on considerations of the site-specific test results and regional hydraulic conductivity data, a value of 2×10^{-7} m/s has been used as a typical value for the Sedimentary Rock Aquifers of the Eurombah Formation, Springbok Sandstone and Pilliga Sandstone. This value reflects site-specific data and comparison with similar rocks in the region.

Sedimentary Rock Aquifer (WCM)

Seven tests (310-01-BH2203, 310-01-BH2206, 10-01-BH2210, 310-01-BH2216, 310-01-BH2308, 310-01-BH2309, 310-01-BH2326) were specifically conducted for this Project, within units identified as WCM during the Phase 2 Feasibility Design Geotechnical Investigation¹⁵. Hydraulic conductivity values obtained from these seven tests range between 7×10^{-10} and 6.3×10^{-7} m/s. Hydraulic conductivity of the WCM from 85 regional tests¹⁶ range between 2×10^{-11} and 8×10^{-4} m/s based mostly on specific capacity test records; 40 (47%) are above 1×10^{-7} m/s and 31 (36%) are above 1×10^{-6} m/s. The test records indicate that the hydraulic

¹⁴ Refer Condamine Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

¹⁵ Refer Condamine Geotechnical Factual Report 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

¹⁶ Regional tests data is sourced from an in-house database comprising the specific tests, tests associated with other Projects in the region by Golder Associates and others.

conductivity of the WCM is highly variable, reflecting the fractured nature of the aquifer and the variability in hydraulic conductivity of the siliciclastic rocks with depth across the weathering profile.

Based on considerations of the site-specific test results and regional hydraulic conductivity data, a value of 6×10^{-8} m/s has been used as a typical value for the Sedimentary Rock Aquifers of the WCM. This value reflects both the regional data and the site-specific data to derive a value that is more likely to represent local conditions.

Tertiary Sediments (MRV)

Two tests (310-01-BH2344 partially in sediments and partially in basalt, 310-01-BH2347) were conducted within units identified as Tertiary Sediments during the Phase 2 Feasibility Geotechnical Investigation. Hydraulic conductivity of the Tertiary Sediments from the Clarence-Moreton Basin and Phase 2 Feasibility Geotechnical Investigation includes 20 regional tests ranging between 7×10^{-11} and 2×10^{-6} m/s; 11 (55%) are above 1×10^{-9} m/s and 8 (40%) are above 1×10^{-8} m/s. The test records indicate that the hydraulic conductivity of the Tertiary Sediment is typically low, reflecting the low conductivity of clay and other fine material.

A value of 2×10^{-9} m/s has been used as a typical value for the Tertiary Sediments for inflow assessments. This value reflects both the regional data in absence of site-specific information.

Fractured Basalt Aquifer (MRV)

One test was carried out in 310-01-BH2344 during the Phase 2 Feasibility Geotechnical Investigation. Hydraulic conductivity of the MRV from the Clarence-Moreton Basin and Phase 2 Feasibility Geotechnical Investigation includes 69 regional tests ranging between 1×10^{-9} to 3×10^{-2} m/s. Of these 69 permeability test records, 54 (78%) are above 1×10^{-7} m/s and 43 (62%) are above 1×10^{-6} m/s. The test records indicate that the hydraulic conductivity of the MRV is highly variable, reflecting the fractured nature of the aquifer.

A value of 7×10^{-6} m/s has been used as a typical value for the MRV for inflow assessments. This value reflects both the regional data in absence of site-specific information.

Quaternary Alluvium Aquifer

Five tests were conducted in Quaternary alluvium (310-01-BH2617, 310-01-BH2231, 310-01-BH2233, 310-01-BH2234, 310-01-BH2235) during the Phase 2 Feasibility Geotechnical Investigation. A total of 108 regional test records are available for the alluvium of the Quaternary aquifer from locations across the Clarence-Moreton basin and literature with horizontal hydraulic conductivity values ranging between 1×10^{-6} and 2×10^{-2} m/s. Of these 108 permeability test records, 88 (81%) are above 1×10^{-4} m/s and 39 (36%) are above 1×10^{-3} m/s.

Test records are considered strongly biased towards the high end of the conductivity range due to tested bores mostly drilled for irrigation purpose and therefore, targeted the high yielding alluvial gravel and sand Quaternary aquifers. The Quaternary aquifers are likely transversely isotropic due to interbedding of sandy layers with beds of silt and clay. Specific yield data were unavailable for the rail corridor and a range of specific yield values reported in literature for similar materials has been adopted for design purpose.

This unit has been used in the assessment of cuts, embankments and bridges. A typical value of 7×10^{-4} m/s has been adopted for the Quaternary aquifer units.

Design Parameter Summary

A statistical distribution of hydraulic conductivity test results for each formation is shown in Figure 9 and statistical parameters for the test records are summarised in Table 8. Anisotropy ratios adopted for this assessment are reported in Table 8.

There are no specific yield values derived from field testing for the Sedimentary Rock aquifers, fractured basalt aquifer or the Quaternary aquifer(s). A range of specific yield values has been estimated from previous modelling studies conducted in the Surat Basin by the University of Southern Queensland (2011) for similar sandstones (Hutton Sandstone and Precipice Sandstone), the New Acland EIS for the Walloon Coal Measures in 2013 (Barnett, 2013) and other literature. Lower, typical and upper specific yield estimates are provided in Table 8.

Table 8: Preliminary Hydrogeological Design Parameters

Formation	Hydraulic Parameter	No. Samples/Tests	Lower	Typical	Upper
Sedimentary rock aquifer (Eurombah Formation, Springbok Sandstone and Pilliga Sandstone) ^E	Hydraulic Conductivity (m/s) ^A	Estimate ^E	4.0×10^{-8}	2.9×10^{-7}	1.4×10^{-6}
	Estimated Vertical Hydraulic Conductivity ^B	Estimate ^E	4.0×10^{-9}	2.9×10^{-8}	1.4×10^{-7}
	Specific Yield ^C	Estimate ^E	0.015	0.05	0.10
	Rainfall Recharge (mm/year) ^D	21 ^E	1.6	2.7	5.9
Sedimentary Rock aquifer (Walloon Coal Measures)	Hydraulic Conductivity (m/s) ^A	85	9.7×10^{-9}	5.8×10^{-8}	6.3×10^{-6}
	Estimated Vertical Hydraulic Conductivity ^B	Estimate	9.7×10^{-11}	5.8×10^{-9}	6.3×10^{-7}
	Specific Yield ^C	Estimate	0.005	0.035	0.05
	Rainfall Recharge (mm/year) ^D	90	1.3	3.5	9.7
Tertiary Sediments	Hydraulic Conductivity (m/s) ^A	20	1.6×10^{-10}	1.6×10^{-9}	8.0×10^{-7}
	Estimated Vertical Hydraulic Conductivity ^B	(Estimated – no test data available)	1.6×10^{-11}	1.6×10^{-10}	8.0×10^{-8}
	Specific Yield ^C	(Estimated – no test data available)	0.03	0.07	0.12
	Rainfall Recharge (mm/year) ^D	NA	NA	NA	NA
Main Range Volcanics	Hydraulic Conductivity (m/s) ^A	69	1.4×10^{-7}	7.0×10^{-6}	5.3×10^{-5}
	Estimated Vertical Hydraulic Conductivity ^B	Estimate	2.6×10^{-9}	6.0×10^{-7}	5.3×10^{-6}
	Specific Yield ^C	Estimate	0.01	0.1	0.15
	Rainfall Recharge (mm/year) ^D	48	11.3	25.8	41.4
Alluvium	Hydraulic Conductivity (m/s) ^A	107	2.6×10^{-4}	6.8×10^{-4}	1.4×10^{-3}

Formation	Hydraulic Parameter	No. Samples/Tests	Lower	Typical	Upper
	Estimated Vertical Hydraulic Conductivity ^B	Estimate	2.6×10^{-6}	6.8×10^{-5}	1.4×10^{-3}
	Specific Yield ^C	Estimate	0.05	0.10	0.15
	Rainfall Recharge (mm/year) ^D	2677	3.9	10.7	32.5

^A Lower, typical and upper values are represented by $\mu - \sigma$, μ , $\mu + \sigma$ of hydraulic test records with μ , median, and σ , one standard deviation, of the logarithmised test values. Tests were conducted at locations across the Clarence-Moreton Basin.

^B Vertical hydraulic conductivity, estimates are based on the lithological characteristics of the different formations and experience with formations of similar lithology.

^C Estimates based on model calibration results of sandstone in the Surat Basin. Judgement was applied by Golder to adjust literature values considering textural features of the different formations

^D Lower, typical and upper values are represented by 25th, 50th (median) and 75th percentiles of recharge estimates for locations across the Clarence-Moreton bioregion. Actual recharge values may vary depending on relief, soil and vegetation cover. Data source: Raiber et al., 2016.

^E Limited data is available for the Sedimentary rock aquifer (Eurombah Formation, Springbok Sandstone and Pilliga Sandstone); therefore, values for the Marburg Subgroup have been adopted.

5.2 Observed and Inferred Groundwater Levels

Groundwater monitoring bores equipped with standpipe piezometers and automated water level probes were constructed along the proposed alignment for monitoring groundwater levels. Groundwater level measurements available at the time of reporting are summarised in Table C1 of APPENDIX C.

Groundwater levels along the embankments and cuts locations have been estimated based on the available groundwater level data within the same rock formation, similar ground relief and land use. Estimates were derived using statistical methods based on the correlation between depth to water table and ground surface elevation. These estimated groundwater levels in various parts of the alignment are discussed below.

Registered bores with historical groundwater level records are typically located in low lying areas near watercourses or gently sloping terrain with limited data available at higher elevations. To account for limitations in the groundwater monitoring data from spatial distribution and limited data at higher elevations, preliminary groundwater levels along the alignment were estimated based on a correlation of available groundwater level data within the same rock formation, similar ground relief and land use.

Slope Cuts

A summary of estimates of preliminary groundwater level at deep cuts relative to cut elevations is presented in Table 9. Estimated groundwater level and cut elevations for the remaining cuts are provided in APPENDIX E

Based on a review of available information, groundwater is anticipated to be encountered in at least seven of the 15 deep critical cut locations. Locally perched groundwater may exist, which will require further assessment after more detailed site investigations have been conducted for the detailed design.

Table 9: Locations where Critical Cuts are Anticipated to Encounter Groundwater Table

Name ¹⁷	Start (km)	End (km)	Length (km)	Median CL Elevation Along Cut (m AHD) ¹	Median GW Level at Cut (m AHD)	Maximum GW Level at Cut (m AHD)	Bore Geology ²
310-C08	56.55	60.00	3.45	314.3	309.7	320.4	Sandstone
310-C09	60.65	61.24	0.59	310.0	304.8	310.7	Sandstone
310-C10	62.08	62.66	0.58	301.5	297.5	301.8	Sandstone
310-C31	163.54	165.22	1.68	474.0	454.3	479.0	Sandstone and Shale
310-C37	172.65	174.94	2.29	548.1	541.9	562.0	Basalt
310-C44	188.32	189.82	1.50	509.3	505.5	518.1	Basalt
310-C45	191.70	192.69	0.99	478	472.8	485.5	Basalt

¹CL refers to the rail corridor control line, or the centre of the proposed rail alignment, GW refers to groundwater.

²Assumed Geology from Desktop Review and Phase 2 Feasibility Design geotechnical investigation Groundwater Bores

Embankments

A summary of estimates of preliminary groundwater level at embankments is presented in APPENDIX E. Groundwater mounding may be expected at up to 16 embankment locations as discussed in Section 6.2.

6.0 HYDROGEOLOGICAL DESIGN CONSIDERATIONS

The quality of groundwater within each formation which may be produced through seepage at cuts will provide an indication of the scaling and aggressivity potential or potential treatment requirements. The aggressivity and scaling potential are important for their influence on engineered surfaces including concrete, reinforcements or foundations that may contact groundwater, resulting in chemical reactions that could potentially reduce the strength or design life of the engineered structure(s).

6.1 Groundwater Quality and Seepage to Cuts

6.1.1 Seepage Rate Estimates

Based on the Phase 2 Feasibility Design Geotechnical Investigation¹⁸ Golder developed five two-dimensional, cross-sectional models oriented perpendicular to corridor alignment. The models were developed using the SEEP/W modelling package. The main goals of this modelling activity were to:

- assess potential groundwater drawdown due to drainage of cuts;
- estimate groundwater seepage rates for cuts.

This section addresses the assessment of hydraulic conditions along the cuts and includes the following components:

- General modelling methodology
- Summary of available data;

¹⁷ For further information on the location and cutting details refer to the Feasibility Design Report (2-0001-310-PEN-10-RP-0001)

¹⁸ Refer Condamine Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

- Selection of cuts to be modelled;
- Model development (geometry, parametrization, boundary conditions);
- Results; and
- Sensitivity analysis.

6.1.1.1 General Modelling Methodology

Golder developed five simplified groundwater models that represent the expected range of hydrogeological conditions present during the Project development. The models were developed as two dimensional (2D) cross-sectional models oriented perpendicular to corridor alignment, using SEEP/W. The models were then used to estimate steady-state inflows to deep cuts and the resulting drawdown impacts from excavations. Initial inflows to excavations will be at higher rates. Given that there exists a significant degree of uncertainty, model sensitivity testing was undertaken.

Following sections outline and where appropriate discuss model development including selection of representative cuts, model parameters and sensitivity assessment.

6.1.1.2 Available Data

The data used in the development of the models is as per data supplied by FFJV, based on alignment data as of 12 December 2018.

Based on the available information Golder selected five representative cuts to be modelled (Table 10). Further information is outlined in the Geotechnical Interpretive Report (2-0001-310-IGE-03-RP-0001).

Table 10: List of Selected Cuts for Modelling

Cut ID	Model Section at Kilometrage (km)	Justification	Closest Water Course/Water Bore	Cut Length (m)
310-C08	57.670	Deepest cut in C1-Jw (XW) ground model	Non-perennial Macintyre Brook to the south-east (1400 m), Nearest bore is 310-01-BH2308 (1710 m)	3450
310-C25	114.460	Deepest cut in C2-Qs/Jw (XW) model ground	Non-perennial tributary of Nicol Creek to the south (230 m), Nearest bore is 310-01-BH2323 (460 m)	380

Cut ID	Model Section at Kilometrage (km)	Justification	Closest Water Course/Water Bore	Cut Length (m)
310-C31	164.600	Deepest cut in C3-1-Jw model ground, most significant variation in topography	Non-perennial tributary of Condamine River (North Branch) (320 m), Nearest bore is 310-01-BH2337 (535 m)	1680
310-C37	174.520	Deepest cut in C3-3-Tm model ground	Perrier Gully Tributary (560 m), Nearest bore is RN19886 (360 m)	2290
310-C44	188.910	Deepest cut in C3-5-Tm model ground	Non-perennial tributary of Westbrook Creek to the north (355 m), Nearest bore is 310-01-BH-2345 (42 m)	1500

Based on the very low hydraulic conductivity values (see below) it is assumed that pumping from the bores (presented in Table 10) and water courses do not have impact on the calculated pressure distributions.

6.1.1.3 Geometry

Layering of each model section is summarised in Table 11.

Table 11: Geological Layers of Model Sections

Cut ID	Model Section at Kilometrage (km)	Ground Model ¹⁹	Layer 1	Layer 2	Layer 3	Layer 4
310-C08	57.670	C1-Jw(XW)	Topsoil	Dense Clayey Sand/Sandy Clay	Dense to Very Dense Sand or Very Low Strength Sandstone	NA
310-C25	114.460	C2-Qs/Jw(XW)	Topsoil	Stiff to Hard Sandy Clay	Hard Lateritised Clay	NA
310-C31	164.600	C3-1-Jw	Topsoil	Stiff to Hard Clay	Sandstone/Mudstone	Sandstone and Shale
310-C37	174.520	C3-3-Tm	Topsoil	VL-L Strength Basalt	High to Very High Strength Basalt	NA
310-C44	188.910	C3-5-Tm	Topsoil	Stiff to hard clay	VL – L Str Basalt	High to very high strength Basalt

The spatial distribution of various geological layers along the model sections is displayed in a series of figures (Figure 10 to Figure 14).

¹⁹ For further information on the geological models refer to the Geotechnical Interpretive Report (2-0001-310-IGE-03-RP-0001).

6.1.1.4 Hydraulic Parameters

Numerous slug tests have been carried out to estimate hydraulic properties of the geological material at the standpipe piezometers. These test results are summarized in Section 5.1. Seepage rate modelling use the results of site-specific testing of nearby material. In summary, in 12 piezometers, 14 (either rising or falling head) recovery tests were completed. Field measurements were evaluated by using various analytical solutions (Hvorslev, KGS). To have only one value for each test (and rock type), the average value of different interpretations has been used. The list of average hydraulic conductivity values adopted, piezometers and rock types are listed in Table 12.

Table 12: Average Hydraulic Conductivity Vales from in-situ Measurements

Piezometer ID	Soil Type Tested	Average Hydraulic Conductivity (m/s)
310-01-BH2309	Sandy Silt/Clayey Sand	3.8×10^{-8}
310-01-BH2203	Sandstone	3.7×10^{-9}
310-01-BH2206	Sand/Clay/Sandy Clay	5.5×10^{-7}
310-01-BH2216	Clay/Sandy Clay	9.7×10^{-9}
310-01-BH2210	Siltstone/Sandy Clay/Sandstone/Sandy Gravel	1.5×10^{-9}
310-01-BH2308	Clayey Sand	1.1×10^{-8}
310-01-BH2323	Silt (extremely weathered sandstone)	8.3×10^{-6}
310-01-BH2617	Sand	2.2×10^{-6}
310-01-BH2326	Clay/Sandy Clay	6.3×10^{-9}
310-01-BH2347	Silt/Gravelly Silt	3.1×10^{-6}
310-01-BH2344	Sandy Gravel/Basalt	7.0×10^{-7}
310-01-BH2201	Silty Sand/Sandy Gravel	3.3×10^{-6}

Based on Table 12, hydraulic conductivities listed in Table 13 have been assigned to the layers of each model.

Table 13: Hydraulic Conductivities (k-value) Assigned to Model Layers, with justification

Cut ID	Model Section at Kilometrage (km)	Layer 1	Layer 2	Layer 3	Layer 4
310-C08	57.670	8.2×10^{-6} (highest measured k value)	1.0×10^{-8} (estimated k for clay from Figure 12)	3.7×10^{-9} (sandstone value from Figure 12)	NA
310-C25	114.460	8.3×10^{-6} (highest measured k value)	1.0×10^{-8} (estimated k for clay from Figure 12)	1.0×10^{-8} (estimated k for clay from Figure 12)	NA
310-C31	164.600	8.3×10^{-6} (highest measured k value)	1.0×10^{-8} (estimated k for clay from Figure 12)	3.7×10^{-9} (sandstone value from Figure 12)	3.7×10^{-9} (sandstone value from Figure 12)
310-C37	174.520	8.3×10^{-6} (highest measured k value)	7.0×10^{-7} (k value for basalt from Figure 12)	1.0×10^{-8} (estimated value)	NA
310-C44	188.910	8.3×10^{-6} (highest measured k value)	1.0×10^{-8} (estimated k for clay from Figure 12)	7.0×10^{-7} (k value for basalt from Figure 12)	1.0×10^{-8} (estimated value)

Infill hydraulic conductivity was set to 1×10^{-5} m/s.

6.1.1.5 Boundary Conditions

Tabulated results of static water level measurements are presented elsewhere in this report (Section 4.1). A plot of static water level versus ground surface elevation, and showing the correlation between these two parameters, is presented in Figure 15.

This correlation was used to assess the constant head boundary condition assigned to the left and right side of each model sections (Table 14) based on local topography.

Table 14: Boundary Conditions Assigned

Cut ID	Model Section at Kilometrage (km)	Constant Head Boundary (m AHD)	
		Left Side of Model	Right Side of Model
310-C08	57.670	315.9	306.7
310-C25	114.460	453.0	444.4
310-C31	164.600	491.0	462.7
310-C37	174.520	569.8	563.3
310-C44	188.910	523.4	516.1

At the area of the model sections, 650 mm/year annual rainfall was assumed (BOM, 2010), and 1% of this rainfall was assigned to the upper model surface as boundary condition.

Seepage face boundary condition was assigned to cut surfaces.

The location of different boundary conditions for each section is shown in Figure 10 to Figure 14.

6.1.1.6 Results

Models were run under steady-state conditions with typical and upper value of the expected parameter ranges. Upper range values were estimated base on the following assumptions:

- The estimate of expected hydraulic conductivity of model layers was increased by one order of magnitude;
- Estimated expected rainfall rate at model top was doubled;
- Expected groundwater elevation estimates at the right and left side of the model sections (boundary conditions) were increased by 2 m.

The length of each cut was obtained from Table 10 and multiplied by the respective model results to obtain seepage rate estimates for the entire length of the cut. It should be noted that the model geology and cut geometry for each model section has been extrapolated across the entirety of each cut to calculate seepage of the entire cut resulting in conservative estimates of seepage rates. Simulated pore pressure distributions are presented in Figure 16 to Figure 20 for typical values of the expected parameter range.

Simulation results suggest that seepage is concentrated at the bottom of the cuts, on both sides of infill material. To demonstrate this nodal flow rates along the cut of Kilometrage 174.520 km were extracted from the model (Figure 21).

Simulated annual seepage is tabulated in Table 15. In general, these values are very low which can be attributed to the very low hydraulic conductivities applied. However, it is noted that:

- Temporary increases in seepage may be observed in cuts with sandy soil or weathered sandstone following rainfall events.
- Seepage of groundwater from bedrock is anticipated to be low, except where enhanced by weathering of fractures.

Initial inflow rates to excavations will be at higher rates than the average (steady-state) inflows predicted.

Table 15: Seepage Estimates to Cuts Based on Modelling Results

Cut ID	Modelled Section Location (chainage)	Cut Length	Expected Seepage for Entire Cut	Upper Range Seepage for Entire Cut
Units	km	m	m ³ /year	m ³ /year
310-C08	57.67	3450	1,750	11,100
310-C25	114.46	380	30	280
310-C31	164.6	1680	260	740
310-C37	174.52	2290	7100	105000
310-C44	188.91	1500	1870	17500

Estimated drawdown values due to the drainage of cuts is listed in Table 16. Maximum values of drawdown were calculated at the centreline ($x=0$) of each model, and the extent of drawdown was estimated using the following threshold values to define the extent of drawdown:

- Sedimentary rocks – drawdown higher than 2 m;
- Hard rocks – drawdown higher than 5 m.

Table 16: Estimated Drawdown Values at Centreline of Models

Cut ID	Model Section at Kilometrage (km)	Estimated Drawdown at Centreline (m)	Extent of Drawdown from Centreline (m)
310-C08	57.670	3.7	Drawdown threshold of 2 m at 10 to 15 m distance from centreline
310-C25	114.460	<1.0	NA
310-C31	164.600	<1.0	NA
310-C37	174.520	12.2	Drawdown threshold of 5 m at 40 to 60 m distance from centreline
310-C44	188.910	11.7	Drawdown threshold of 5 m at 60 to 80 m distance from centreline

Note: NA – Not Applicable

Simulation results suggest that drawdown impacted area is localized around the cuts. Table 10 lists the closest water courses and bores around the cuts. The closest bore is 310-01-BH-2345 (42 m from C44), which is a monitoring bore.

6.1.2 Water Quality for Seepage to Cuts

Of the proposed cuts along the alignment, seven are anticipated to intercept groundwater. Groundwater quality at these locations has been assessed based on the Phase 2 Feasibility Geotechnical Investigation groundwater bores and registered groundwater bores within 50 m of the seven cut locations. The cut names and locations, median estimated groundwater level, electrical conductivity, pH and assumed geology are presented in Table 17.

Table 17: Estimated Groundwater Quality at Cut Locations Anticipated to Intercept Groundwater

Cut Name	Kilometrage Start (km)	Kilometrage End (km)	Estimated Groundwater Level at Cut (m AHD) ^A	EC (µS/cm)	pH (pH Units)	Geology
310-C08	56.550	60.000	309.7	2900	8.2	Sandstone
310-C09	60.650	61.240	304.8	2680	8.1	Sandstone
310-C10	62.080	62.660	297.5	2680	8.1	Sandstone
310-C31	163.540	165.220	454.3	1930	8.1	Sandstone and Shale

Cut Name	Kilometrage Start (km)	Kilometrage End (km)	Estimated Groundwater Level at Cut (m AHD) ^A	EC (µS/cm)	pH (pH Units)	Geology
310-C37	172.650	174.940	541.9	1450	7.8	Basalt
310-C44	188.320	189.820	505.5	1185	7.8	Basalt
310-C45	191.700	192.690	472.8	1125	8	Basalt

Notes: µS/cm – micro-Siemens per centimetre,

^A Estimated Groundwater levels displayed in this table are the typical values, which have been calculated based on the methods described above.

Typical groundwater quality encountered at cut locations (that are anticipated to intercept the groundwater) is brackish, with electrical conductivity values between 1125 to 2900 µS/cm. Typical pH values at these cut locations is generally neutral to slightly basic, with values in the range of 7.8 to 8.2 pH units.

Estimates of seepage rates for most of the cuts is very low and it is anticipated that groundwater seepage will evaporate. In this case drainage and management of groundwater seepage would not be required. Cut 310-C37 is located within the Central Condamine catchment waters. Groundwater seepage for this cut is estimated to 3 L/s and may require management. The Water Quality Objectives (WQOs) for the aquatic ecosystem for this region are as follows:

- pH: 7.5-8.3
- EC: 885 µS/cm

The typical electrical conductivity value exceeds the WQOs and may prohibit discharge of untreated seepage flow from the cut.

6.2 Potential for Groundwater Level Mounding along Embankments

Obstruction of natural drainage pathways due to embankments may cause more frequent inundation of areas upstream of the embankment, with the potential for the development of a groundwater mound beneath inundated areas. Drainage systems need to be designed to accommodate flood flows otherwise this could have long-term adverse impacts on groundwater depths and soil salinity. In extreme cases, complete saturation of the soil profile may also affect the stability of embankment on clay foundations.

Potential for groundwater mounding at embankments has been calculated using estimated current groundwater levels, and an estimate of the potential increases in groundwater level based on records of groundwater variation around the time of historical flood events or increased observed from hydrographs. Estimated current groundwater levels at embankments are reported in Table 18. Based on the available records it is assessed that:

- In the basalt of the MRV, low effective porosity and variable fracture permeability may result in a potential groundwater rise of between 1.2 m and up to about 15.1 m, depending on connectivity of fractures and weathering of the basalt following large rainfall or flood events as observed in regional hydrographs due to limited data near the Project alignment.
- In the sedimentary units, local variations in groundwater levels due to rainfall events may be up to an estimated 2 to 3 m.

- Where flood plains overlie areas with deep alluvium, a potential increase of groundwater levels by up to 6 m is anticipated. This estimate in level increase is based on historical water level records within the Condamine River Alluvium reported in Section 4.1.1. Increased seepage as a result of rainfall events may occur and is anticipated to occur over a short-duration. Locally perched water may be observed which is anticipated to be observed during construction and not long-term.
- Where flooding is indicated by the 1% AEP, groundwater is anticipated to rise to the surface where alluvium is encountered. Groundwater levels in the bedrock aquifers are not anticipated to rise to the surface with the potential exception of water levels within the MRV where fracture networks are connected to flooded alluvial units or outcrop in flooded areas. Surficial geology and the flood extent of the 1% AEP is reported in Figure 22.

The majority of embankments overlie either MRV or alluvium. Where the embankments are overlying rock, these areas are susceptible to larger potential increases in groundwater level from the assessed “typical” groundwater levels. Where alluvium units are thick or in close proximity to watercourses, these areas are susceptible to large increases during high flow events and water levels increases may be observed rapidly depending on the alluvial material. The locations of the fill sections and ground surface were determined on the basis of the summary of the embankments and cuts. Table 18 summarises the embankment locations that could potentially see a rise in groundwater levels, to within 2 m of the ground surface and based on the above criteria.

Table 18: Estimated Groundwater Level Mounding at Selected Embankment Locations

Embankment	Median Estimated Surface Elevation (m AHD) ¹	Median Estimated GW Level (m AHD) ²	Median Estimated GW Level (m bgl)	Potential Mounded GW Level (m bgl)	Formation
310-E08	243.5	240.6	2.9	0.0	Alluvium
310-E09	249.5	245.9	3.7	0.0	Alluvium
310-E10	259.2	254.3	4.9	0.0	Alluvium
310-E11	257.3	252.6	4.7	0.0	Alluvium
310-E12	267.3	261.4	6.0	0.0	Alluvium
310-E58	499.6	484.2	15.4	0.3	MRV
310-E59	499.6	484.2	15.4	0.3	MRV
310-E60	499.1	483.7	15.4	0.3	MRV
310-E61	502.4	486.7	15.7	0.6	MRV
310-E71	514.6	497.6	17.0	1.9	MRV
310-E72	484.4	470.5	13.8	0.0	MRV
310-E73	432.9	423.1	9.6	0.0	Alluvium & MRV
310-E74	450.5	440.1	10.4	0.0	MRV

Embankment	Median Estimated Surface Elevation (m AHD) ¹	Median Estimated GW Level (m AHD) ²	Median Estimated GW Level (m bgl)	Potential Mounded GW Level (m bgl)	Formation
310-E75	459.1	447.9	11.2	0.0	MRV
310-E76	451.9	441.4	10.5	0.0	MRV
310-E77	454.5	443.7	10.8	0.0	MRV

Notes: GW = Groundwater, ¹Estimated surface elevation calculated based on the typical value for elevation along the proposed rail alignment (RL), ²Estimated groundwater level based on correlation of groundwater, elevation and formation type.

6.3 Groundwater Aggressivity for Bridge Sub-Structures

Observed and inferred groundwater characteristics for bridge locations along the proposed Project alignment and relevant to durability assessment (i.e. groundwater salinity; electrical conductivity; pH; chloride, magnesium, and sulphate concentrations; and magnesium/calcium ratio) are summarised in Table E3. Groundwater quality parameters were calculated based on the typical value for each formation (MRV, bedrock aquifers including WCM and Marburg Subgroup and alluvium) within 5 km of the proposed alignment.

Results of current data analysis across three formations indicate a broad range of groundwater quality. In general, groundwater is neutral to slightly basic and dominantly fresh, with some brackish water observed in the MRV and bedrock aquifers. Laboratory analysis of water samples from groundwater monitoring bores (310-01-BH2203, 310-01-BH2206 and 310-01-BH2216) has been undertaken and results are available. Table E3 in 51 provides results for bridge locations which are located near the Phase 2 Feasibility Design Geotechnical Investigation²⁰ bores or based on statistical averages of formations for bridges that do not contain Project specific water quality result.

Groundwater level variation up to about 3 m in MRV and bedrock aquifers while up to 6 m should be considered for the design of bridge foundations.

6.4 Durability

Durability has been assessed with reference to AS 2159:2009 Australian Standard for Piling – Design and Installation (2010). Water quality data used for the assessment on durability include information from the registered bores database for Queensland (DNRM, 2018) and Phase 2 Feasibility Design geotechnical investigation. Bores within 10 km of the Project alignment were considered for this assessment. Durability assessment data is provided in Table 19.

²⁰ Refer Condamine Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0001 and Geotechnical Factual Report, 2-0001-310-IGE-10-RP-0002

Table 19: Durability Assessment (Exposure Classification for Concrete Piles – AS 2159-2009)

	Typical Value ^A									Range ^A							
	Alluvium	Tertiary	MRV	WCM	Kumbarilla Beds	Marburg Subgroup	Pilliga Sandstone	Springbok Sandstone	Hutton Sandstone	Alluvium	Tertiary	MRV	WCM	Kumbarilla Beds	Marburg Subgroup	Pilliga Sandstone	Hutton Sandstone
Sulfate (mg/L)	9.3	6.0	11.7	13.0	14.0	11.0	65.0	10.0	4.0	0.1-925	4-10.5	1-610	1-299.5	1-40.5	1-60	22-108	1-45
Chloride (mg/L)	95.0	70.0	180.0	375.0	95.0	450.0	1465	149.0	532.5	3-4150	56-140	12-2703	28-7700	68-303.3	61-1250	1060-1870	480-560
Mg (mg/L)	30.0	15.0	67.0	19.0	0.3	6.0	33.5	4.0	4.5	0.1-360	0.1-31	0.1-440	0.1-350	0.1-28	0.9-110	24-43	1.2-18
Ca/Mg Ratio	1.6	2.0	1.1	1.4	12.0	2.5	0.8	6.0	2.9	0.1-49	1.6-50	0.1-32	0.4-23	1.3-35	0.1-7.3	0.6-1.0	1.4-4.9
pH	7.9	7.9	7.9	7.8	8.3	7.9	7.4	7.6	7.8	7.1-11.6	7.8-8.6	6.4-9.7	6.4-8.6	7.2-8.6	6.8-8.6	7.0-7.8	6.3-8
<u>Exposure Classification for Concrete Piles^C</u>																	
Classification^D	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1-B2	B1	B1-B2	B1-B2	B1	B1	B1	B1

Notes: ^A Based on limited data records, values may not be representative

^B The range of parameters for the Springbok Sandstone Formation is not provided because only one sample is available in this formation

^C Exposure classification based on typical values, locally may exceed classification rating

^D The exposure classification is determined based on Soil Conditions A (high permeability soils) as conservative estimates

7.0 RISK AND MITIGATION

Groundwater related risks and proposed mitigation measures are summarised in Table 20.

Table 20: Risks Identified and Mitigation

Risk/Issue	Proposed Mitigation
Long-term groundwater levels at cut locations higher than assumed for current assessment based on limited data. May result in higher than expected inflows, and may reduce Factors of Safety for cut batters.	Continuous recording of groundwater levels in monitoring bores along the alignment at each cut location anticipated to intersect the groundwater table prior to construction in order to provide site specific data to designers/constructors. Upper limits of seepage as established in Table 15 should be accommodated by standard cess drain dimensions.
Groundwater characteristics (water quality and quantity) vary from those assumed for current assessment based on limited data. This could include local variations, temporal fluctuations (e.g. seasonal) or change in environment (e.g. cut drainage). These variations may result in non-compliance with water quality criteria for discharge from cuts (low likelihood) or exposure classification for concrete piles lower than designed for.	Site specific data to be provided to designers/constructors. Complete three round of sampling of monitoring bores along the alignment prior to design/construction of bridges and the excavation of critical cuts. Samples to be taken during dry and after wet seasons to determine variations in groundwater quality parameters. Cost estimates for the project should make allowance for adopting a minimum exposure classification in accordance with Table 6.3.1 of AS 1597 for concrete in contact with groundwater within and adjacent to areas with potential acid sulphate soils and acid sulphate soils.
Groundwater drawdown from critical cuts greater than anticipated with potential of impacting environmental values of shallow groundwater in the long-term.	Identify environmental values and potential cumulative impacts at cut locations. Allow for effective design and implementation of measures to manage such cumulative effects. Monitor groundwater drawdown in the area surrounding the cuts near potential environmental receptors.

8.0 IMPORTANT INFORMATION RELATING TO THIS REPORT

Your attention is drawn to the document – “Important Information Relating to this Report”, which is included as an Attachment of this report in APPENDIX F. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this Project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

9.0 REFERENCES

- Australian Government, 2018, Bioregional Assessment Programme – Data Register for Product 2.1-2.2 Data Analysis for the Clarence-Moreton Bioregion. <<https://www.bioregionalassessments.gov.au/data/21-22-data-analysis-clarence-moreton-bioregion>> accessed on 13 October 2018.
- Bureau of Meteorology (BOM), 2018. *Climate Data Online – Weather Stations*. Accessed on 12 December 2018, Commonwealth of Australia. Available at <<http://www.bom.gov.au/climate/data/stations/>>
- Bureau of Meteorology (BOM), 2010. Average Annual Rainfall. Available at <http://www.bom.gov.au/jsp/ncc/climate_averages/rainfall/index.jsp>
- Barnett, 2013. *Groundwater Numerical Modelling Report: New Acland Coal Mine Stage 3 Project – Version 3*. Prepared for New Hope Group by SKM. 13 August 2013.
- Cranfield, L.C., Schwarzbock, H., 1973. *Ipswich 1:250 000 geological series, sheet SG56-14*. Geological Survey of Queensland, Department of Natural Resources and Mines (DNRM), 2016. *Hydrogeological Conceptualisation Report for the Surat Cumulative Management Area*. State of Queensland, 2016.
- Department of Natural Resources and Mines (DNRM), 2018. *Groundwater Database – Queensland*. Accessed from: <https://data.qld.gov.au/dataset/groundwater-database-queensland>, 3 August 2018.
- Exon, N. and Burger, D., 1981. *Sedimentary cycles in the Surat Basin and global changes of sea level*, BMR Journal of Australian Geology and Geophysics 6(2):153-159
- Future Freight Joint Venture (FFJV) 2018. *Inland Rail: Phase 2 – NSW/Qld Border to Gowrie Geotechnical Interpretive Report Revision A Draft* 9 August 2018. Brisbane. Document number 2-0001-310-IGE-03-RP-0001.
- Gasfields Commission Queensland (GCQ), 2014. *Groundwater Aquifer Connectivity in Queensland Australia*. Technical Communication 1, November 2014.
- Golder Associates (Golder), 2018a. *Inland Rail – Package 310 (B2G) – 30% Feasibility design scope of works – Hydrogeology*. Prepared for the Future Freight Joint Venture, 3 August 2018.
- Golder Associates (Golder), 2018b. *Inland Rail – Package 310 (B2G) Phase 2 – Condamine River Valley Area Geotechnical Investigation – Factual Report*. Prepared for the Future Freight Joint Venture, 6 December 2018. Document number 2-0001-310-IGE-10-RP-0001.
- Golder Associates (Golder), 2018c. *Inland Rail – Package 310 (B2G) Phase 2 – Geotechnical Factual Report*. Prepared for the Future Freight Joint Venture, 14 December 2018. Document number 2-0001-310-IGE-10-RP-0002.
- Holland KL, Aryal SK, Bruce J, Carey H, Davies P, Ford J, Henderson B, Herr A, Janardhanan S, Merrin LE, Mitchell PJ, Mount RE, O'Grady AP, Ransley T, Sander R and Schmidt RK, Holland, et. al.), 2016. *Conceptual modelling for the Maranoa-Balonne-Condamine subregion. Product 2.3 for the Maranoa-Balonne-Condamine subregion from the Northern Inland Catchments Bioregional Assessment*. Department of the Environment and Energy, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia. <http://data.bioregionalassessments.gov.au/product/NIC/MBC/2.3>.
- Queensland Water Commission (QWC), 2012. *Underground Water Impact Report for the Surat Cumulative Management Area*. Commission QW, State of Queensland.
- Nguyen V. U. and Raudkivi A. J., 1983. *Analytical solution for transient two-dimensional unconfined groundwater flow*. Hydrological Sciences Journal, 28:2, 209-219, DOI: [10.1080/02626668309491961](https://doi.org/10.1080/02626668309491961).

Raiber M., Murray J., Bruce C., Rassam D., Ebner B., Henderson B., O'Grady T., Gilfedder M., and Cui T., 2016. *Conceptual Modelling for the Clarence-Moreton Bioregion*. Product 2.3 from the Clarence-Moreton Bioregional Assessment. Department of the Environment and Energy, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia. <http://data.bioregionalassessments.gov.au/product/CLM/CLM/2.3> accessed on 5 October 2018.

Senior, D., 1973. *1:250 000 Geological Series-Explanatory Notes – Goondiwindi*. Queensland and New South Wales, Sheet SH/56.1/Australian Government, Canberra, 1973.

Standards Australia, 2010. *Australian Standard Piling – Design and Installation*. AS 2159:2009.

State of Queensland, 2016. Queensland land use spatial data. Department of Science, Information, Technology and Innovation. Queensland, Australia.

State of Queensland, 2017. *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017*. Water Act 2000.

University of Southern Queensland, 2011. *Preliminary Assessment of Cumulative Drawdown Impacts in the Surat Basin Associated with the Coal Seam Gas Industry*. Queensland, 4 March 2011.

Signature Page

Golder Associates Pty Ltd



Cristian Loddo
Associate, Geotechnical Group Leader

NMC/HG,SB,KB/AL/hn/rw

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[https://golderassociates.sharepoint.com/sites/1897791/deliverables/016 - hydrogeology - 100% hir/1897791-016-r-rev0-100% hydrogeological design report - new template.docx](https://golderassociates.sharepoint.com/sites/1897791/deliverables/016-hydrogeology-100%hir/1897791-016-r-rev0-100%hydrogeologicaldesignreport-newtemplate.docx)

FIGURES

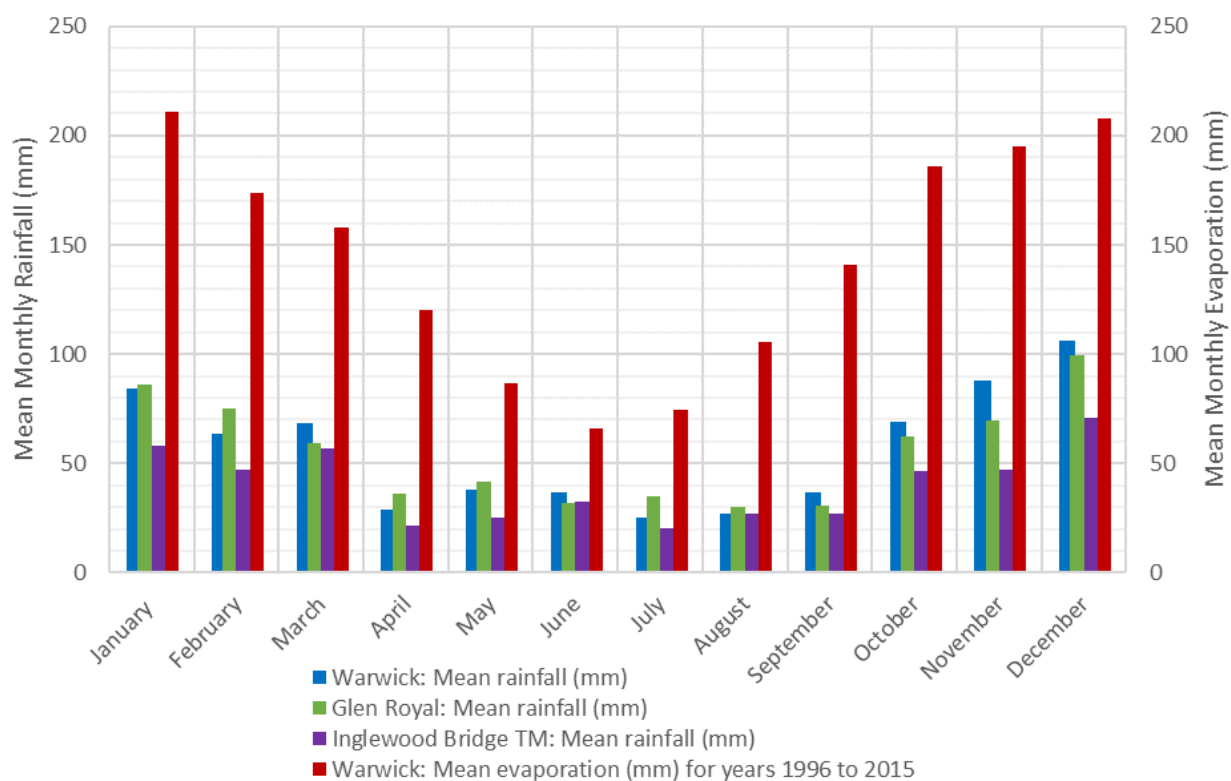


Figure 1: Monthly climate statistics for the Project

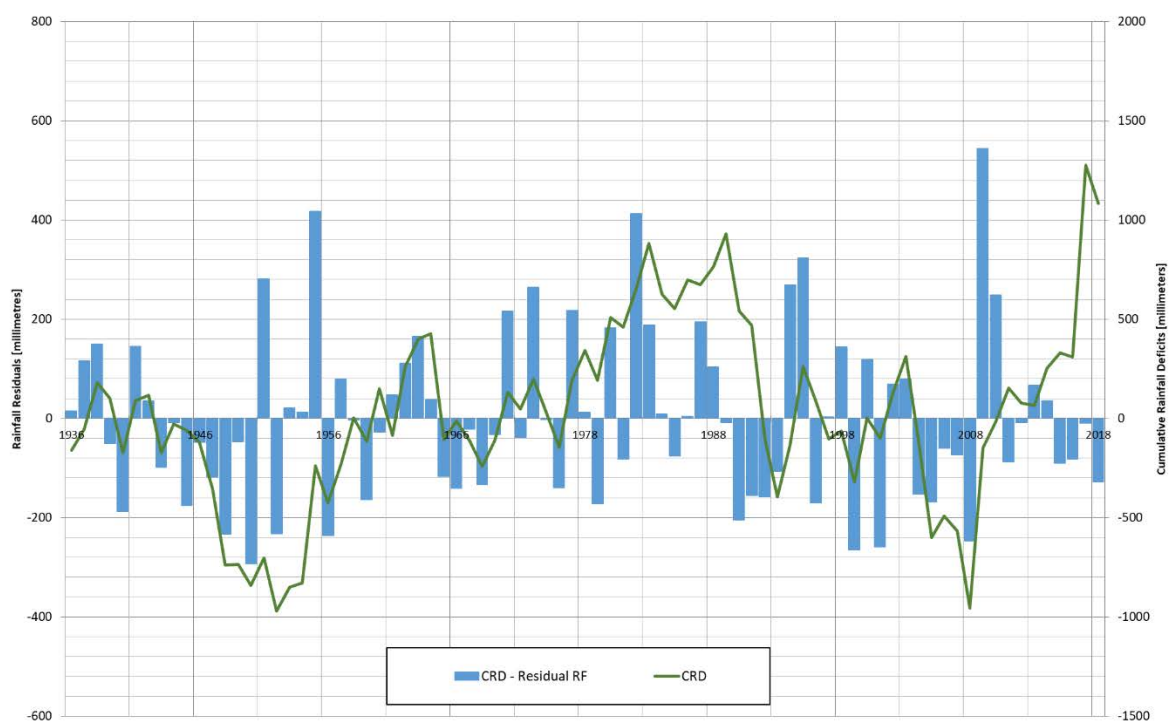
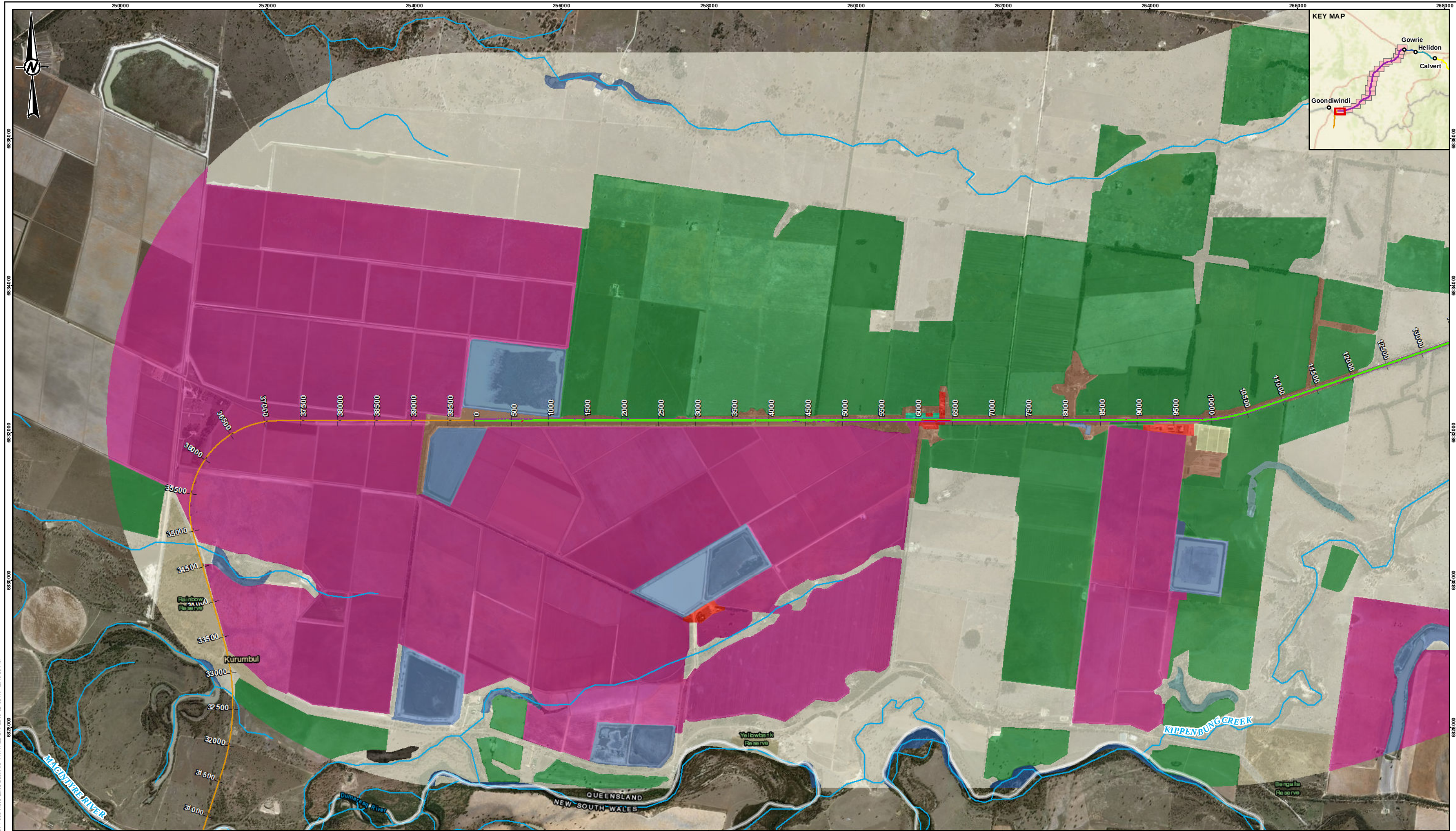


Figure 2: Annual residual rainfall and cumulative rainfall deficit (cumulative deviation from average) for 'Glen Royal' Australian Bureau of Meteorology station number 041504, record period between 1928 and 2018



- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Inland Rail Alignment Section**
 - NS2B - NSW/Qld Border to Gowrie
 - B2G - Border to Gowrie
 - Land use (5km Buffer of Alignment)**
 - Nature conservation
 - Other minimal use
 - Grazing native vegetation
 - Grazing modified pastures
 - Cropping
 - Land in transition
 - Irrigated cropping
 - Residential
 - Mining
 - Reservoir/dam
 - River
 - Marsh/wetland

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

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REFERENCE(S)
1. Watercourses: Geoscience Australia
2. Alignment, Earth Works: Provided by FF JV on 10th Jan 2019.
3. Land Use: State of Queensland (Department of Science, Information Technology and Innovation), September 2016

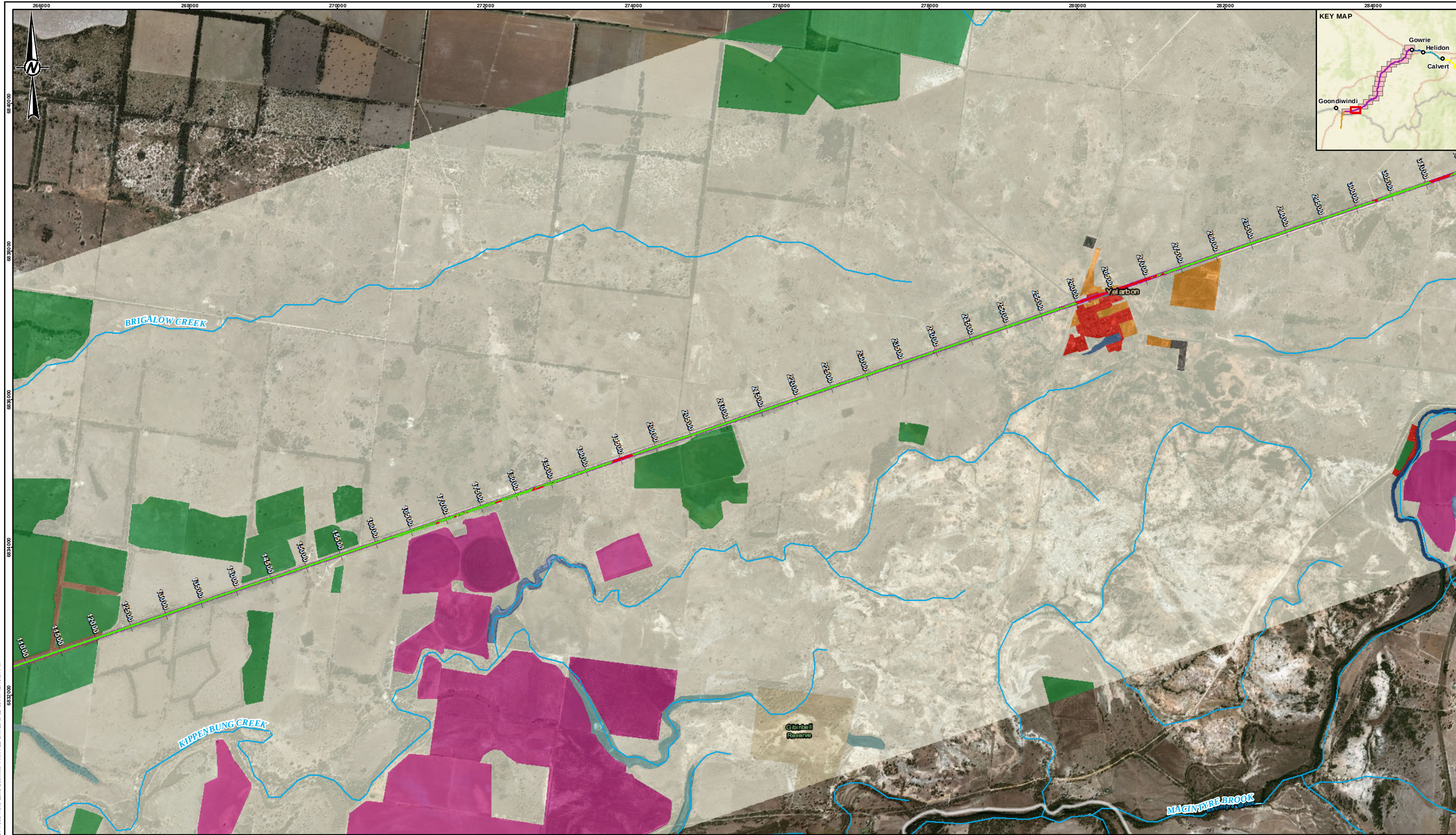
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INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
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LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Inland Rail Alignment Section

B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

Nature conservation

Other minimal use

Grazing native vegetation

Cropping

Irrigated cropping

Manufacturing and industrial

Residential

Services

Waste treatment and disposal

Reservoir/dam

River

Marsh/wetland

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	BG
	PREPARED	BG
	REVIEWED	DP
	APPROVED	NMC

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PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

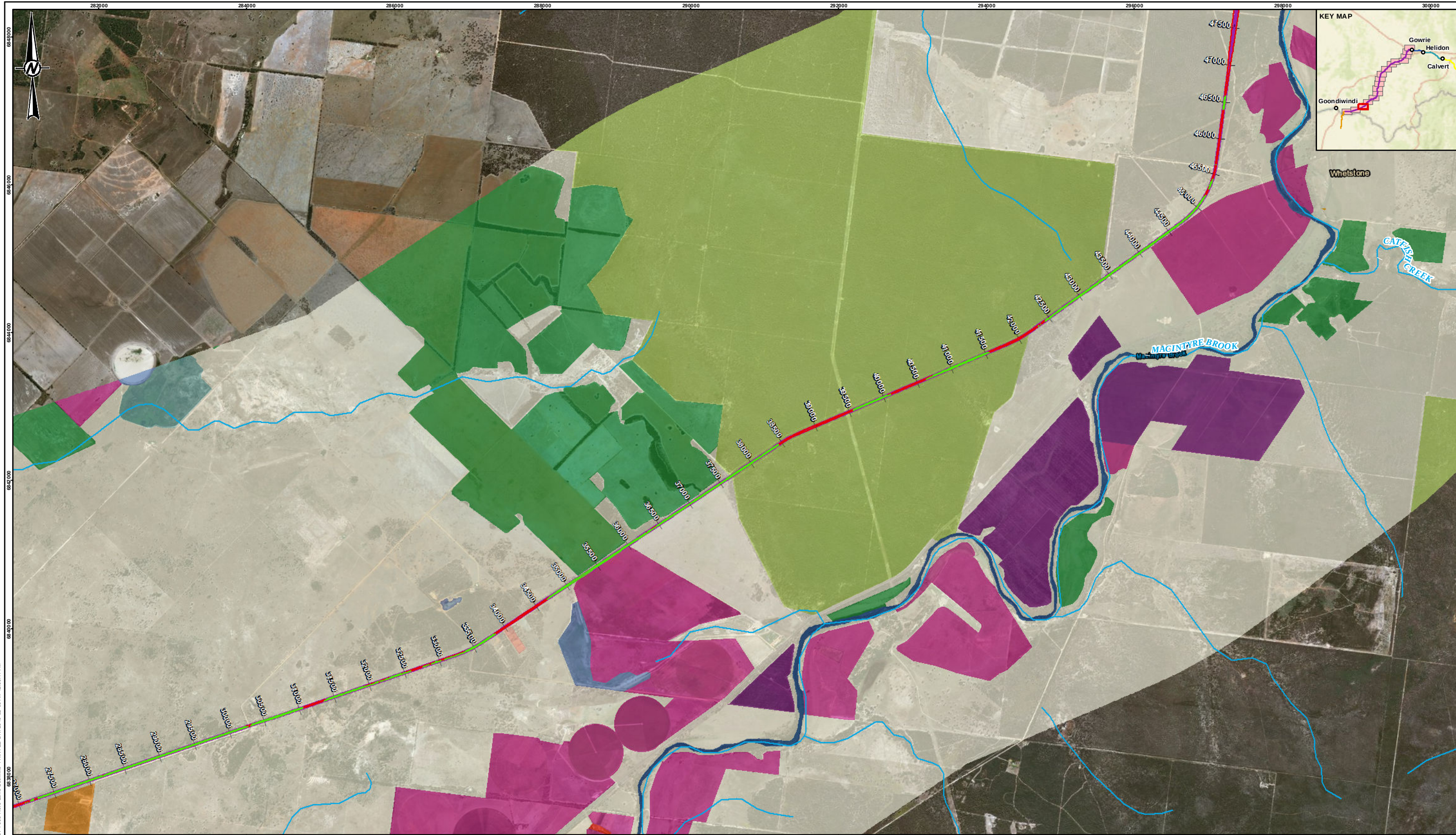
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LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
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- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Inland Rail Alignment Section**
 - B2G - Border to Gowrie
 - Land use (5km Buffer of Alignment)**
 - Grazing native vegetation
 - Production forestry
 - Cropping
 - Irrigated cropping
 - Irrigated perennial horticulture
 - Intensive animal husbandry
 - Residential
 - Services
 - Transport and communication
 - Reservoir/dam
 - River
 - Marsh/wetland

FOR DISCUSSION PURPOSE ONLY
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Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	BG
	PREPARED	BG
	REVIEWED	DP
	APPROVED	NMC

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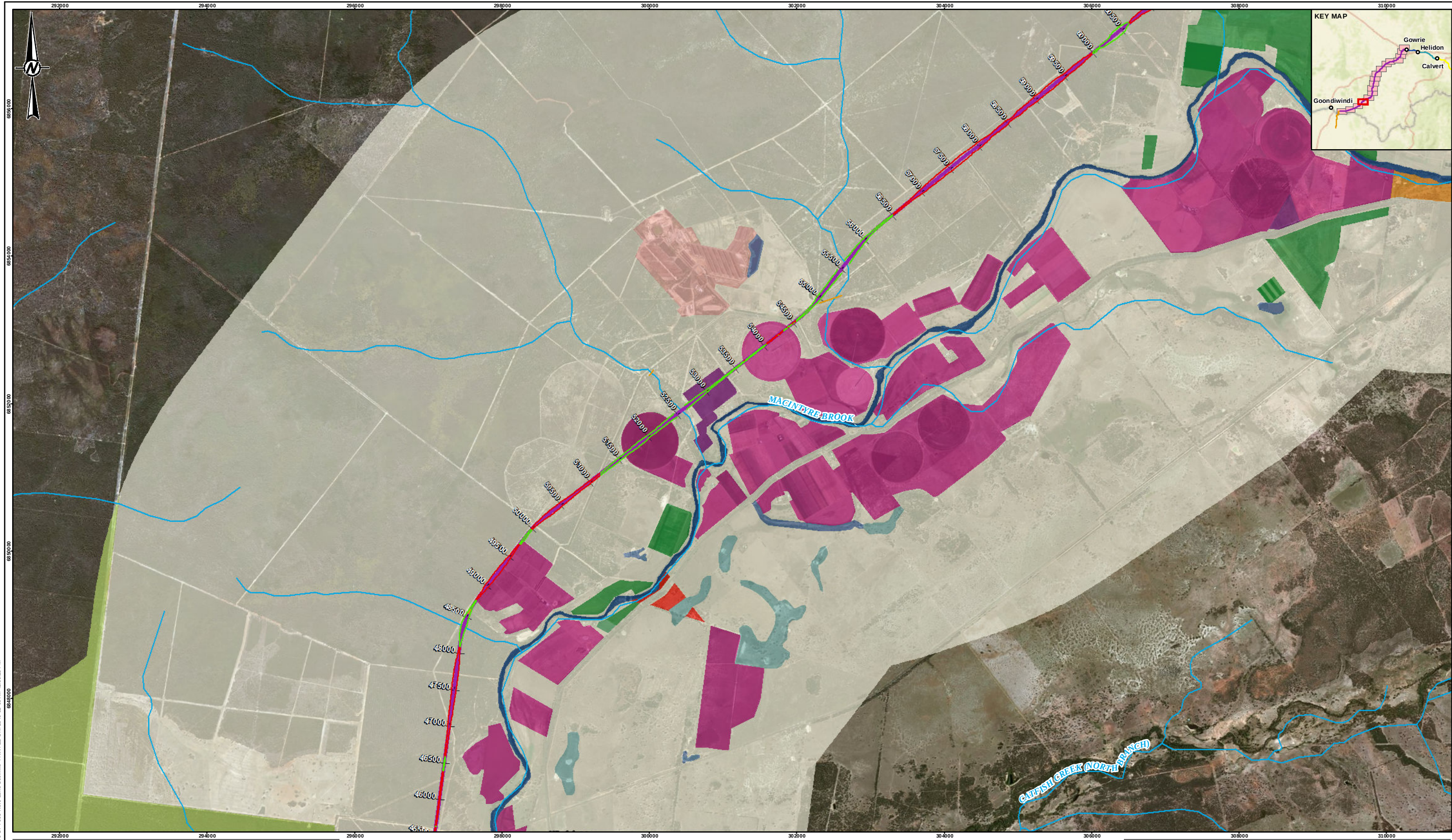
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INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

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- LEGEND**
- Watercourse
- Type of Earth Works**
- Cut
 - Fill
 - Bridge
- Inland Rail Alignment Section**
- B2G - Border to Gowrie
- Land use (5km Buffer of Alignment)**
- Grazing native vegetation
 - Production forestry
 - Cropping
 - Perennial horticulture
 - Irrigated cropping
 - Irrigated perennial horticulture
 - Intensive animal husbandry
 - Residential
 - Services
 - Reservoir/dam
 - River
 - Marsh/wetland

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Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

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PREPARED	BG
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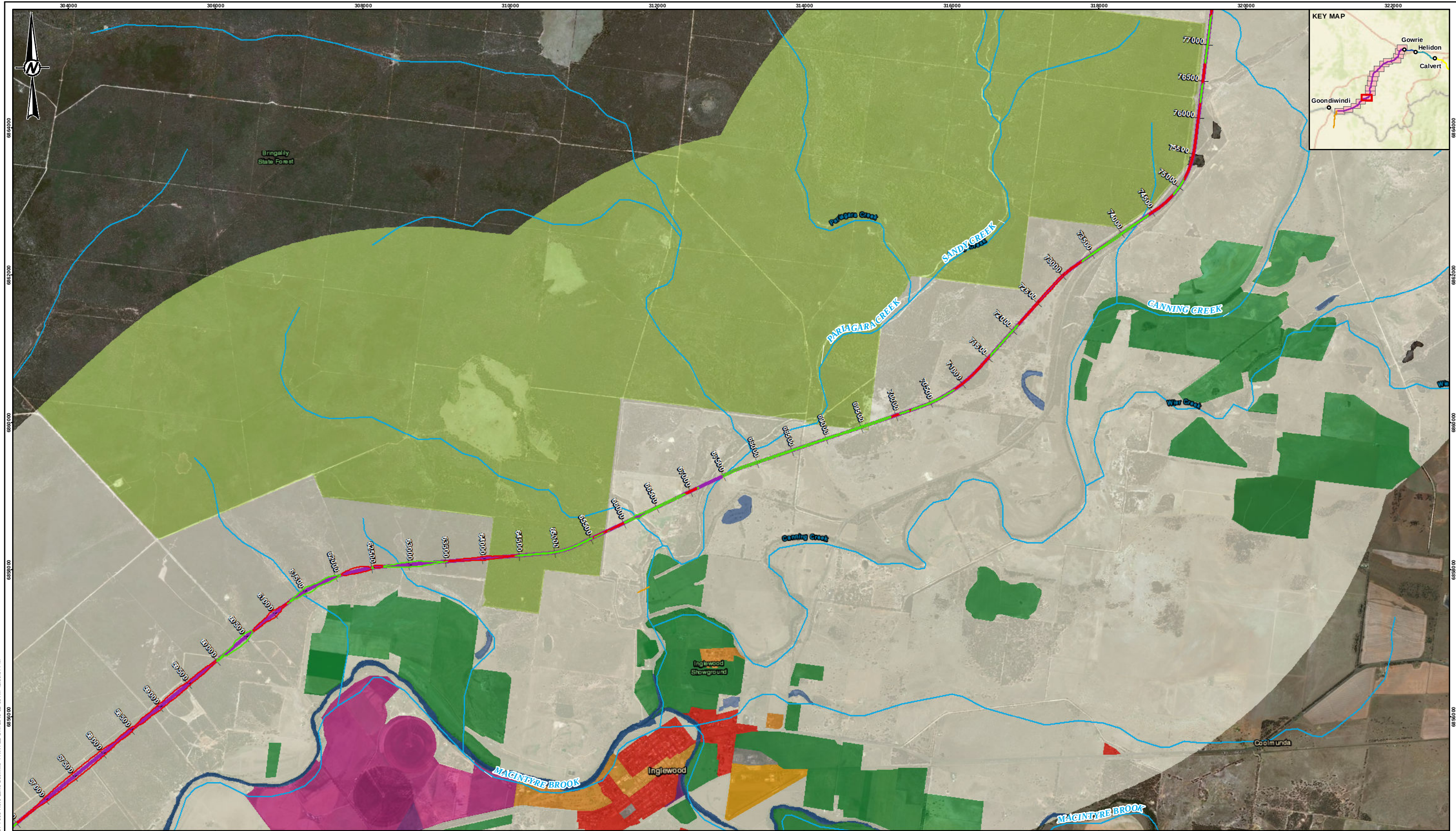
PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
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LEGEND

Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

- Grazing native vegetation
- Production forestry
- Cropping
- Irrigated cropping
- Irrigated perennial horticulture
- Manufacturing and industrial
- Residential
- Services
- Transport and communication
- Mining
- Reservoir/dam
- River

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

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PREPARED	BG
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PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

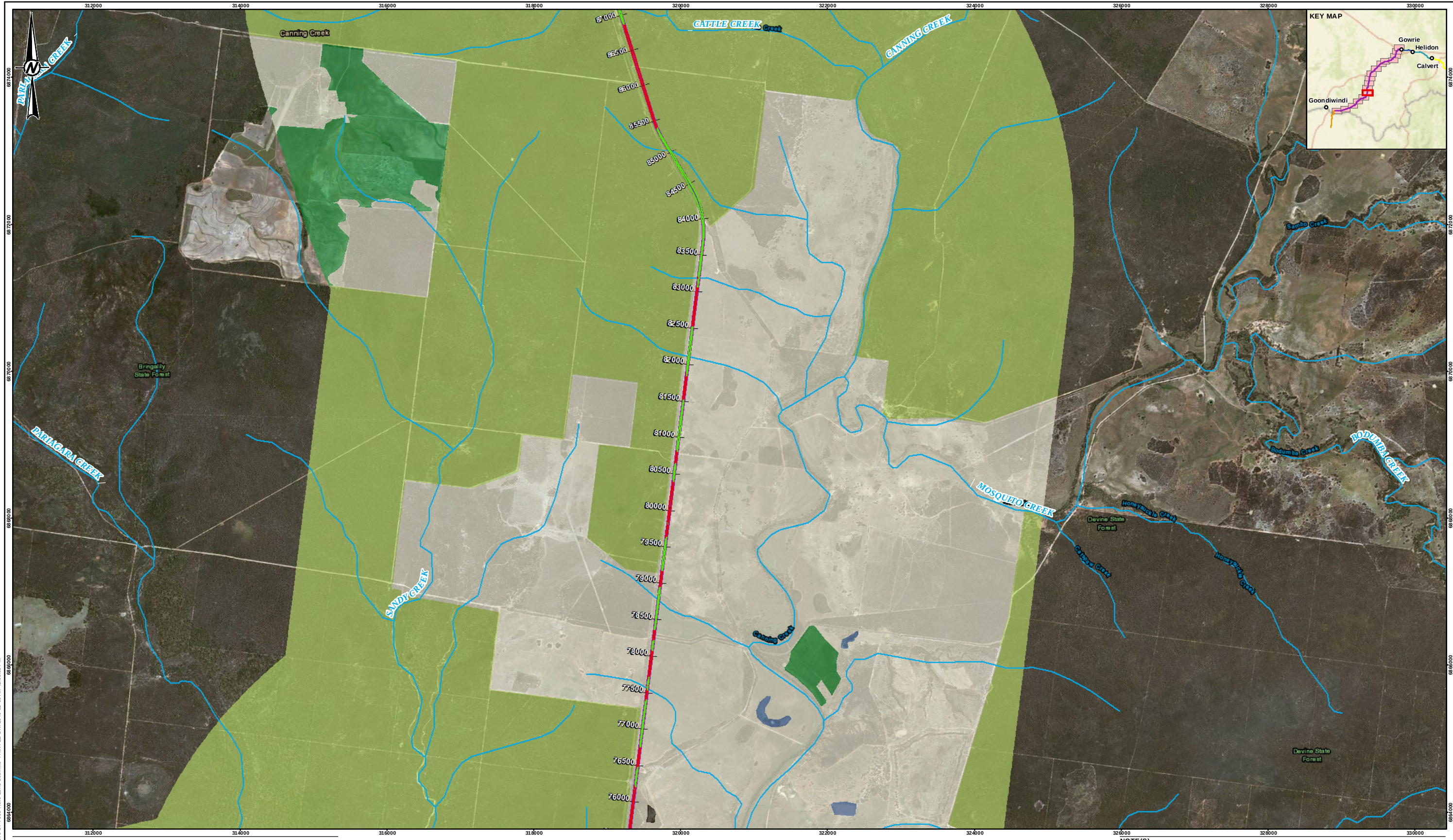
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LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
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LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Inland Rail Alignment Section

B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

Grazing native vegetation

Production forestry

Cropping

Mining

Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

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CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

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PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.

1897791

CONTROL

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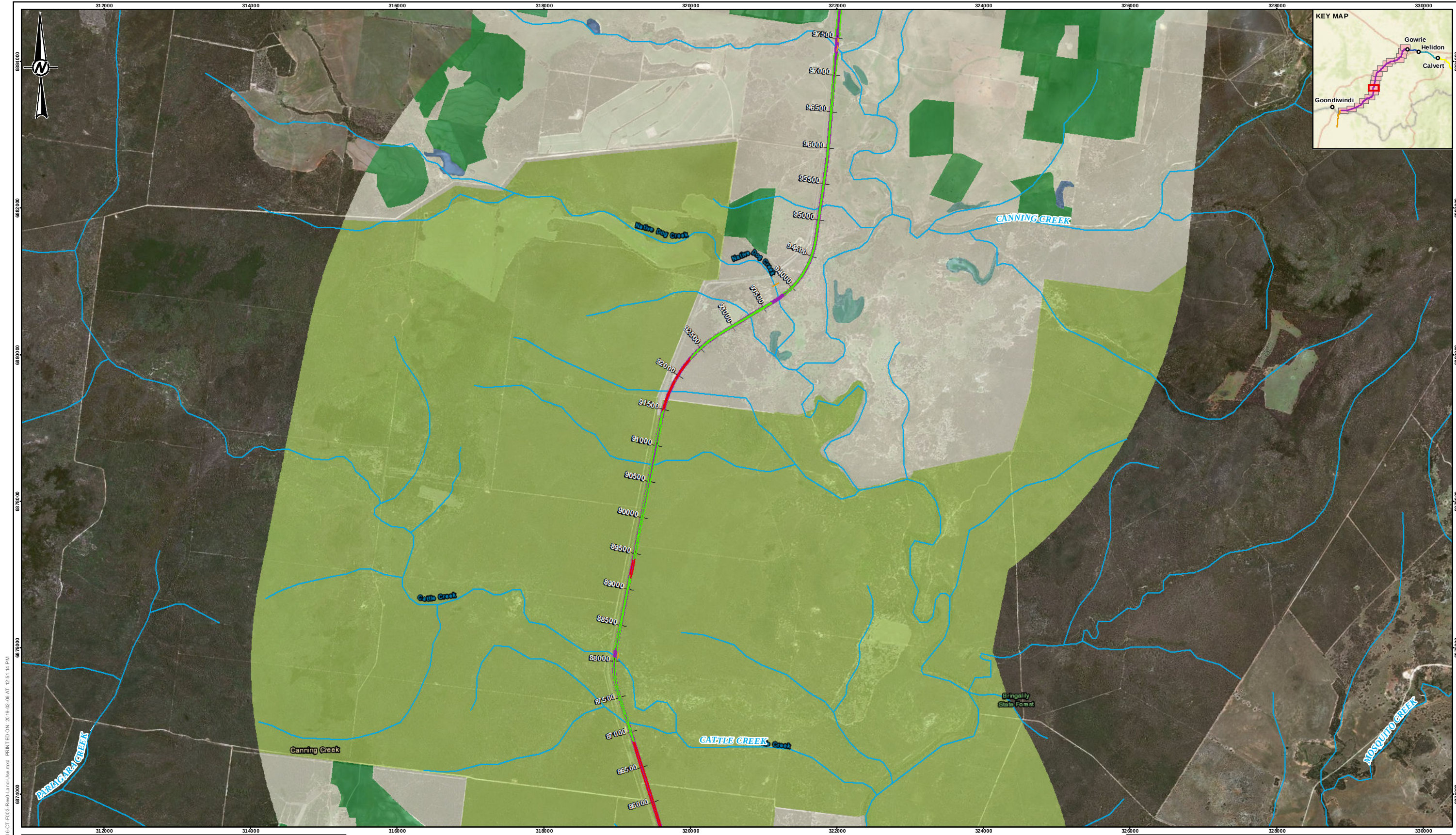
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FIGURE

3-6

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LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Reservoir/dam

Marsh/wetland

Inland Rail Alignment Section

B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

Grazing native vegetation

Production forestry

Cropping

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

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PREPARED

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REVIEWED

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2. Alignment, Earth Works: Provided by FF JV on 10th Jan 2019.

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PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

TITLE

LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.

1897791

CONTROL

016

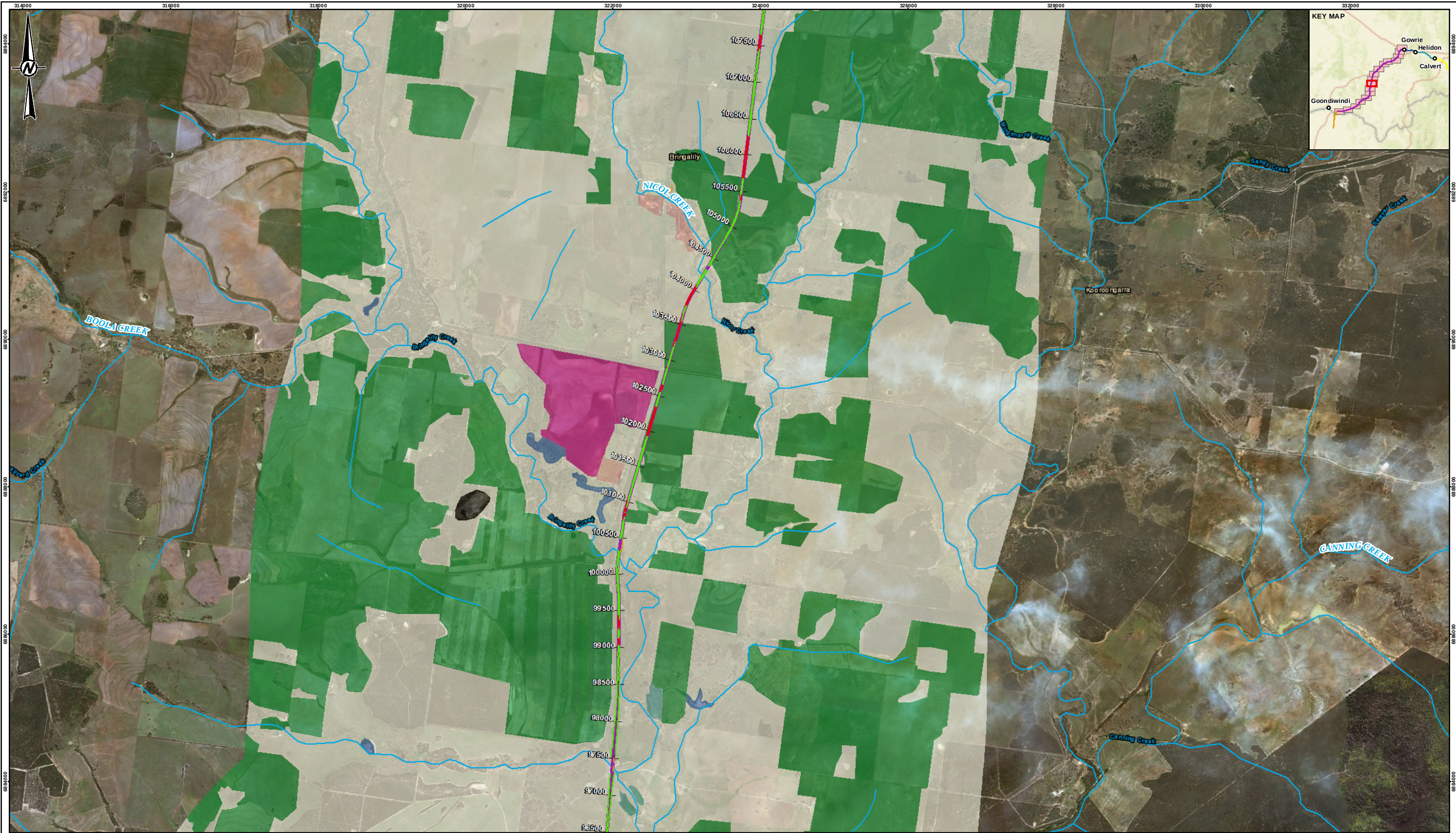
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FIGURE

3-7

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

- Grazing native vegetation
- Cropping
- Irrigated cropping
- Intensive animal husbandry
- Mining
- Reservoir/dam
- Marsh/wetland

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

GOLDER

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PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

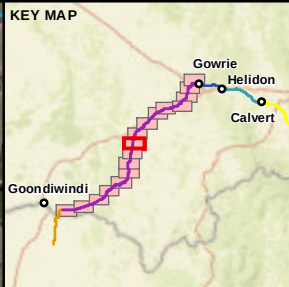
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LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
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LEGEND

Watercourse

Type of Earth Works

- Cut
- Fill

Inland Rail Alignment Section

- B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

- Other minimal use
- Grazing native vegetation
- Production forestry
- Cropping
- Perennial horticulture
- Irrigated perennial horticulture
- Intensive animal husbandry
- Residential
- Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
DESIGNED	BG	
PREPARED	BG	
REVIEWED	DP	
APPROVED	NMC	

GOLDER

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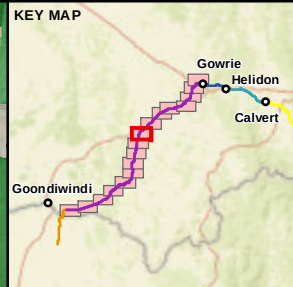
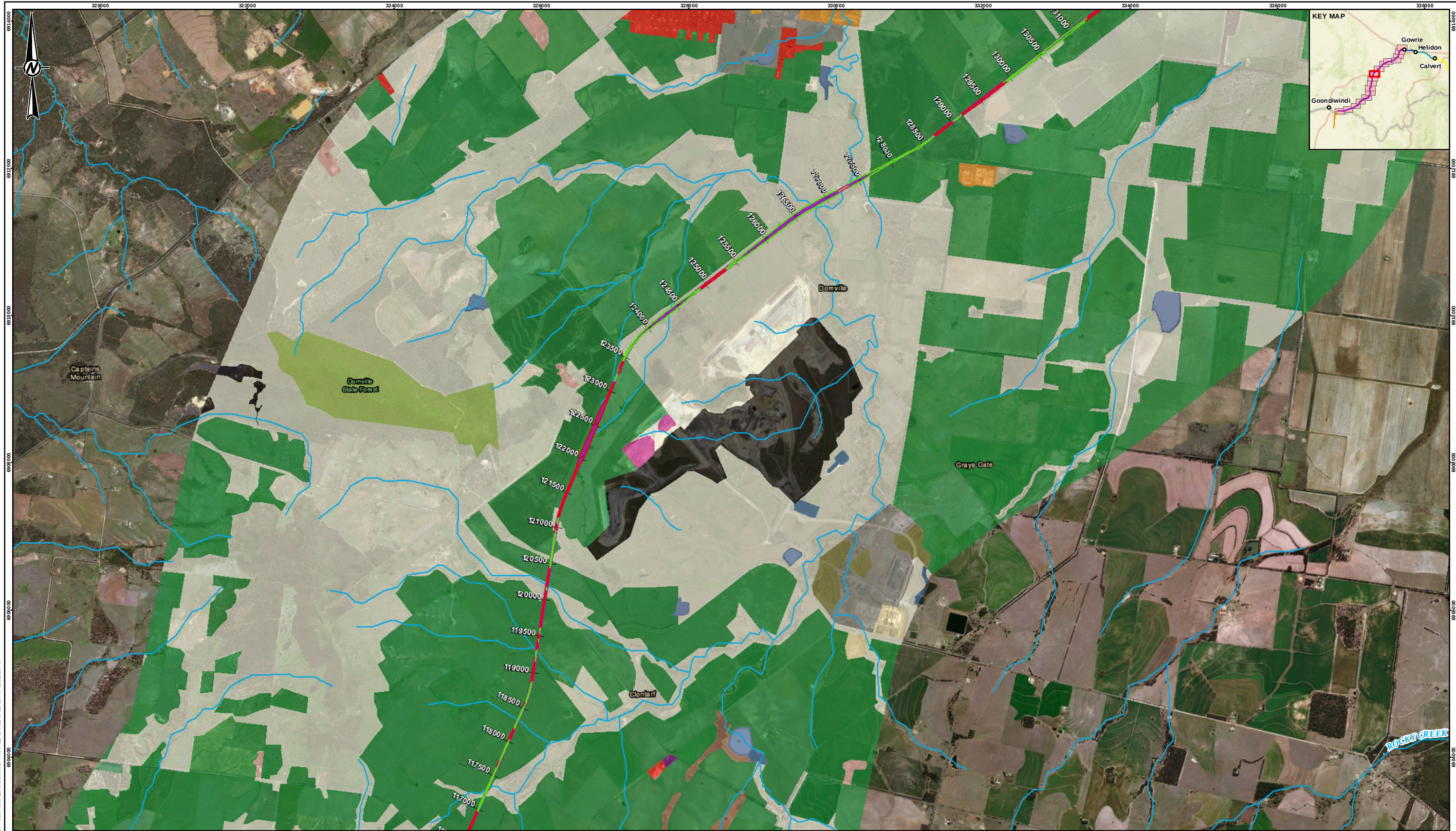
REFERENCE(S)

1. Watercourses: Geoscience Australia
2. Alignment, Earth Works: Provided by FF JV on 10th Jan 2019.
3. Land Use: State of Queensland (Department of Science, Information Technology and Innovation), September 2016

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	3-9



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

Nature conservation

Other minimal use

Grazing native vegetation

Production forestry

Plantation forestry

Cropping

Perennial horticulture

Irrigated cropping

Irrigated perennial horticulture

Intensive animal husbandry

Manufacturing and industrial

Residential

Services

Utilities

Transport and communication

Mining

Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

BG

PREPARED

BG

REVIEWED

DP

APPROVED

NMC

GOLDER

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

1. Watercourses: Geoscience Australia

2. Alignment, Earth Works: Provided by FF JV on 10th Jan 2019.

3. Land Use: State of Queensland (Department of Science, Information Technology and Innovation), September 2016

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.

1897791

CONTROL

016

REV.

0

FIGURE

3-10

PATH: B:\INLAND_RAIL_Hydrogeology_Folder\99_PROJECTS\B2G-111897791\16-CT-F003-Rev0-LandUse.mxd PRINTED ON: 2019-02-06 AT: 12:52:03 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

Nature conservation

Other minimal use

Grazing native vegetation

Grazing modified pastures

Cropping

Perennial horticulture

Land in transition

Irrigated cropping

Intensive animal husbandry

Manufacturing and industrial

Residential

Services

Transport and communication

Reservoir/dam

River

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

BG

PREPARED

BG

REVIEWED

DP

APPROVED

NMC

GOLDER

0

500

1,000

1,500

2,000

METRES

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Watercourses: Geoscience Australia
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3. Land Use: State of Queensland (Department of Science, Information Technology and Innovation), September 2016

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.
1897791

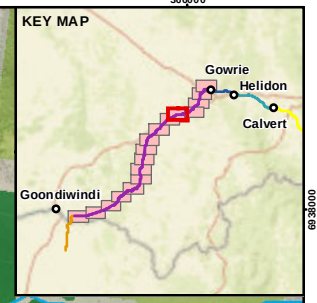
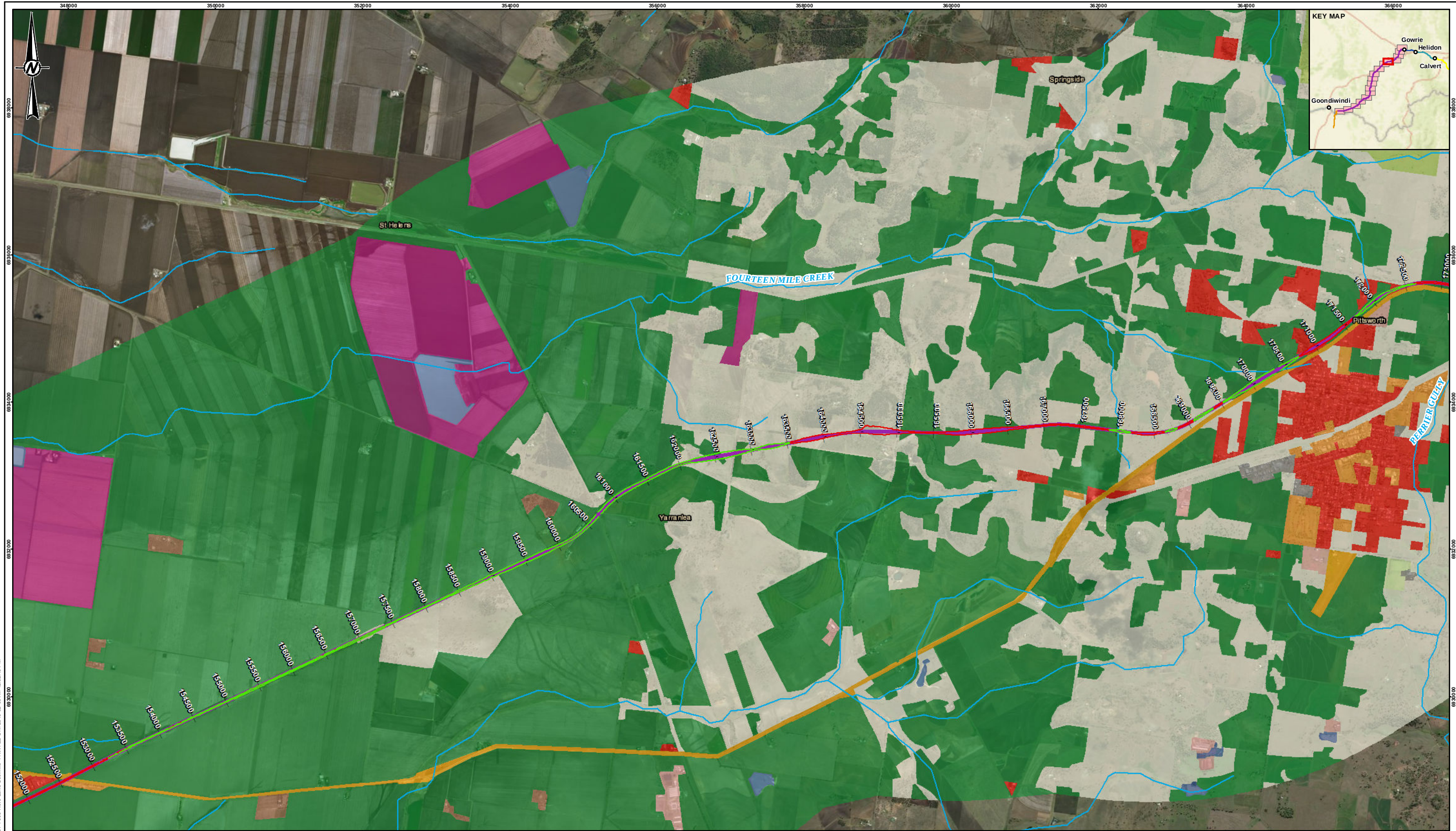
CONTROL
016

REV.
0

FIGURE
3-11

PATH: B:\INLAND_RAIL_Hydrogeology_Folder99_PROJECTS\Bridging_111897791\16-CT-F003-Rev0-Land-Use.mxd PRINTED ON: 2019-02-06 AT: 12:52:17 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Inland Rail Alignment Section**
 - B2G - Border to Gowrie
 - Land use (5km Buffer of Alignment)**
 - Other minimal use
 - Grazing native vegetation
 - Production forestry
 - Grazing modified pastures
 - Cropping
 - Irrigated cropping
 - Intensive animal husbandry
 - Manufacturing and industrial
 - Residential
 - Services
 - Utilities
 - Transport and communication
 - Reservoir/dam

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

GOLDER

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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1. Watercourses: Geoscience Australia
2. Alignment, Earth Works: Provided by FF JV on 10th Jan 2019.
3. Land Use: State of Queensland (Department of Science, Information Technology and Innovation), September 2016

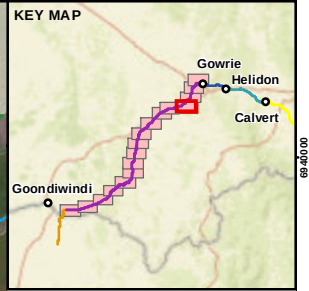
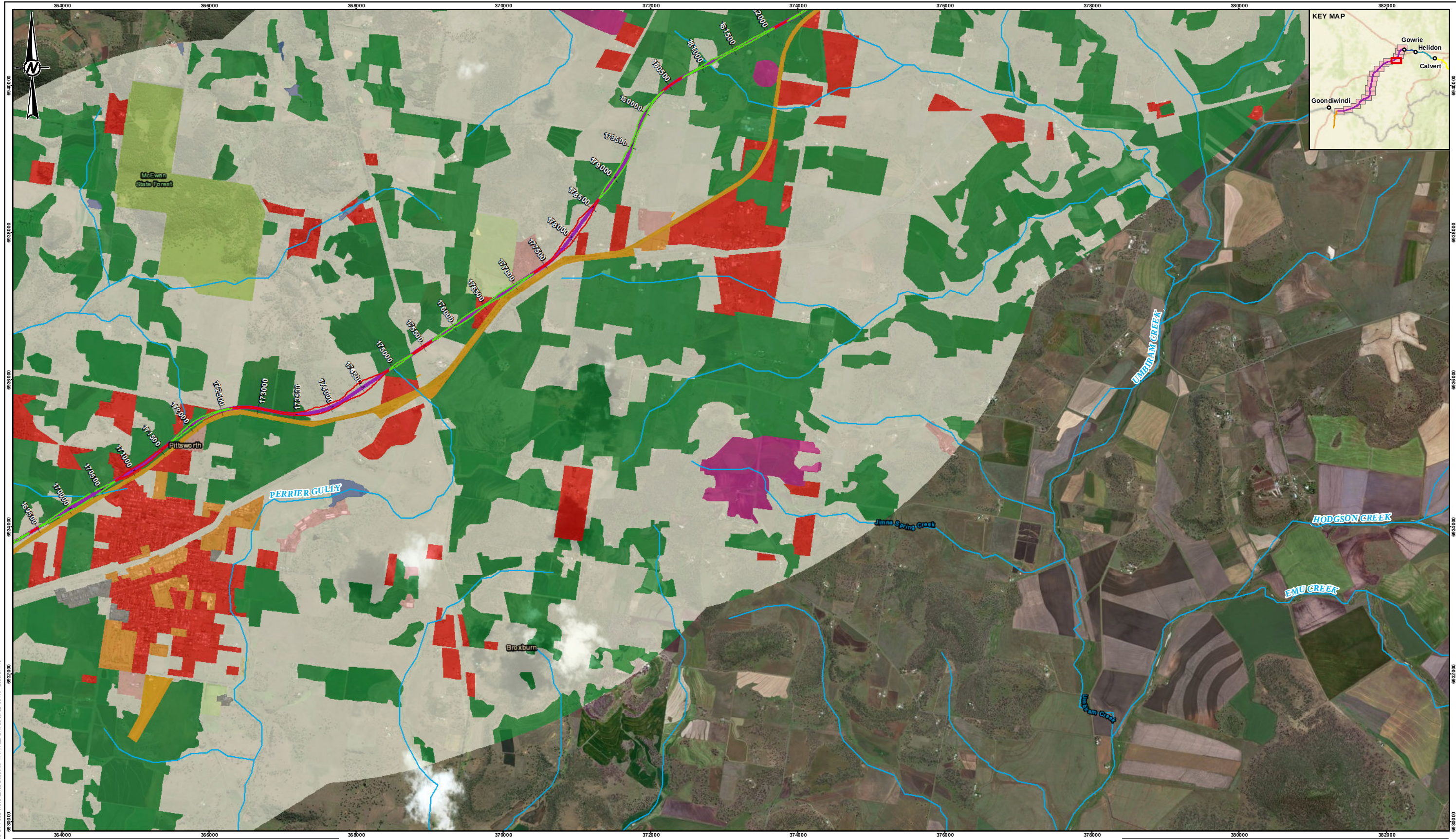
PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	3-13

PATH: B:\INLAND_RAIL_Hydrogeology_Folder99_PROJECTS\Bridges_111897791\16-CT-FWD3-ReoLand-Use.mxd PRINTED ON: 2019-02-06 AT: 12:52:48 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

Grazing native vegetation

Production forestry

Grazing modified pastures

Cropping

Irrigated cropping

Intensive animal husbandry

Manufacturing and industrial

Residential

Services

Utilities

Transport and communication

Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

BG

PREPARED

BG

REVIEWED

DP

APPROVED

NMC

GOLDER

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.
1897791

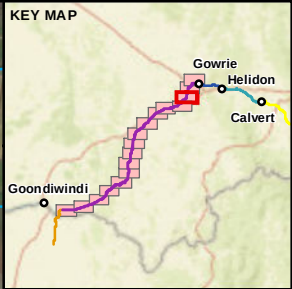
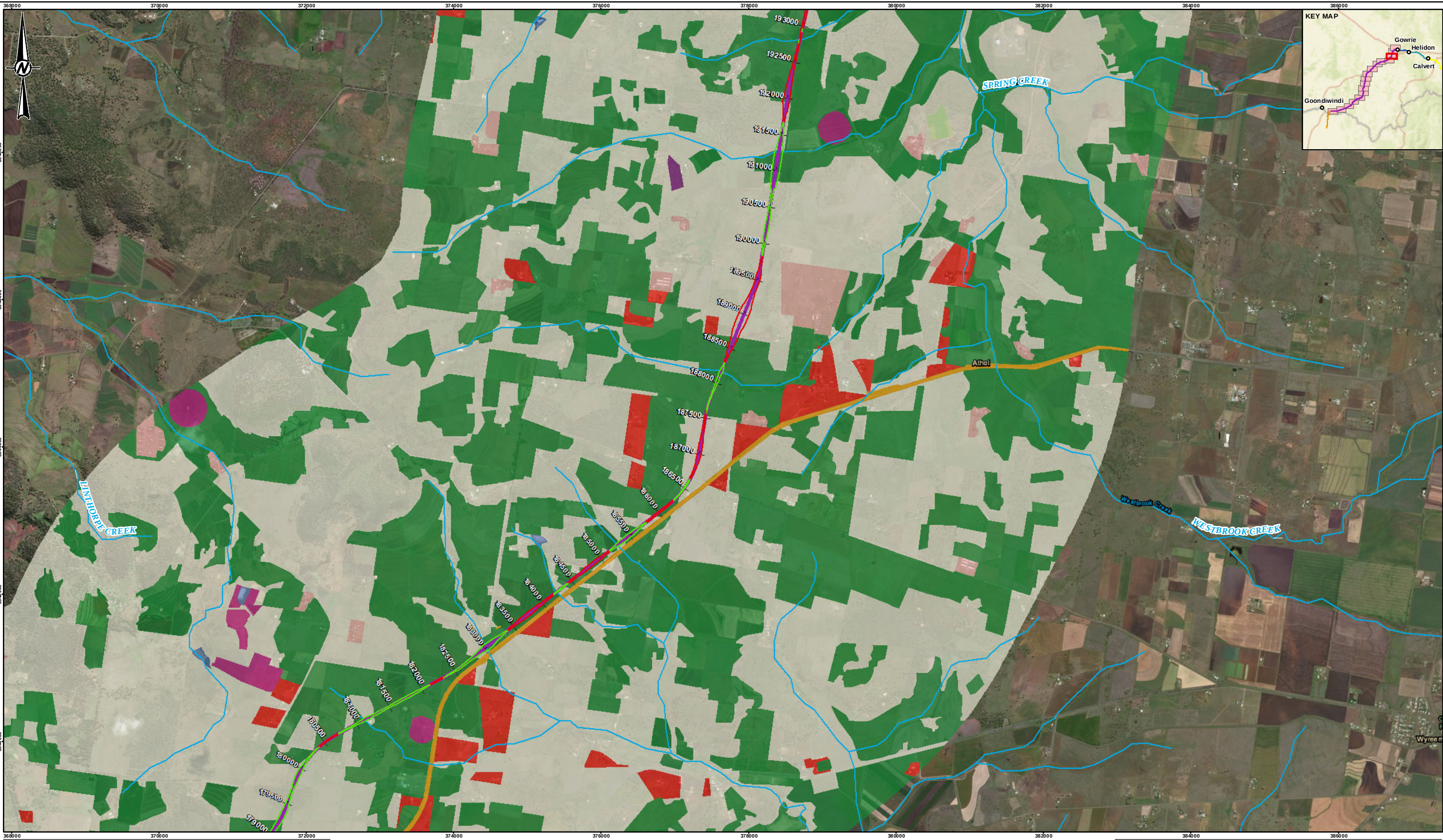
CONTROL
016

REV.
0

FIGURE
3-14

PATH: B:\INLAND_RAIL\Hydrogeology\Folder99_PROJECTS\Bridges_111897791\16-CT-F003-RecoLandUse.mxd PRINTED ON: 2019-02-06 AT: 12:43:07 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie

Land use (5km Buffer of Alignment)

- Grazing native vegetation
- Grazing modified pastures
- Cropping

- Irrigated cropping
- Irrigated perennial horticulture
- Intensive animal husbandry
- Residential
- Transport and communication
- Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

GOLDER

0 500 1,000 1,500 2,000

1:50,000@A3

METRES

DD-MMM-YY	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)

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REFERENCE(S)

1. **Watercourses:** Geoscience Australia
2. **Alignment, Earth Works:** Provided by FF JV on 10th Jan 2019.
3. **Land Use:** State of Queensland (Department of Science, Information Technology and Innovation), September 2016

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

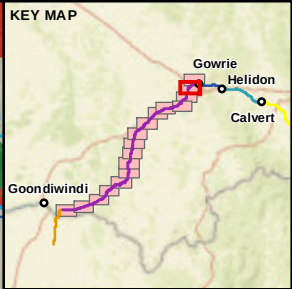
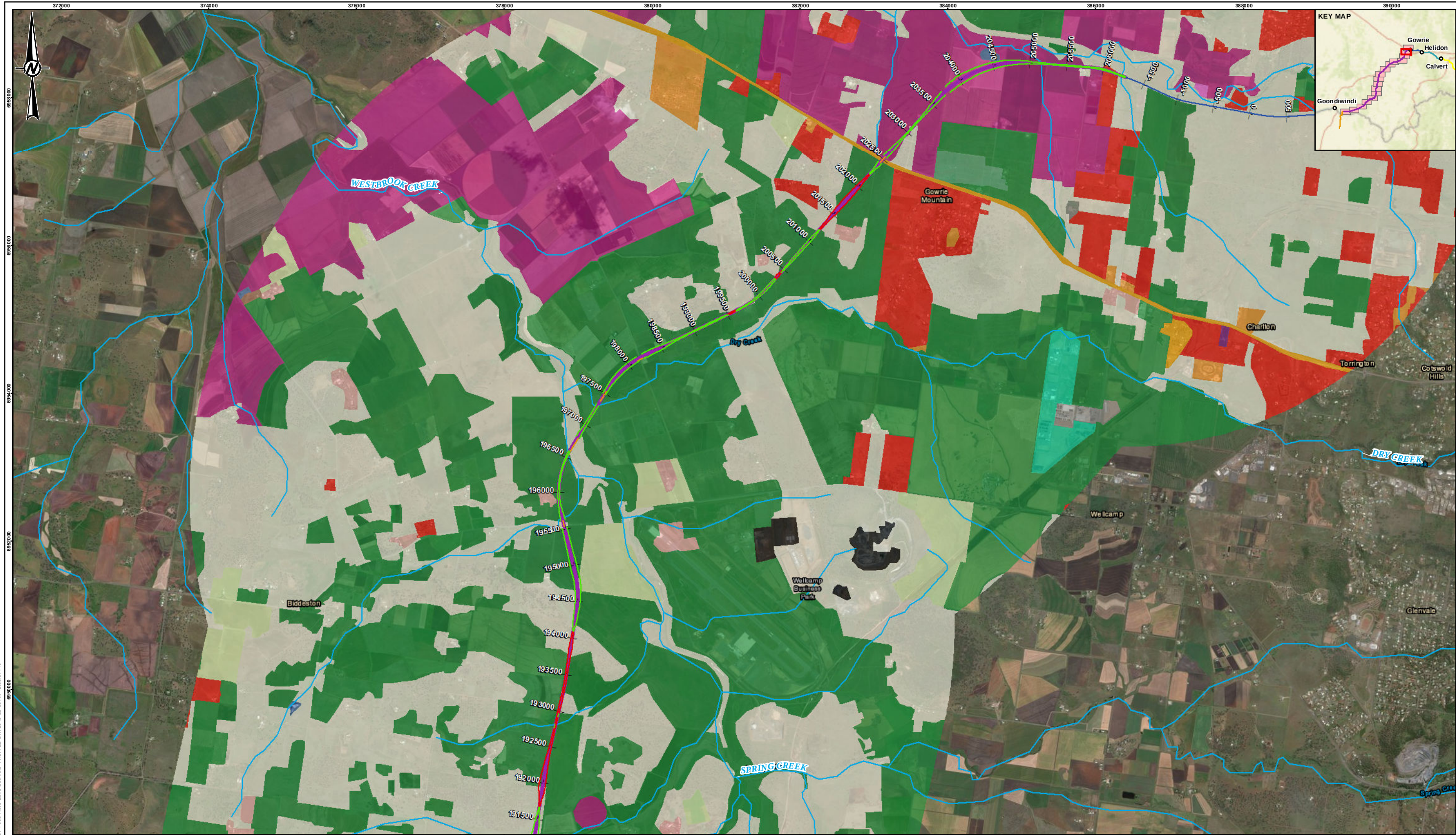
TITLE

LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	3-15

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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

G2H - Gowrie to Helidon

Land use (5km Buffer of Alignment)

Other minimal use

Grazing native vegetation

Grazing modified pastures

Cropping

Perennial horticulture

Land in transition

Irrigated modified pastures

Irrigated cropping

Irrigated perennial horticulture

Intensive animal husbandry

Manufacturing and industrial

Residential

Services

Transport and communication

Mining

Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

BG

PREPARED

BG

REVIEWED

DP

APPROVED

NMC

GOLDER

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, incrementP Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

1. Watercourses: Geoscience Australia

2. Alignment, Earth Works: Provided by FF JV on 10th Jan 2019.

3. Land Use: State of Queensland (Department of Science, Information Technology and Innovation), September 2016

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.

1897791

CONTROL

016

REV.

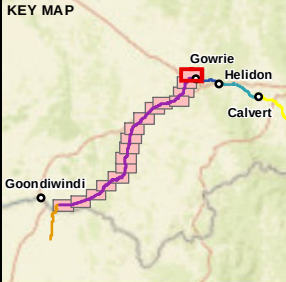
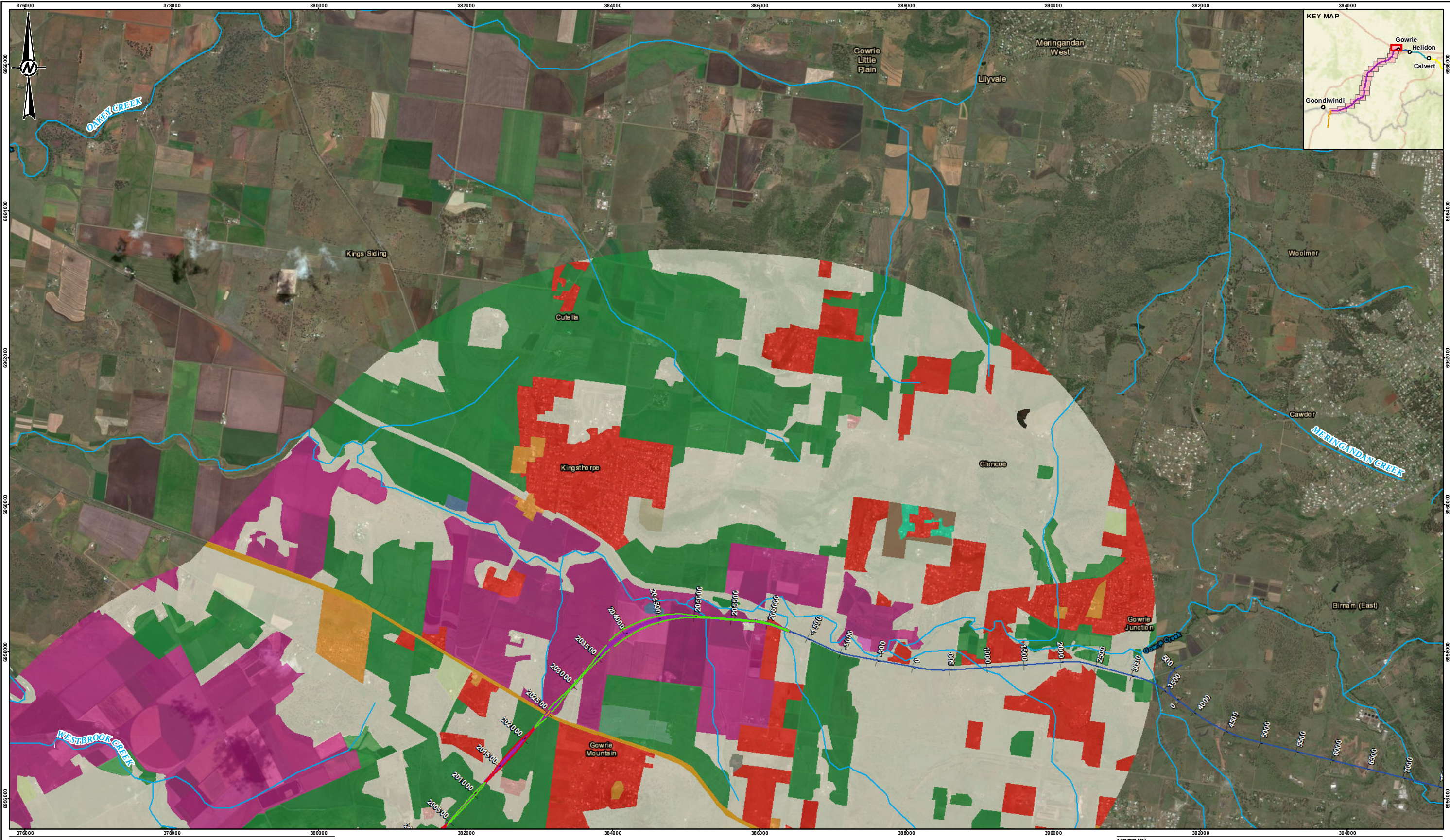
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FIGURE

3-16

PATH: B:\INLAND_RAIL\Hydrogeology\Folder99_PROJECTS\Bridges_111897791\016-CT-F003-Rev0-Land-Use.mxd PRINTED ON: 2019-02-06 AT: 12:43:34 PM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie
- G2H - Gowrie to Helidon

Land use (5km Buffer of Alignment)

- Nature conservation
- Other minimal use

- Grazing native vegetation
- Grazing modified pastures
- Cropping
- Perennial horticulture
- Land in transition
- Irrigated modified pastures
- Irrigated cropping
- Intensive animal husbandry
- Manufacturing and industrial
- Residential
- Services

- Transport and communication
- Mining
- Reservoir/dam

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

GOLDER

0 500 1,000 1,500 2,000

1:50,000@A3 METRES

DD-MMM-YY	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)

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REFERENCE(S)

1. **Watercourses:** Geoscience Australia
2. **Alignment, Earth Works:** Provided by FF JV on 10th Jan 2019.
3. **Land Use:** State of Queensland (Department of Science, Information Technology and Innovation), September 2016

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

TITLE

LAND USE OF THE BORDER TO GOWRIE RAIL CORRIDOR

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	3-17

PATH: B:\INLAND_RAIL_Hydrogeology_Folder99_PROJECTS\Bridges_111897791\16-CT-F003-RecoLandUse.mxd PRINTED ON: 2019-02-06 AT: 12:53:42 PM



- LEGEND**
- Registered Bores (Water Levels)
 - Registered Bores (Water Quality)
 - Watercourse
 - Type of Earth Works
 - Cut
 - Fill
 - Inland Rail Alignment Section**
 - NS2B - NSW/Qld Border to Gowrie
 - B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000 @A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

GOLDER

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO. 1897791	CONTROL 016	REV. 0	FIGURE 4-1
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P:\B\INLAND_RAIL\Hydrogeology\Folder09_PROJECTS\Bridges_111897791\16-CT-FIN-FE-VolInvestigation-and-Register-of-Bore-Locations.mxd, PRINTED ON: 2019-02-06 AT: 1:30:54 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



Registered Bores (Water Levels)

Registered Bores (Water Quality)

Watercourse

Cut

Fill

Legend

Inland Rail Alignment Section

B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

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2,000

1:50,000 @A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD

6/02/2019

DESIGNED

BG

PREPARED

BG

REVIEWED

DP

APPROVED

NMC

GOLDER

NOTE(S)

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2. Registered Bores: Queensland Groundwater Database (2018)

3. Watercourse: Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

BORDER TO GOWRIE FFJV INVESTIGATION AND REGISTERED BORE LOCATIONS

PROJECT NO.

1897791

CONTROL

016

REV.

0

FIGURE

4-2

PATH: B:\INLAND_RAIL_Hydrogeology_Folder99_PROJECTS\Bridges_111897791\016-CT-FIN04-Reco-FE-VInvestigation-and-Bore-Locations.mxd, PRINTED ON: 2019-02-06 AT: 1:31:09 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Golder Site Investigation Locations

Registered Bores (Water Levels)

Registered Bores (Water Quality)

Watercourse

Type of Earth Works

Cut

Fill

Inland Rail Alignment Section

B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0500100015002000

1:50,000 @A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
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3. Watercourse: Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE

BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS

PROJECT NO.

1897791

CONTROL

016

REV.

0

FIGURE

4-3

PATH: B:\INLAND_RAIL\Hydrogeology\Folder99_PROJECTS\Bridges_111897791\016-CT-FIN04-Rev01-Final-Location-and-Registered-Bore-Locations.mxd. PRINTED ON: 2019/02/06 AT: 1:31:24 PM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Golder Site Investigation Locations

Registered Bores (Water Levels)

Registered Bores (Water Quality)

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

0 500 1,000 1,500 2,000

1:50,000 @A3 METRES

NOTE(S)

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2. **Registered Bores:** Queensland Groundwater Database (2018)
3. **Watercourse:** Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

BORDER TO GOWRIE FFJV INVESTIGATION AND REGISTERED BORE LOCATIONS

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	4-4

PATH: B:\INLAND_RAIL\Hydrogeology\Folder99_PROJECTS\Bridges_111897791\016-CT-Final-Review\Investigation and Registered Bore Locations.mxd, PRINTED ON: 2019-02-06 AT: 1:31:44 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN ADJUSTED FROM ISO A3



PATH: B:\INLAND_RAIL_Hydrogeology_Folder99_PROJECTS\Bridges_111897791\016-CT-FIN04-Rev01-FE Investigation and Registered Bore Locations.mxd, PRINTED ON: 2019-02-06 AT: 1:32:10 PM

LEGEND

- Golder Site Investigation Locations
- Registered Bores (Water Levels)
- Registered Bores (Water Quality)
- Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

0 500 1,000 1,500 2,000

1:50,000 @A3 METRES

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO. 1897791	CONTROL 016	REV. 0	FIGURE 4-5
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN ADJUSTED FROM ISO A3 25mm



- LEGEND**
- Registered Bores (Water Levels)
 - Registered Bores (Water Quality)
 - Watercourse
 - Type of Earth Works
 - Cut
 - Fill
 - Inland Rail Alignment Section
 - B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000 @A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	YYYY-MM-DD	6/02/2019
	DESIGNED	BG
	PREPARED	BG
	REVIEWED	DP
	APPROVED	NMC

GOLDER

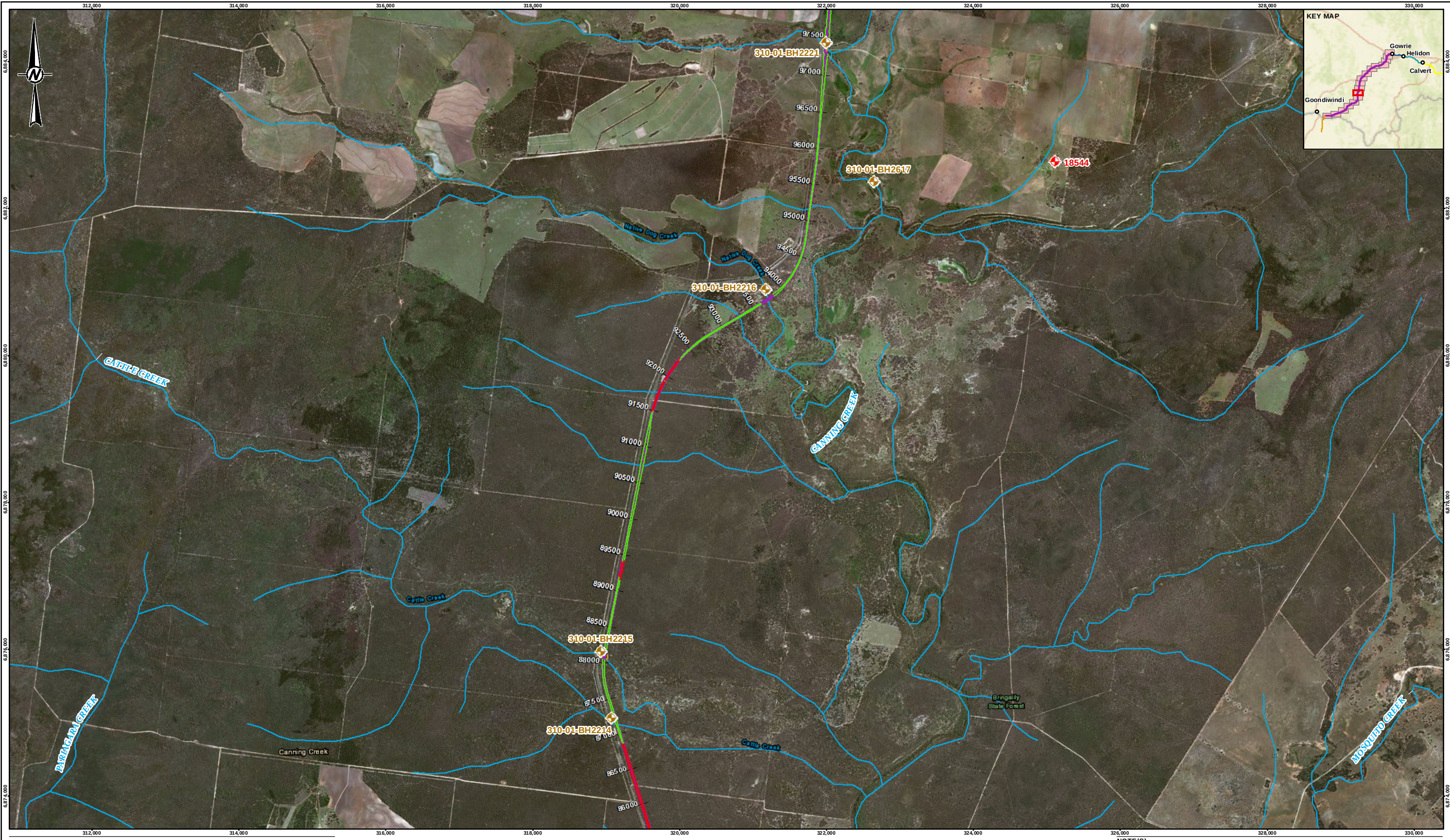
NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	4-6



LEGEND

Golder Site Investigation Locations

Registered Bores (Water Quality)

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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1:50,000 @A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)
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REFERENCE(S)
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS

PROJECT NO. 1897791	CONTROL 016	REV. 0	FIGURE 4-7
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R:\B\INLAND_RAIL\Hydrogeology\Folder99_PROJECTS\Bridges_111897791\16-CT-FIN04-RecD-FE-V-Investigation-and-Registered-Bore-Locations.mxd, PRINTED ON: 2019-02-06 AT: 1:32:43 PM

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LEGEND

✦ Golder Site Investigation Locations

⦿ Registered Bores (Water Levels)

⦿ Registered Bores (Water Quality)

— Watercourse

Type of Earth Works

— Cut

— Fill

Inland Rail Alignment Section

— B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000 @A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)

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REFERENCE(S)

1. **Alignment and Earth Works:** Provided by FFJV on 10th Jan 2019.
2. **Registered Bores:** Queensland Groundwater Database (2018)
3. **Watercourse:** Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

TITLE

BORDER TO GOWRIE FFJV INVESTIGATION AND REGISTERED BORE LOCATIONS

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	4-9

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

- Golder Site Investigation Locations
- Registered Bores (Water Levels)
- Registered Bores (Water Quality)
- Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

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1:50,000 @A3 METRES

NOTE(S)

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REFERENCE(S)

1. **Alignment and Earth Works:** Provided by FFJV on 10th Jan 2019.
2. **Registered Bores:** Queensland Groundwater Database (2018)
3. **Watercourse:** Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

BORDER TO GOWRIE FFJV INVESTIGATION AND REGISTERED BORE LOCATIONS

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	4-10

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LEGEND

- Golder Site Investigation Locations
- Registered Bores (Water Levels)
- Registered Bores (Water Quality)
- Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

0 500 1,000 1,500 2,000

1:50,000 @A3 METRES

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REFERENCE(S)
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO. 1897791	CONTROL 016	REV. 0	FIGURE 4-11
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LEGEND

Goldner Site Investigation Locations

Registered Bores (Water Levels)

Registered Bores (Water Quality)

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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1:50,000 @A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	4-12

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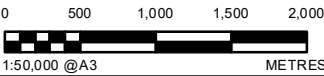
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



- LEGEND**
- Goldner Site Investigation Locations
 - Registered Bores (Water Levels)
 - Registered Bores (Water Quality)
 - Watercourse
 - Type of Earth Works
 - Cut
 - Fill
 - Inland Rail Alignment Section
 - B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994



CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	YYYY-MM-DD	6/02/2019
DESIGNED	BG	
PREPARED	BG	
REVIEWED	DP	
APPROVED	NMC	



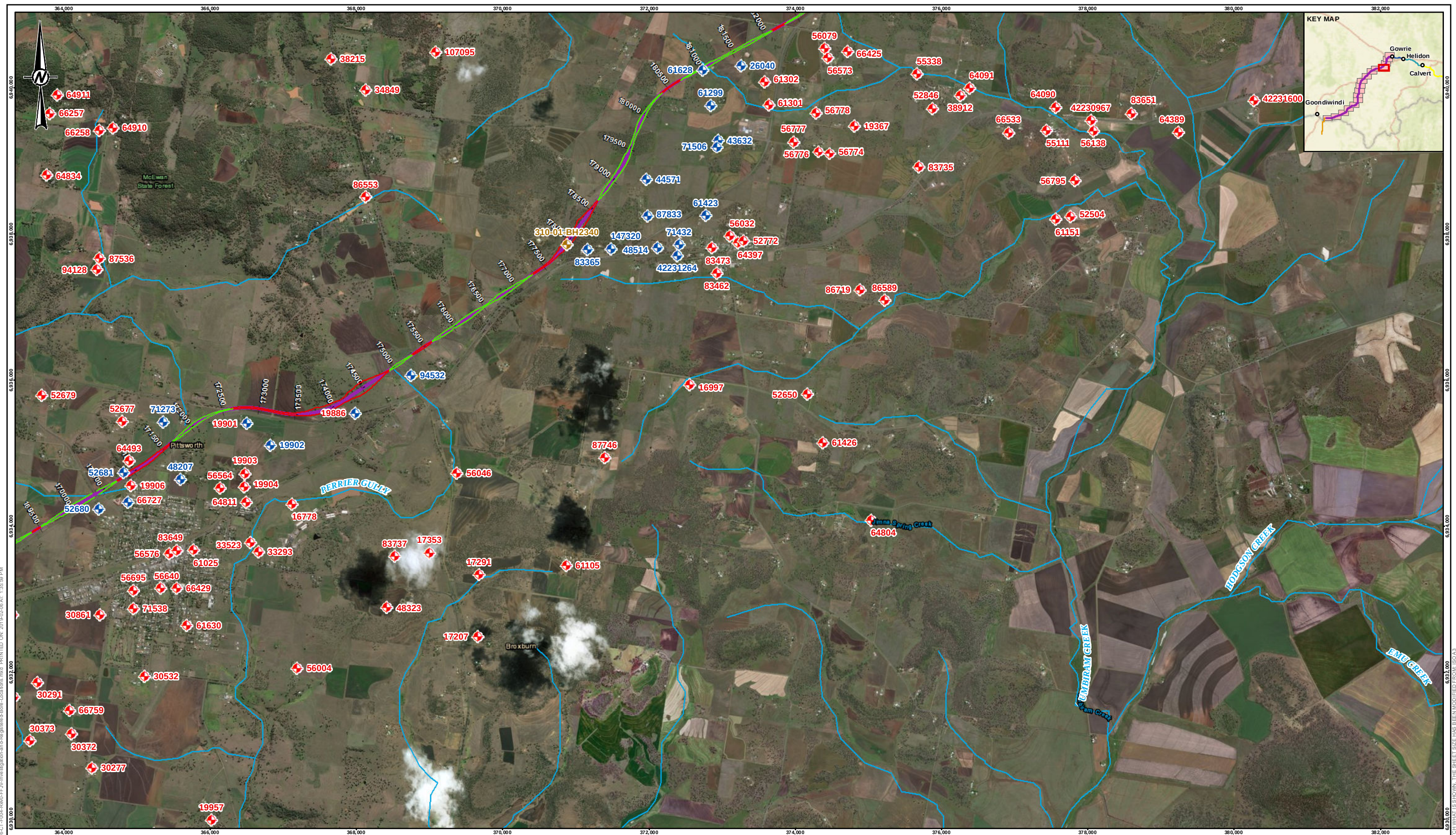
NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	4-13



LEGEND

-  Golder Site Investigation Locations
  Registered Bores (Water Levels)
  Registered Bores (Water Quality)
  Watercourse
- Inland Rail Alignment Section**
 B2G - Border to Gowrie

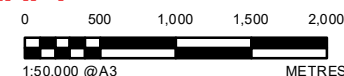
Type of Earth Works

- Cut
- Fill
- Bridge

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994



CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

NOTE(S)

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REFERENCE(S)

1. **Alignment and Earth Works:** Provided by FFJV on 10th Jan 2019.
2. **Registered Bores:** Queensland Groundwater Database (2018)
3. **Watercourse:** Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

	TITLE
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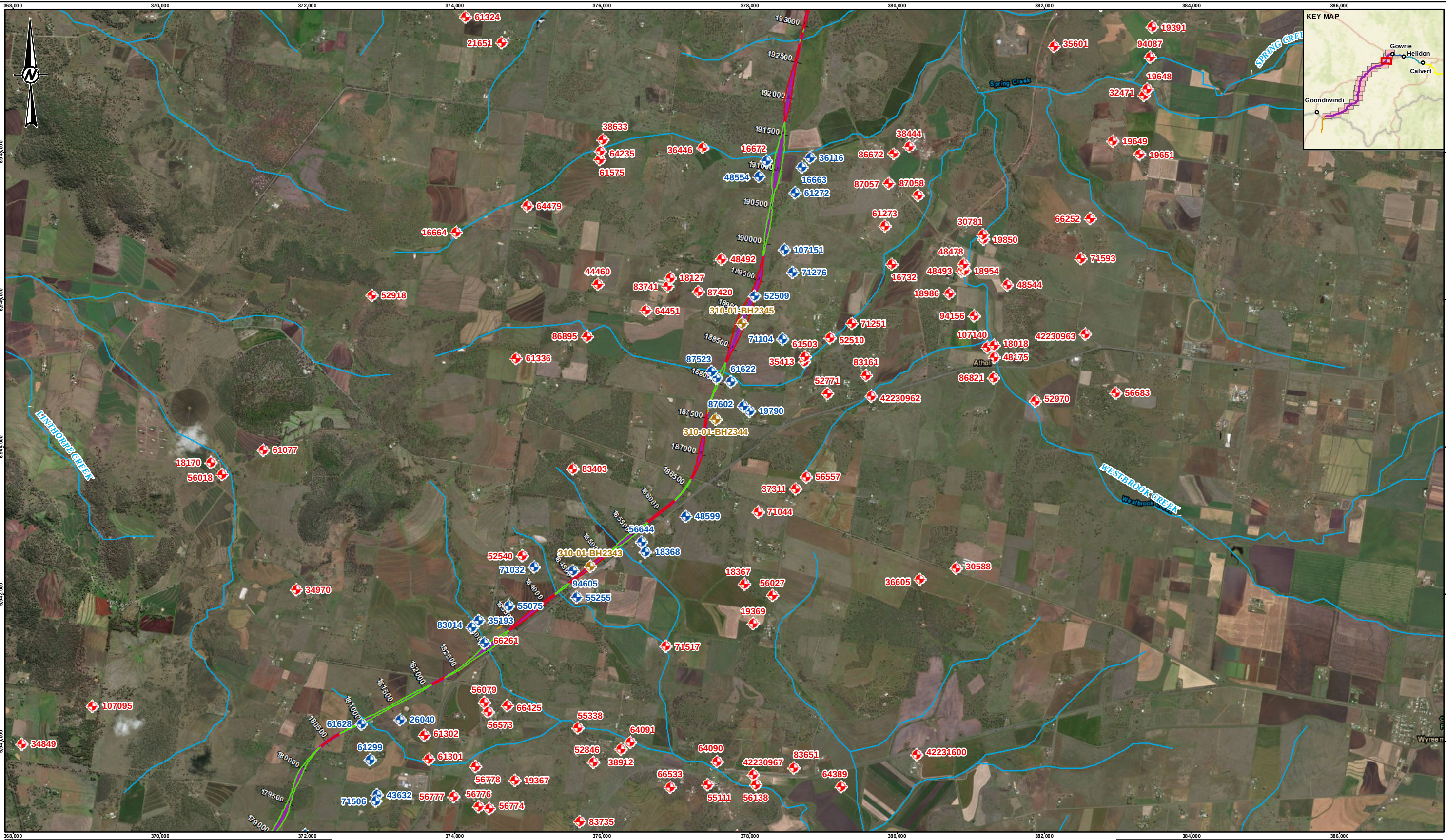
BORDER TO GOWRIE FFJV INVESTIGATION AND REGISTERED BORE LOCATIONS

PROJECT NO.
1897791

CONTROL
016

REV.
0

FIGURE
-14



LEGEND

Gold Star Icon: Golder Site Investigation Locations

Blue Diamond Icon: Registered Bores (Water Levels)

Red Diamond Icon: Registered Bores (Water Quality)

Blue Line Icon: Watercourse

Type of Earth Works

Red Line Icon: Cut

Green Line Icon: Fill

Yellow Line Icon: Bridge

Inland Rail Alignment Section

Purple Line Icon: B2G - Border to Gowrie

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD 6/02/2019

DESIGNED BG

PREPARED BG

REVIEWED DP

APPROVED NMC

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1:50,000 @A3 METRES

NOTE(S)

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REFERENCE(S)

1. **Alignment and Earth Works:** Provided by FFJV on 10th Jan 2019.

2. **Registered Bores:** Queensland Groundwater Database (2018)

3. **Watercourse:** Geoscience Australia

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

BORDER TO GOWRIE FFJV INVESTIGATION AND REGISTERED BORE LOCATIONS

PROJECT NO. 1897791

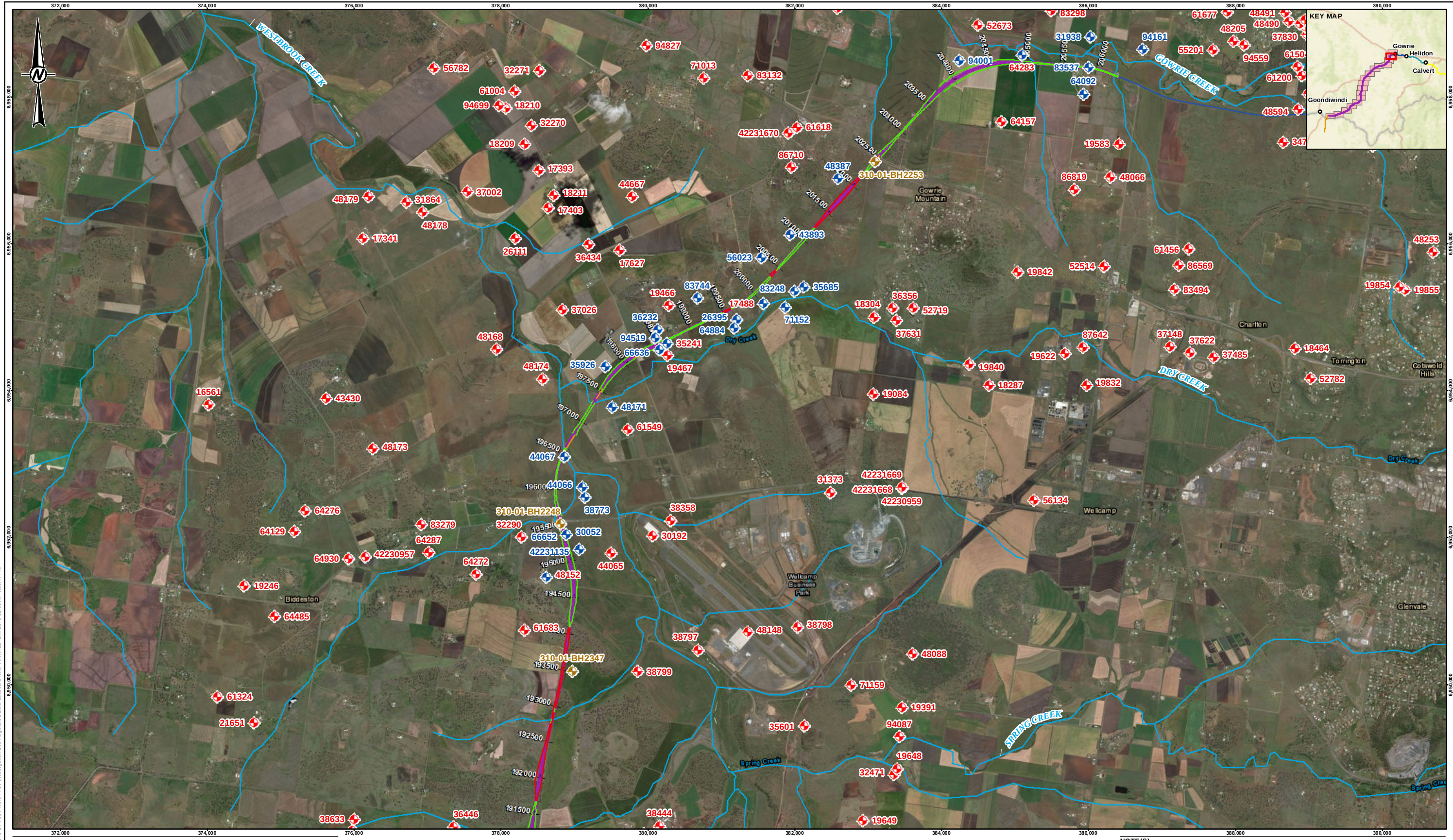
CONTROL 016

REV. 0

FIGURE 4-15

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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



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LEGEND

- Golder Site Investigation Locations
- Registered Bores (Water Levels)
- Registered Bores (Water Quality)
- Watercourse

Type of Earth Works

- Cut
- Fill
- Bridge

Inland Rail Alignment Section

- B2G - Border to Gowrie
- G2H - Gowrie to Helidon

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

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1:50,000 @A3 METRES

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, incrementP Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

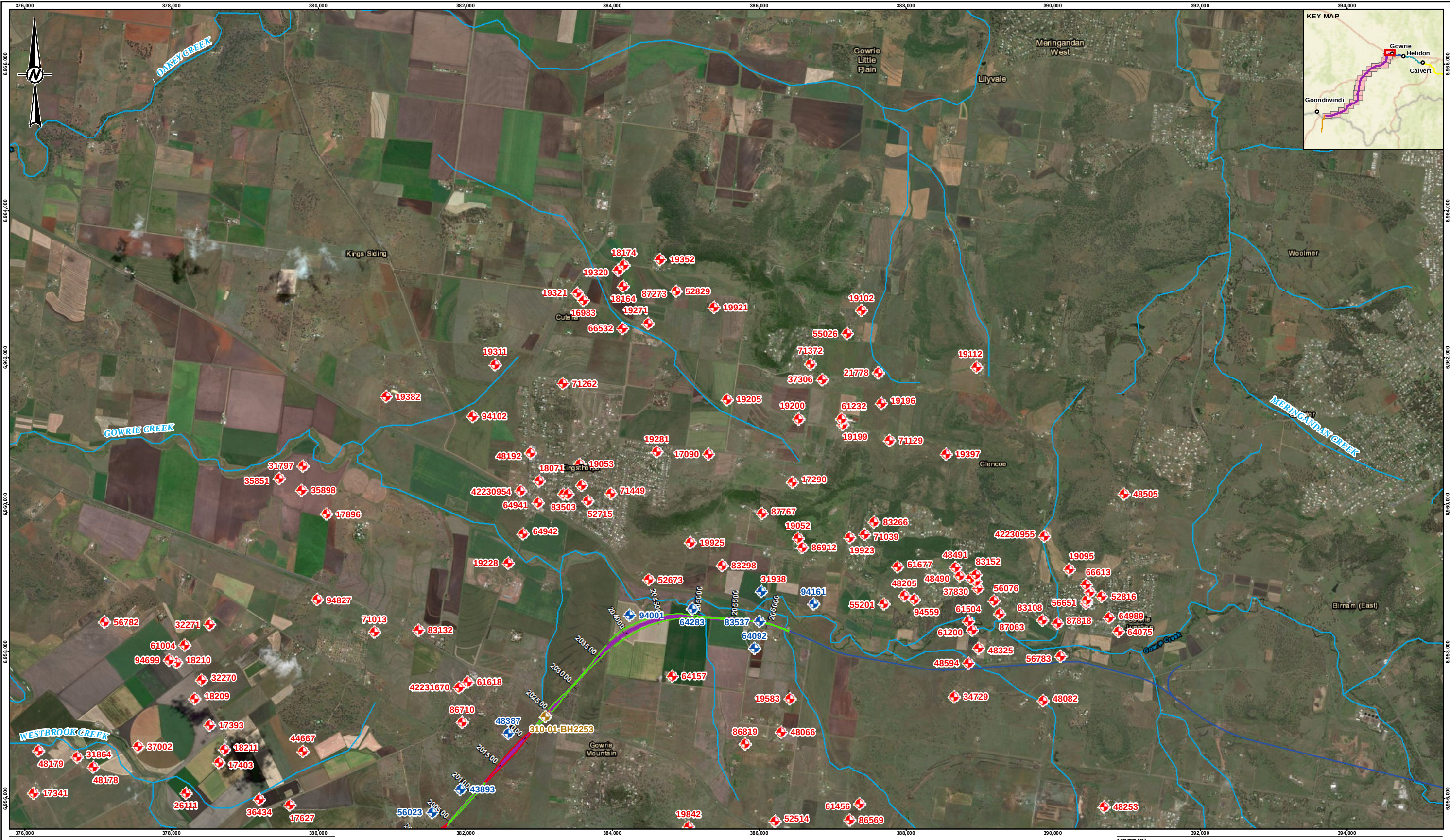
1. Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
2. Registered Bores: Queensland Groundwater Database (2018)
3. Watercourse: Geoscience Australia

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO. 1897791	CONTROL 016	REV. 0	FIGURE 4-16
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Gold Site Investigation Locations

Registered Bores (Water Levels)

Registered Bores (Water Quality)

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

G2H - Gowrie to Helidon

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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1:50,000 @A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD	6/02/2019
DESIGNED	BG
PREPARED	BG
REVIEWED	DP
APPROVED	NMC

GOLDER

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

- Alignment and Earth Works: Provided by FFJV on 10th Jan 2019.
- Registered Bores: Queensland Groundwater Database (2018)
- Watercourse: Geoscience Australia

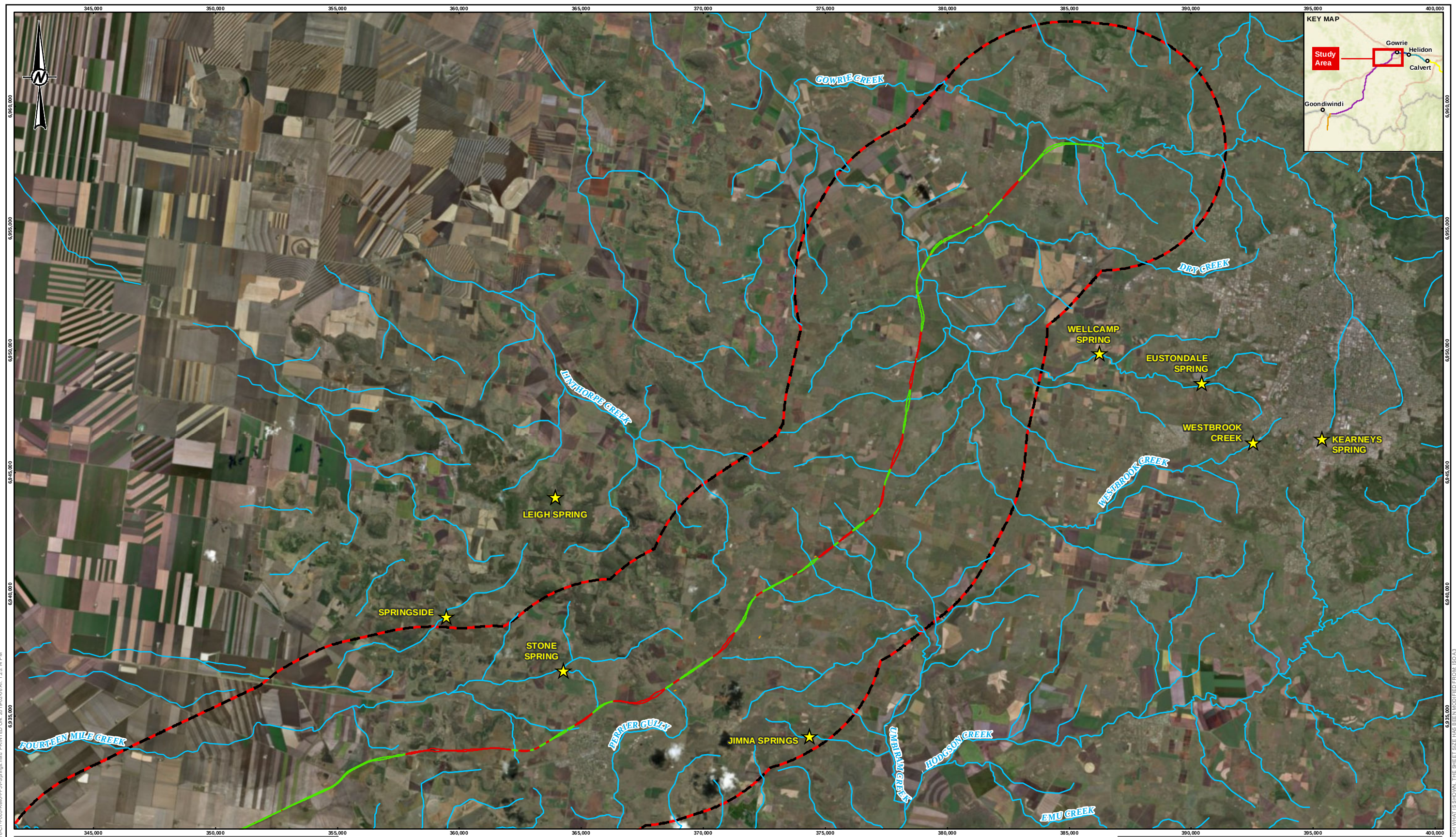
PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
**BORDER TO GOWRIE FFJV INVESTIGATION AND
REGISTERED BORE LOCATIONS**

PROJECT NO. 1897791	CONTROL 016	REV. 0	FIGURE 4-17
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LEGEND

-  Wetland Spring Locations
 Watercourse
Type of Earth Works
 Cut
 Fill
 Bridge
 B2G Alignment 5km Buffer

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

YYYY-MM-DD 6/02/2019

DESIGNED	NMC
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PREPARED	BG
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REVIEWED NMC

NOTE(S)

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REFERENCE(S)

- 5 REFERENCE(S)
 1. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.
 2. **Wetland Spring Locations:** © State of Queensland (Department of Environment and Science)
 2018.
 3. **Watercourse:** Geoscience Australia.

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
- **WETLAND SPRING LOCATIONS**

PROJECT NO.
1897791

CONTROL
016

REV.
0

FIGURE 5

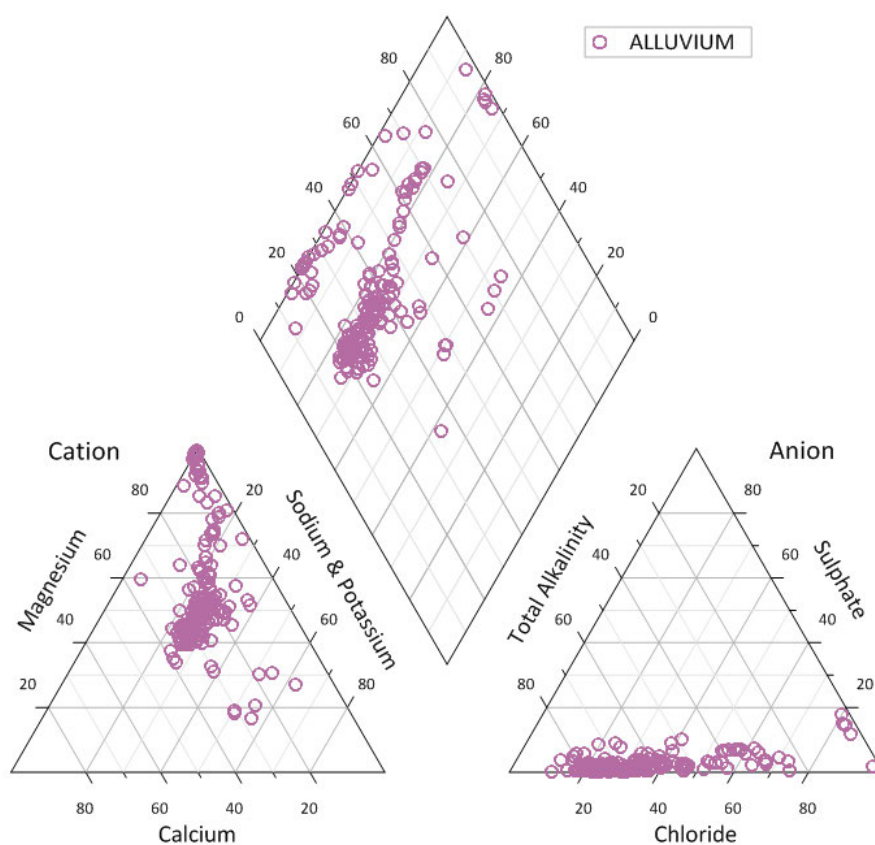


Figure 6: Piper diagram of groundwater of Quaternary Alluvium

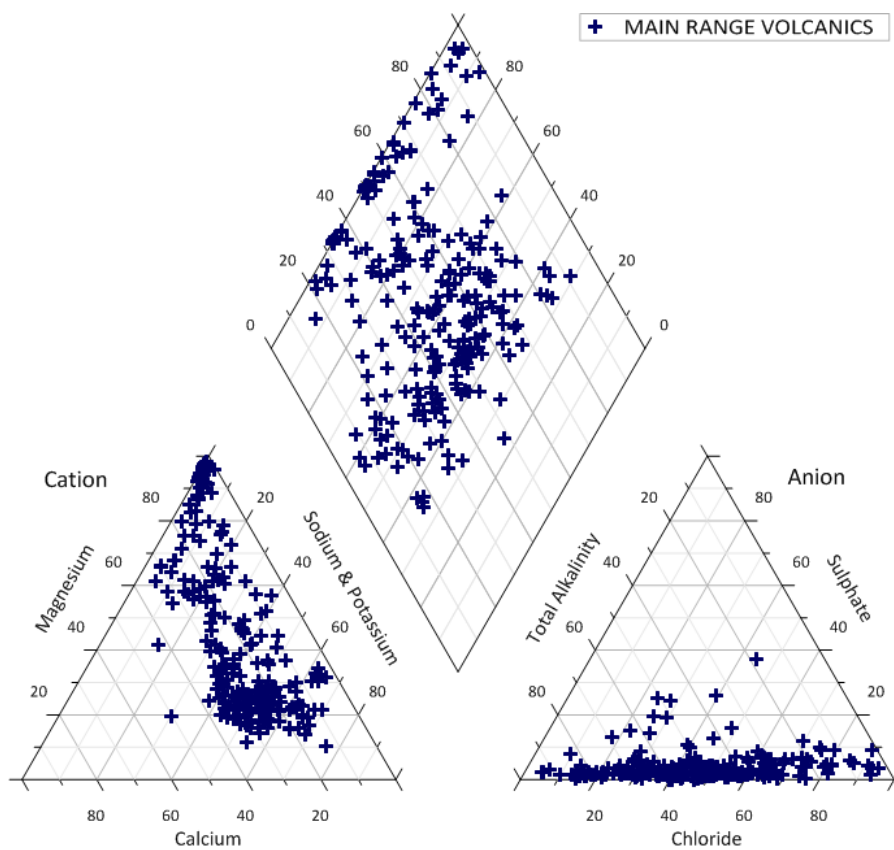


Figure 7: Piper diagram of groundwater of Main Range Volcanics

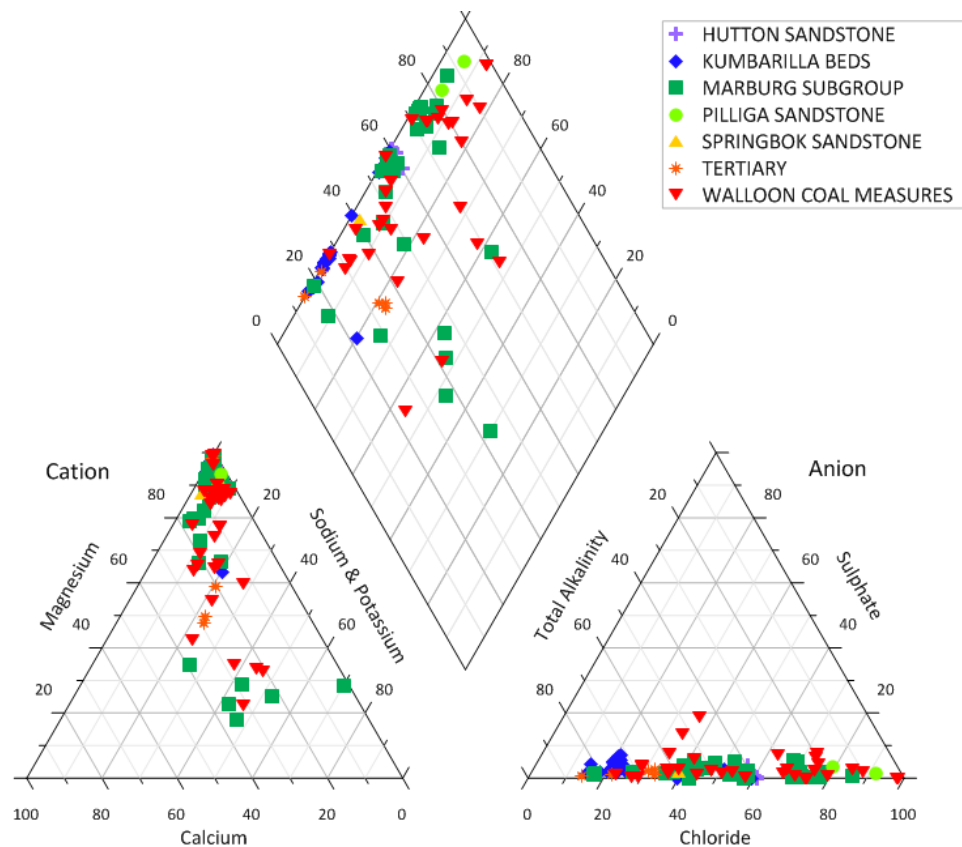


Figure 8: Piper diagram of groundwater of Sedimentary rock aquifers

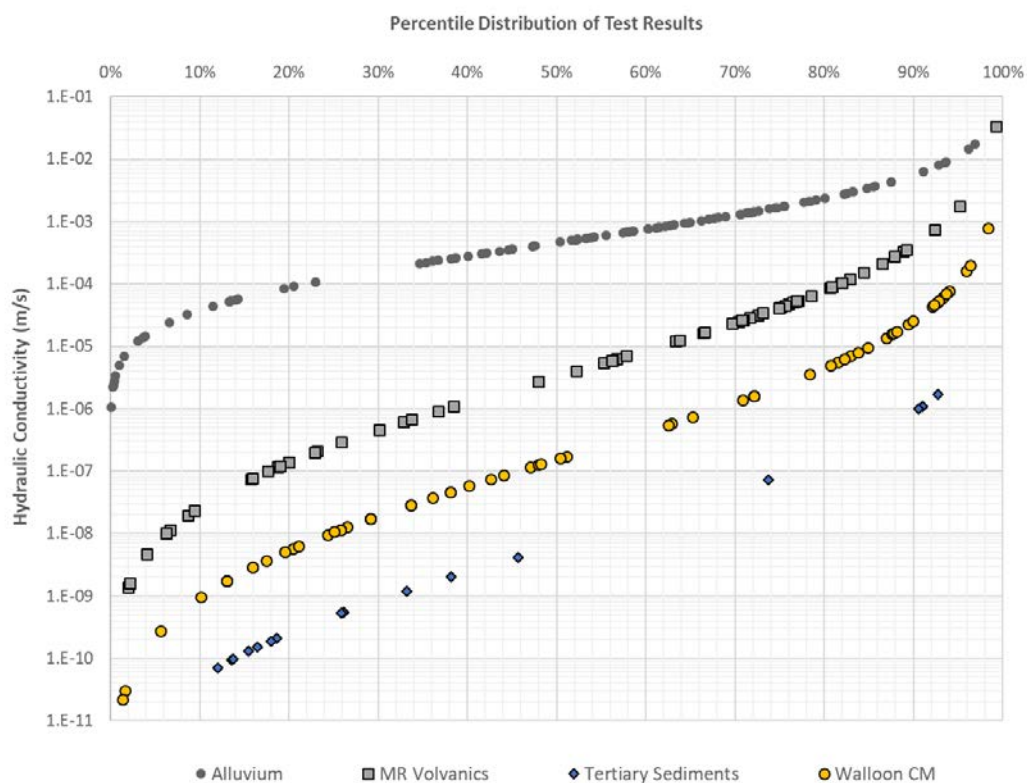


Figure 9: Statistical distribution of permeability values obtained from borehole tests conducted in the Clarence Moreton Basin

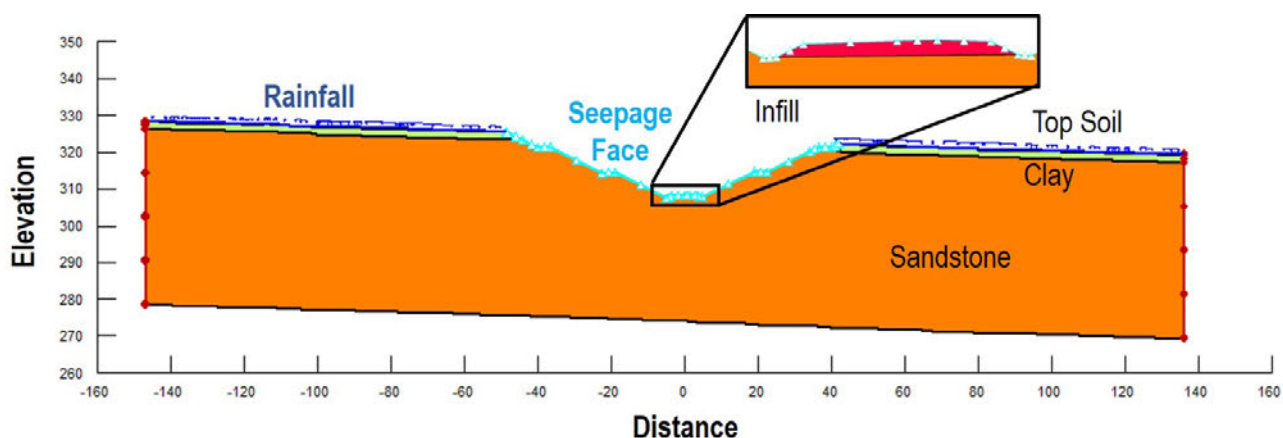


Figure 10 Geometry and boundary conditions along Kilometrage 57.670. Red dots – constant head boundary conditions on the left and right side of the model, blue – rainfall on the model top, light blue – seepage face

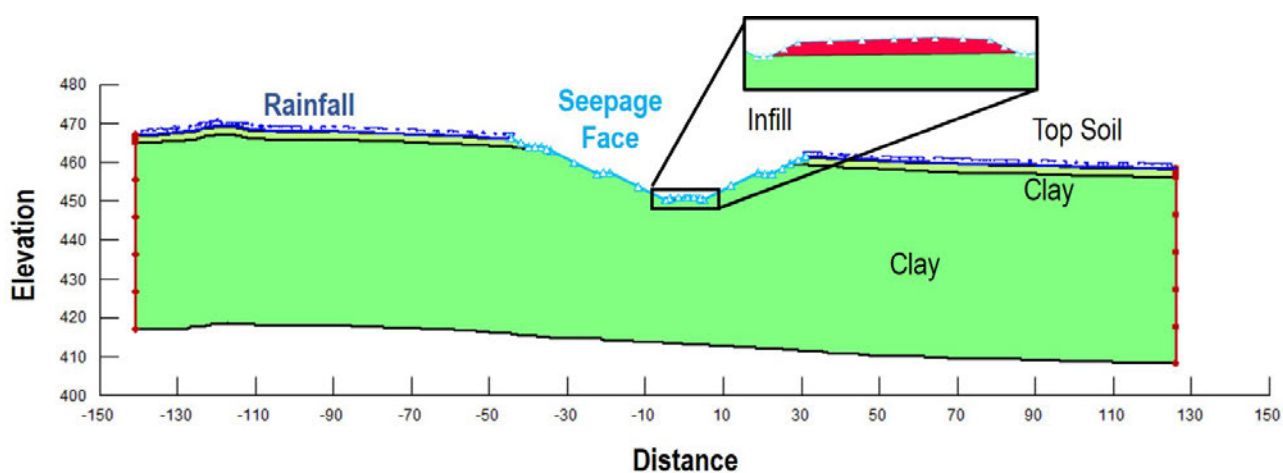


Figure 11: Geometry and boundary conditions along Kilometrage 114.460. Red dots – constant head boundary conditions on the left and right side of the model, blue – rainfall on the model top, light blue – seepage face

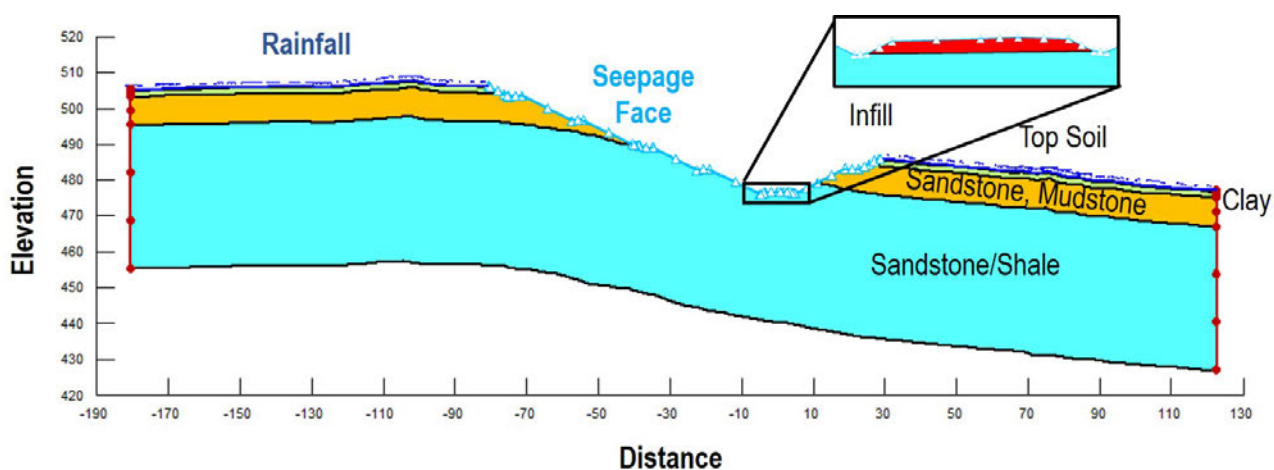


Figure 12 Geometry and boundary conditions along Kilometrage 164.600. Red dots – constant head boundary conditions on the left and right side of the model, blue – rainfall on the model top, light blue – seepage face

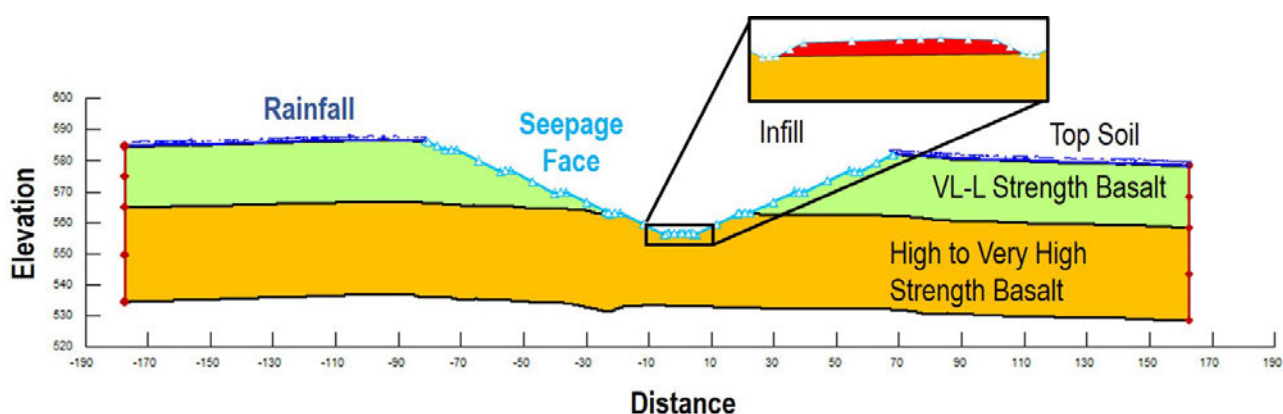


Figure 13 Geometry and boundary conditions along Kilometrage 174.520. Red dots – constant head boundary conditions on the left and right side of the model, blue – rainfall on the model top, light blue – seepage face

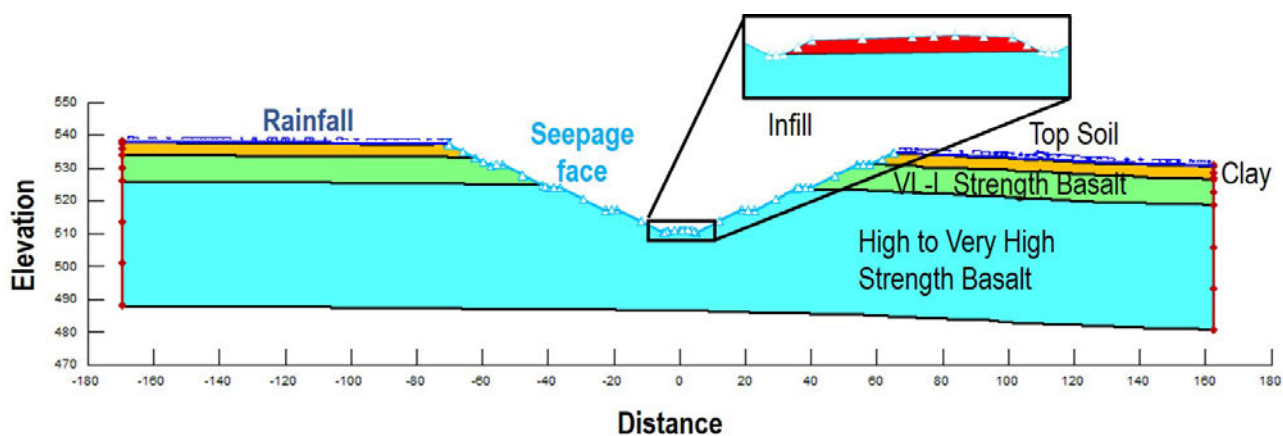


Figure 14: Geometry and boundary conditions along Kilometrage 188.910. Red dots – constant head boundary conditions on the left and right side of the model, blue – rainfall on the model top, light blue – seepage face

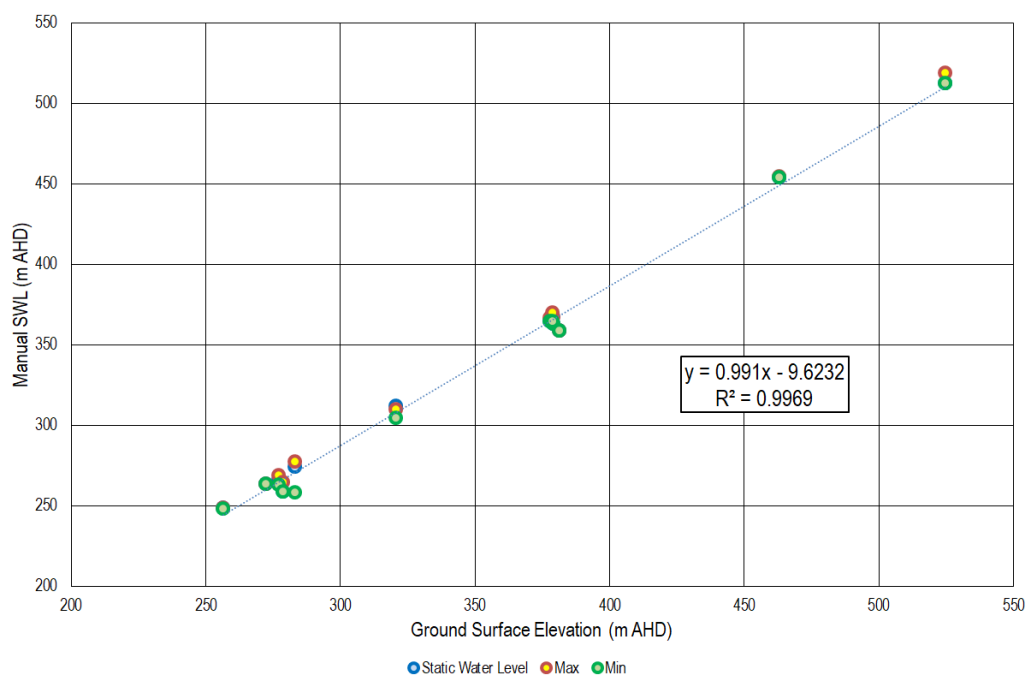


Figure 15: Correlation between static water level and surface topography

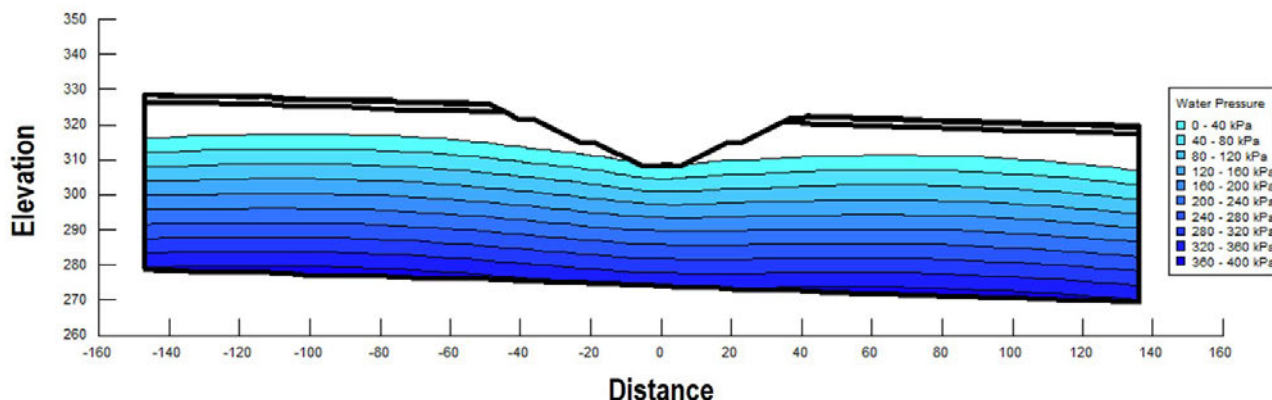


Figure 16: Pore pressure distribution along Kilometrage 57.670. Black lines indicate model layers. Zero pressure line shows water table

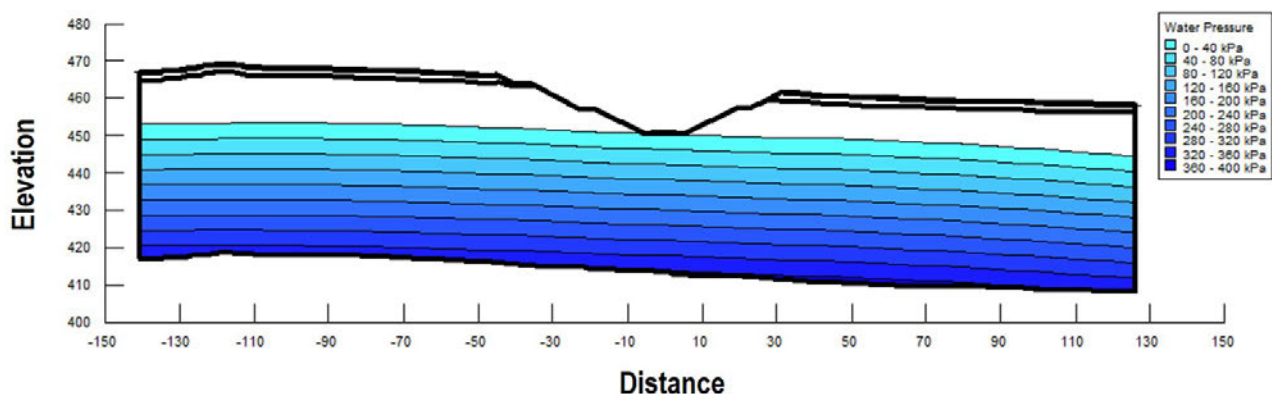


Figure 17: Pore pressure distribution along Kilometrage 114.460. Black lines indicate model layers. Zero pressure line shows water table

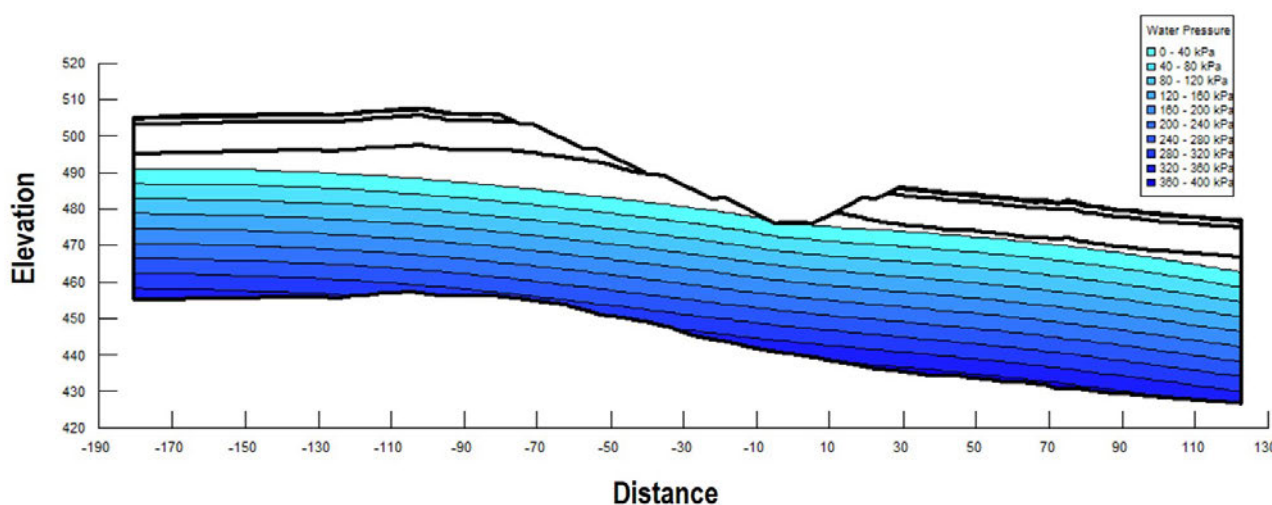


Figure 18: Pore pressure distribution along Kilometrage 164.600. Black lines indicate model layers. Zero pressure line shows water table

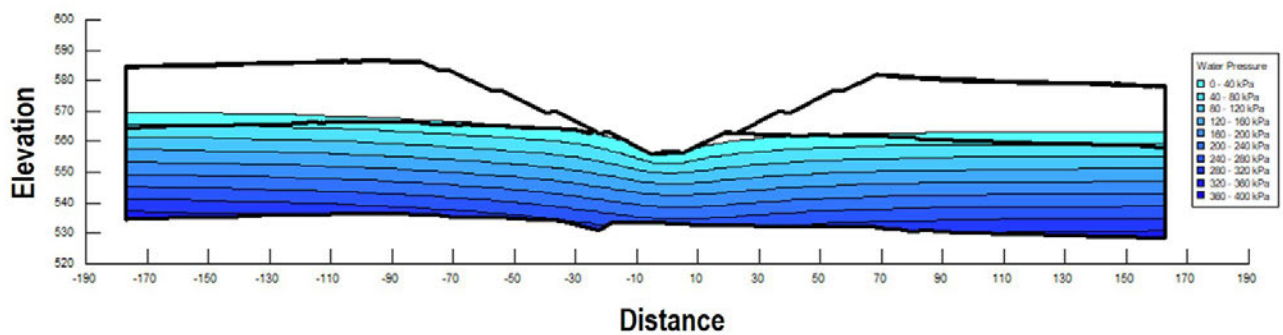


Figure 19: Pore pressure distribution along Kilometrage 174.520. Black lines indicate model layers. Zero pressure line shows water table

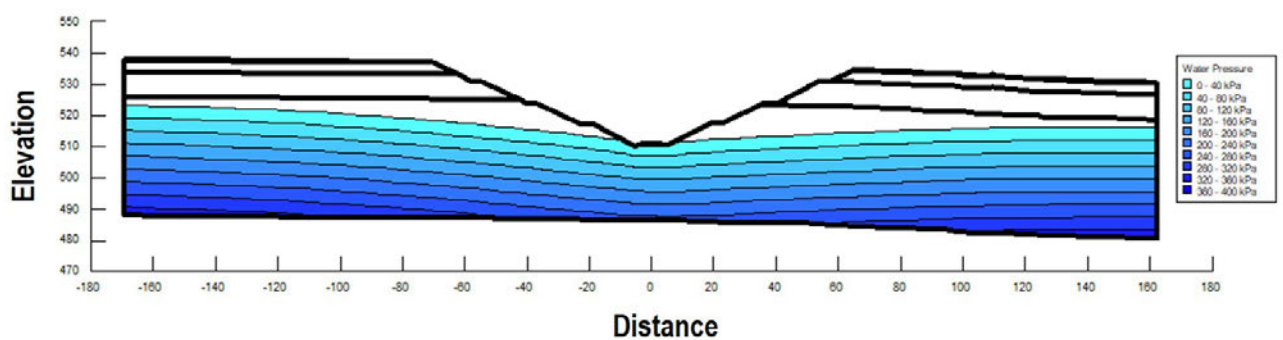


Figure 20: Pore pressure distribution along Kilometrage 188.910. Black lines indicate model layers. Zero pressure line shows water table

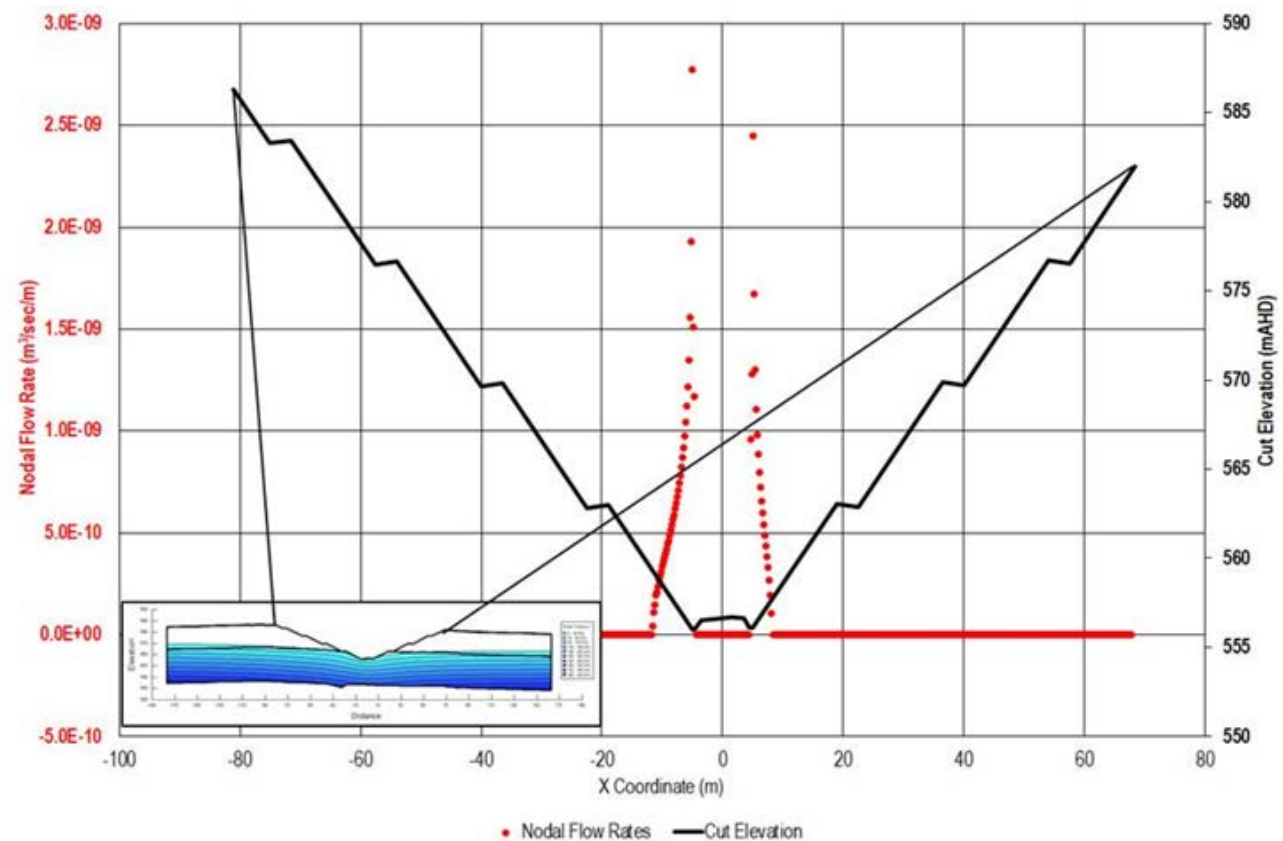
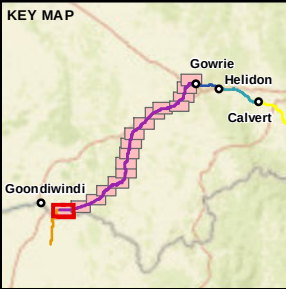
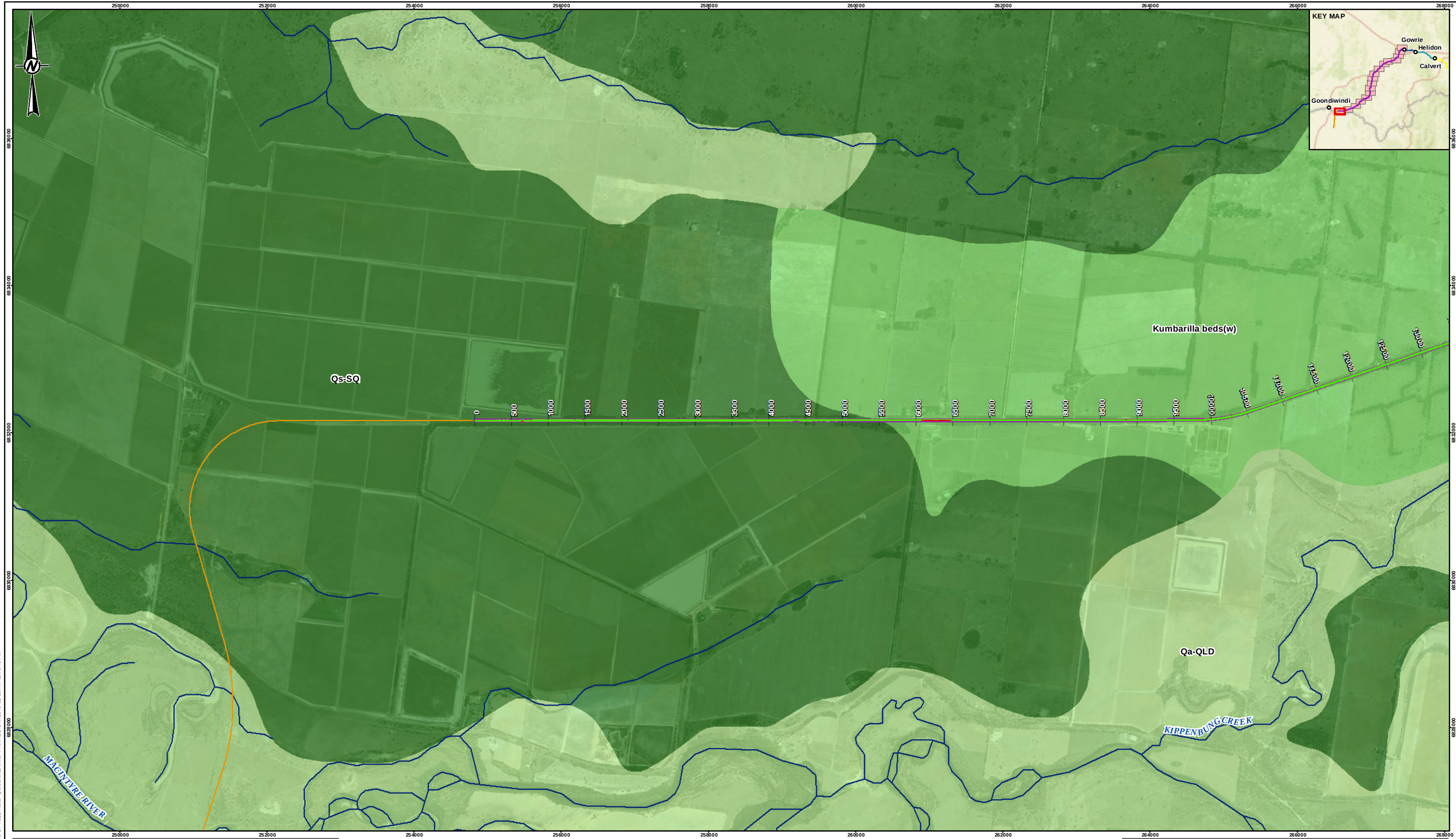


Figure 21: Simulated nodal flow rates along cut of Kilometrage 174.520



- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Inland Rail Alignment Section**
 - NS2B - NSW/Qld Border to Gowrie
 - B2G - Border to Gowrie
 - QLD Detailed Surface Geology**
 - Kumbarilla beds(w)
 - Qa-QLD
 - Qs-SQ

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	NMC
	PREPARED	NMC
	REVIEWED	BG
	APPROVED	DB

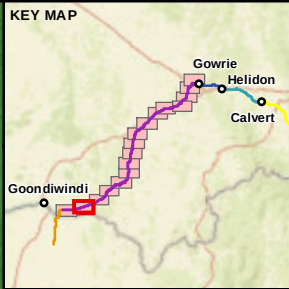
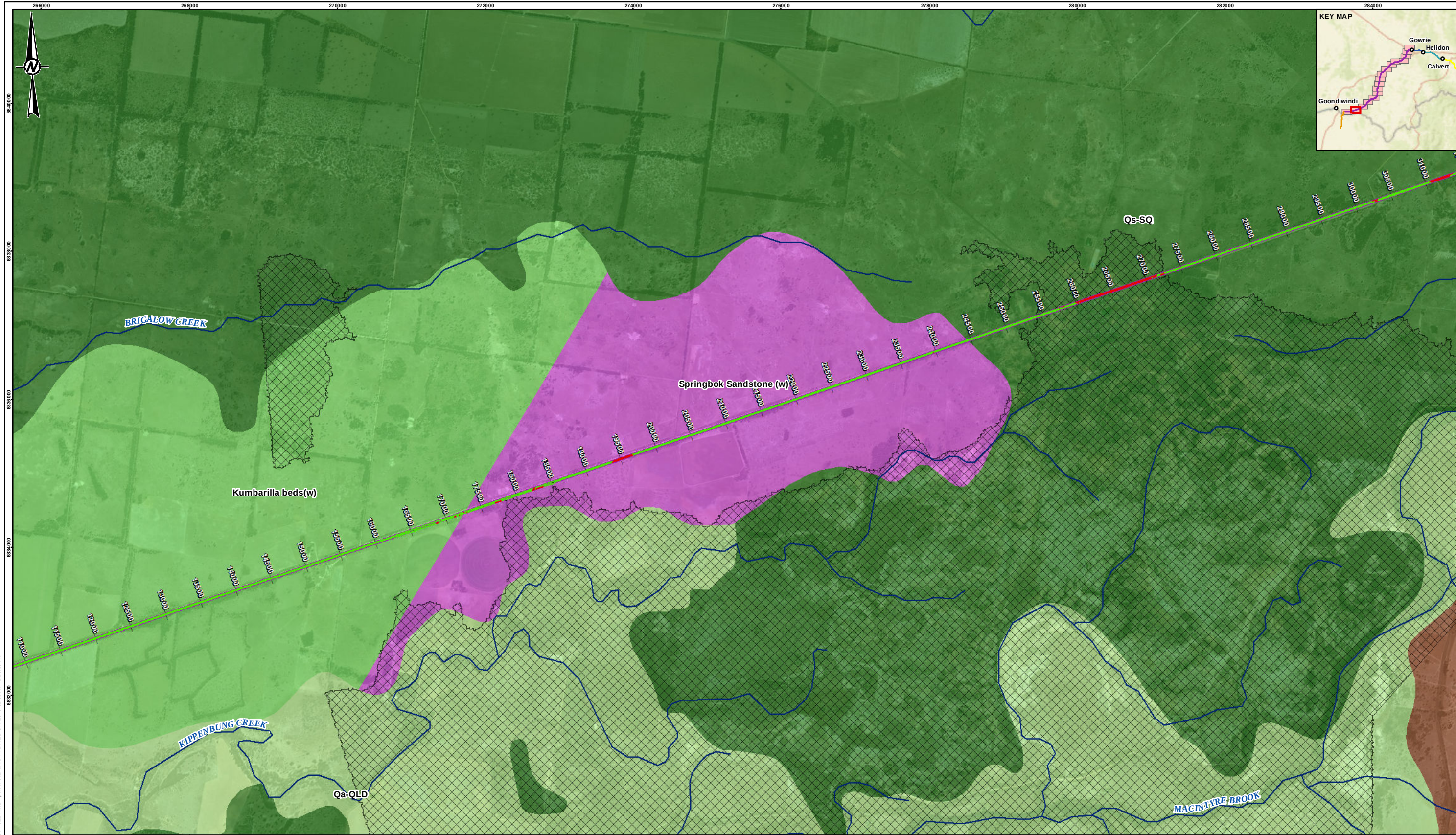
NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Watercourses: Geoscience Australia
2. Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.
3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.
4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-1



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Kumbarilla beds(w)

Qa-QLD

Qs-SQ

Springbok Sandstone (w)

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	NMC
PREPARED	NMC
REVIEWED	BG
APPROVED	DB

NOTE(S)

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3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.
4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

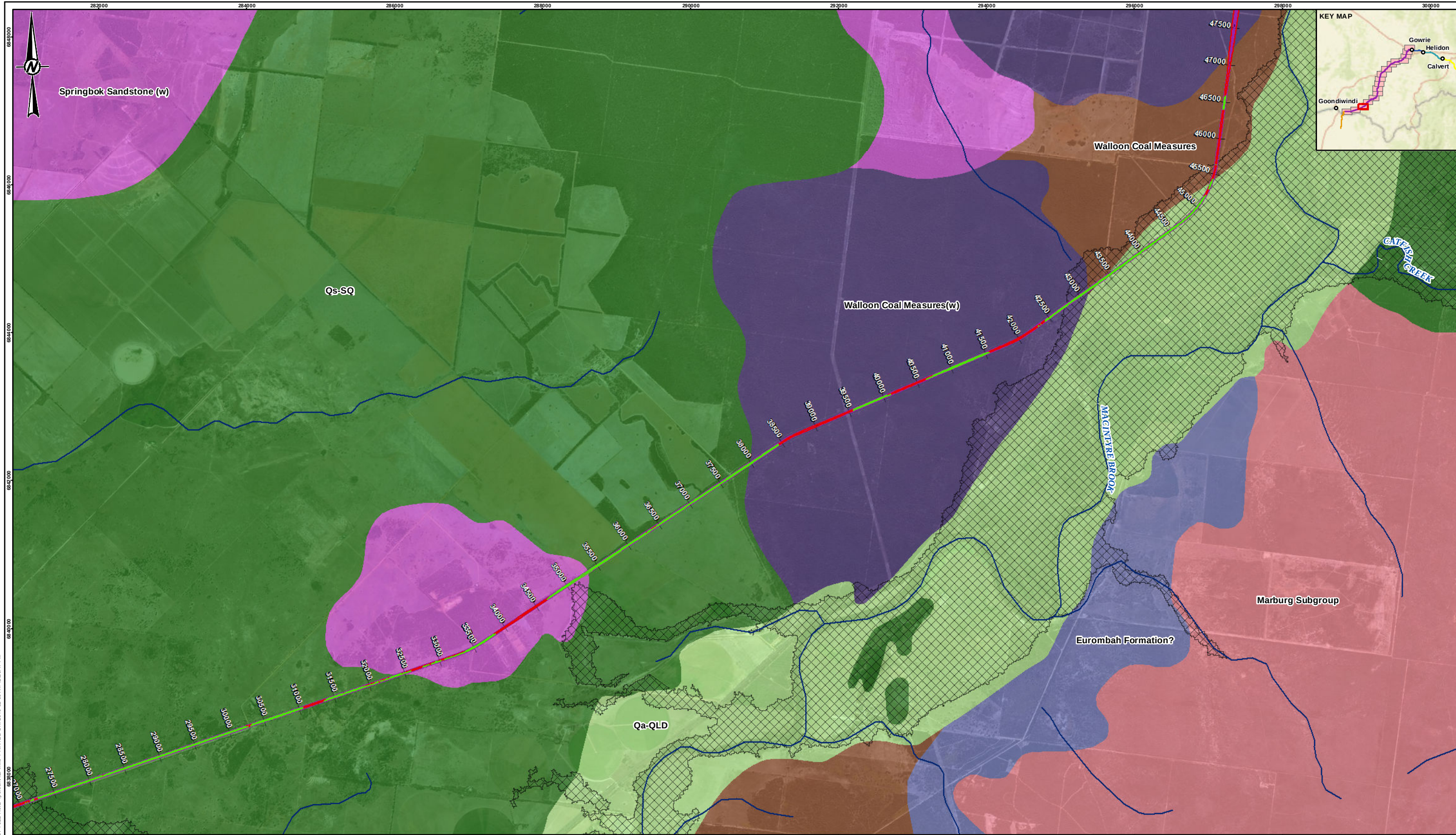
TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-2

R:\B\INLAND_RAIL\Hydrogeology\Folder99_PROJECTS\Bridges_111897791\15-CT-F022-Reds-Increased.mxd PRINTED ON: 2019-06-08 AT 12:01:00 PM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN INCIOTED FROM ISO A3



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Eurombah Formation?

Marburg Subgroup

Qa-QLD

Qs-SQ

Springbok Sandstone (w)

Walloon Coal Measures

Walloon Coal Measures(w)

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	NMC
	PREPARED	NMC
	REVIEWED	BG
	APPROVED	DB

GOLDER

NOTE(S)

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REFERENCE(S)

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2. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.
3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.
4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

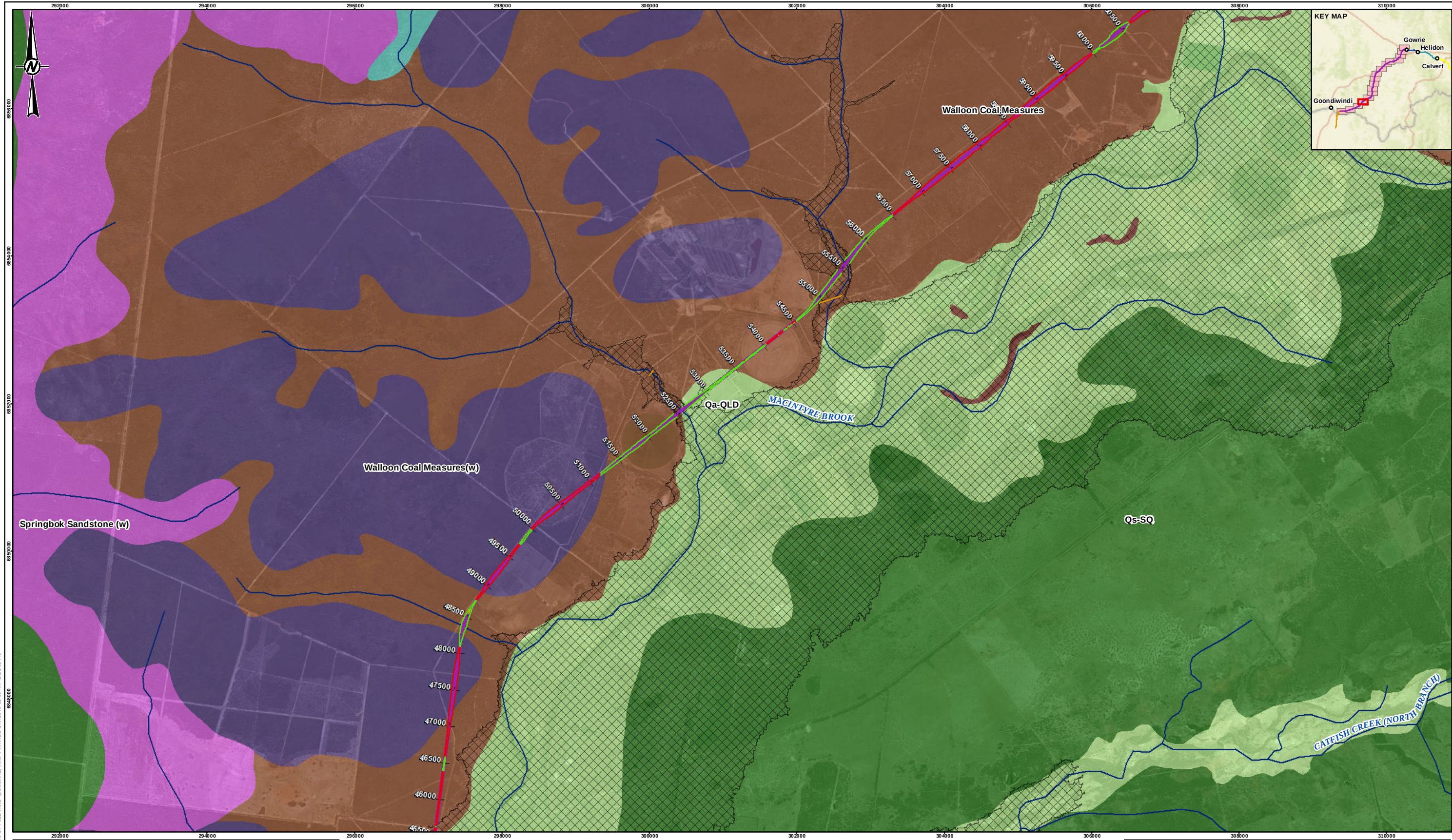
TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-3

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Qa-QLD

Qa-SEQ

Qs-SQ

Springbok Sandstone

Springbok Sandstone (w)

Walloon Coal Measures

Walloon Coal Measures(w)

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

NMC

PREPARED

NMC

REVIEWED

BG

APPROVED

DB

GOLDER

NOTE(S)

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3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.

4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.

1897791

CONTROL

016

REV.

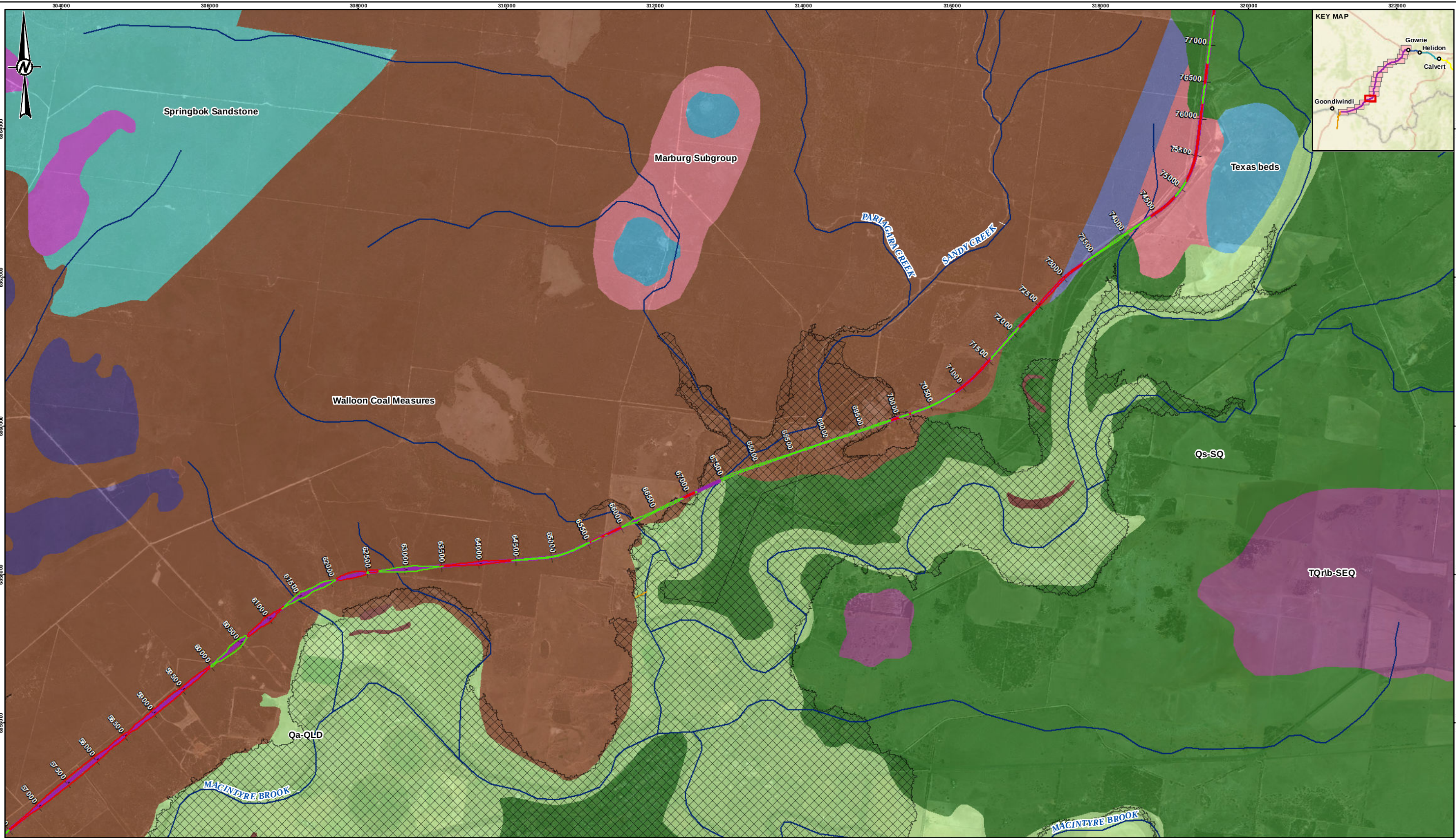
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FIGURE

22-4

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN ROOTED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Eurombah Formation?

Marburg Subgroup

Qa-QLD

QaI-SEQ

Qs-SQ

Springbok Sandstone

Springbok Sandstone (w)

TQrb-SEQ

Texas beds

Walloon Coal Measures

Walloon Coal Measures(w)

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

NMC

PREPARED

NMC

REVIEWED

BG

APPROVED

DB

GOLDER

NOTE(S)

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4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.

1897791

CONTROL

016

REV.

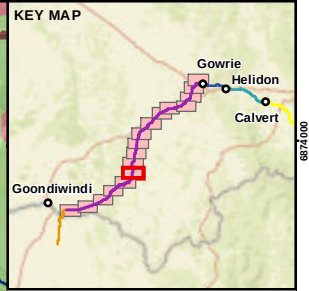
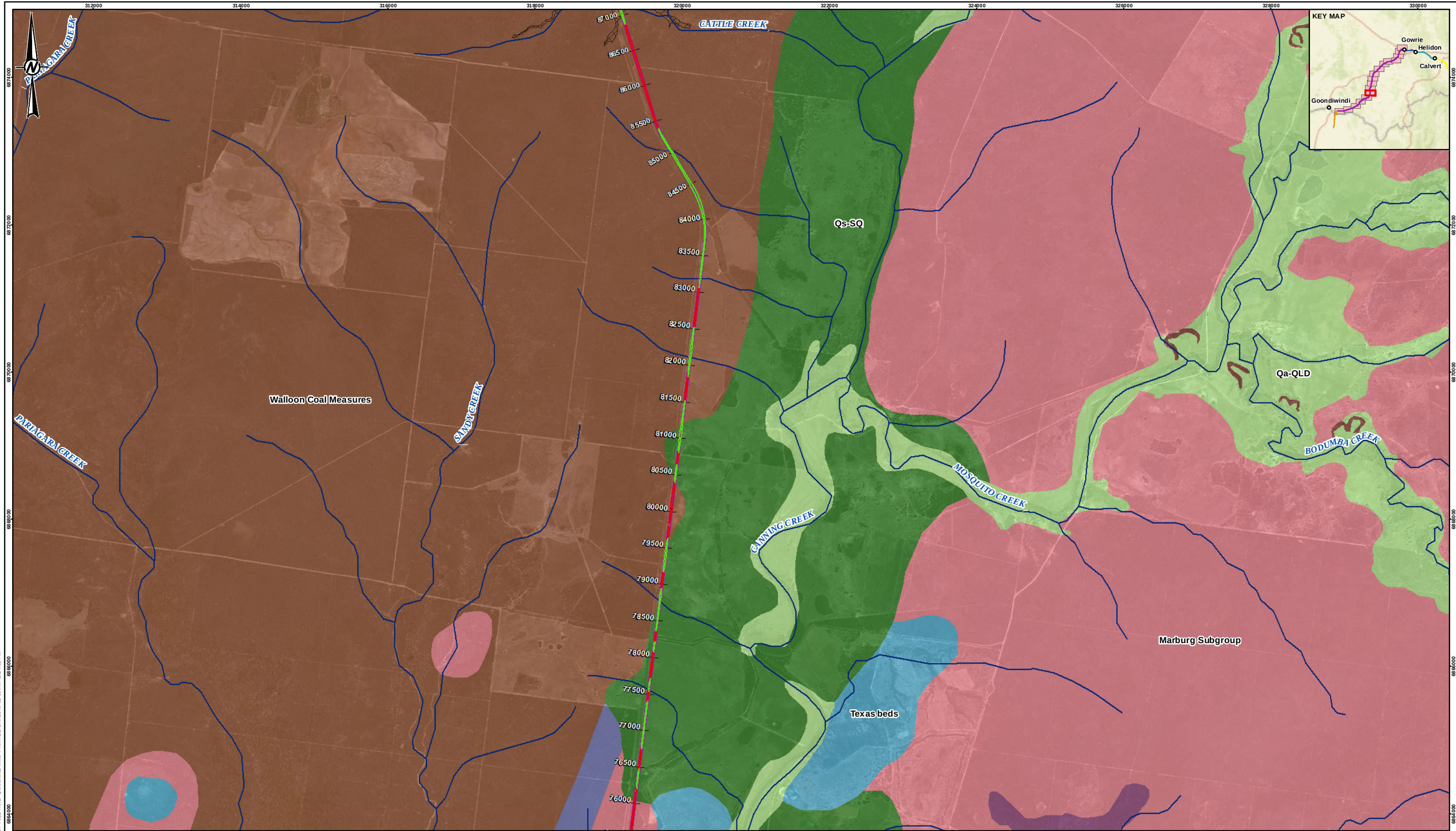
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FIGURE

22-5

R:\1897791\1897791_111897791_015-CT-F022-Rev05-InlandRailMap.mxd PRINTED ON: 2019/06/08 AT 12:20:50 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND
Watercourse
Type of Earth Works
Cut
Fill
Inland Rail Alignment Section
B2G - Border to Gowrie
1% Annual Exceedance Probability
QLD Detailed Surface Geology
Eurombah Formation?
Marburg Subgroup
Qa-QLD

Qa-I-SEQ

Qs-SQ

TQr/b-SEQ

Texas beds

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	NMC
PREPARED	NMC
REVIEWED	BG
APPROVED	DB

0 500 1,000 1,500 2,000

1:50,000@A3 METRES

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Watercourses: Geoscience Australia
2. Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.
3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.
4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

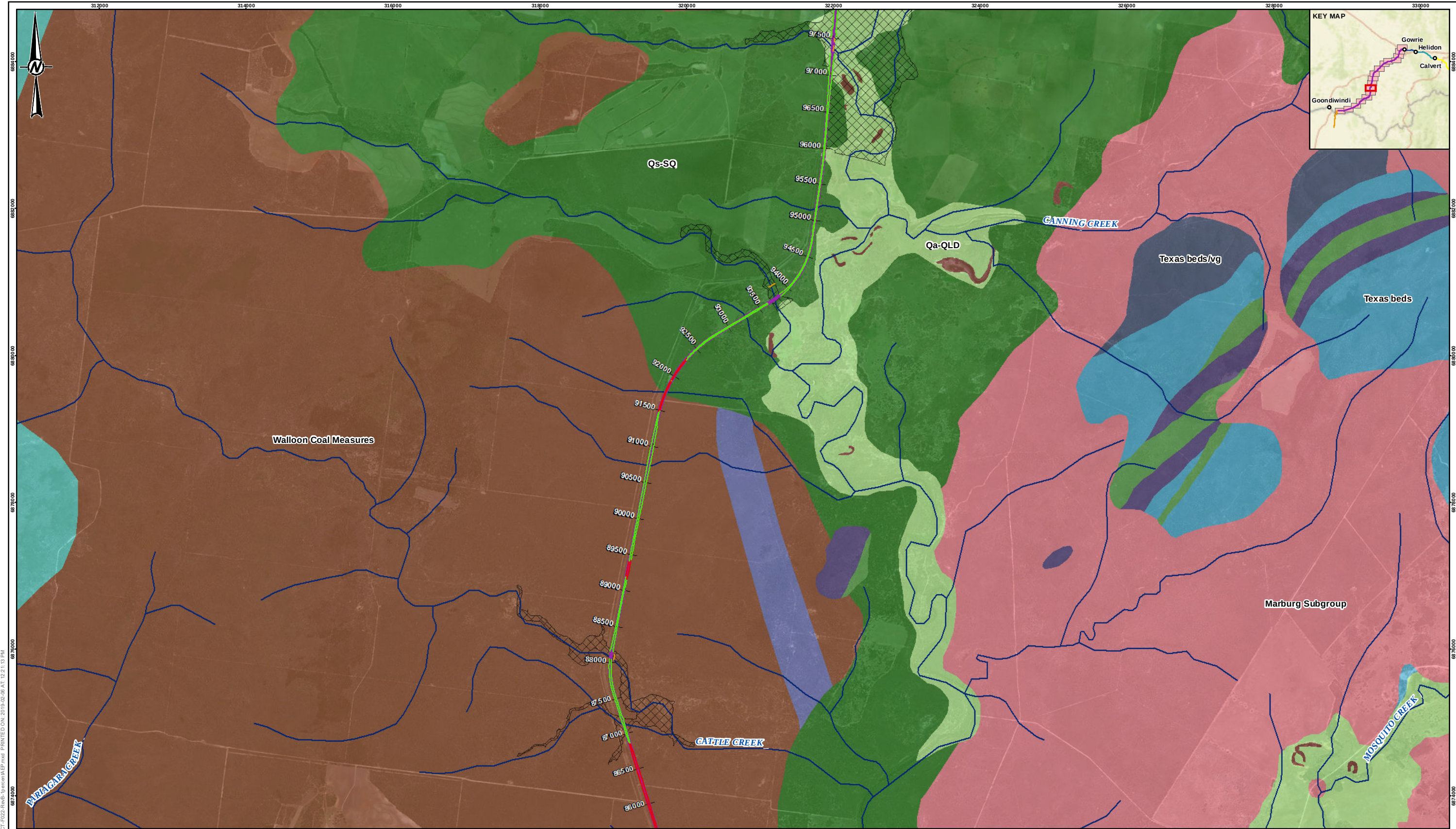
PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-6

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Eurombah Formation?

Marburg Subgroup

Qa-QLD

Qa-SEQ

Qs-SQ

Springbok Sandstone

Texas beds

Texas beds/j

Texas beds/v

Texas beds/vg

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	NMC
PREPARED	NMC
REVIEWED	BG
APPROVED	DB

GOLDER

NOTE(S)

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1. **Watercourses:** Geoscience Australia

2. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.

3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.

4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

TITLE

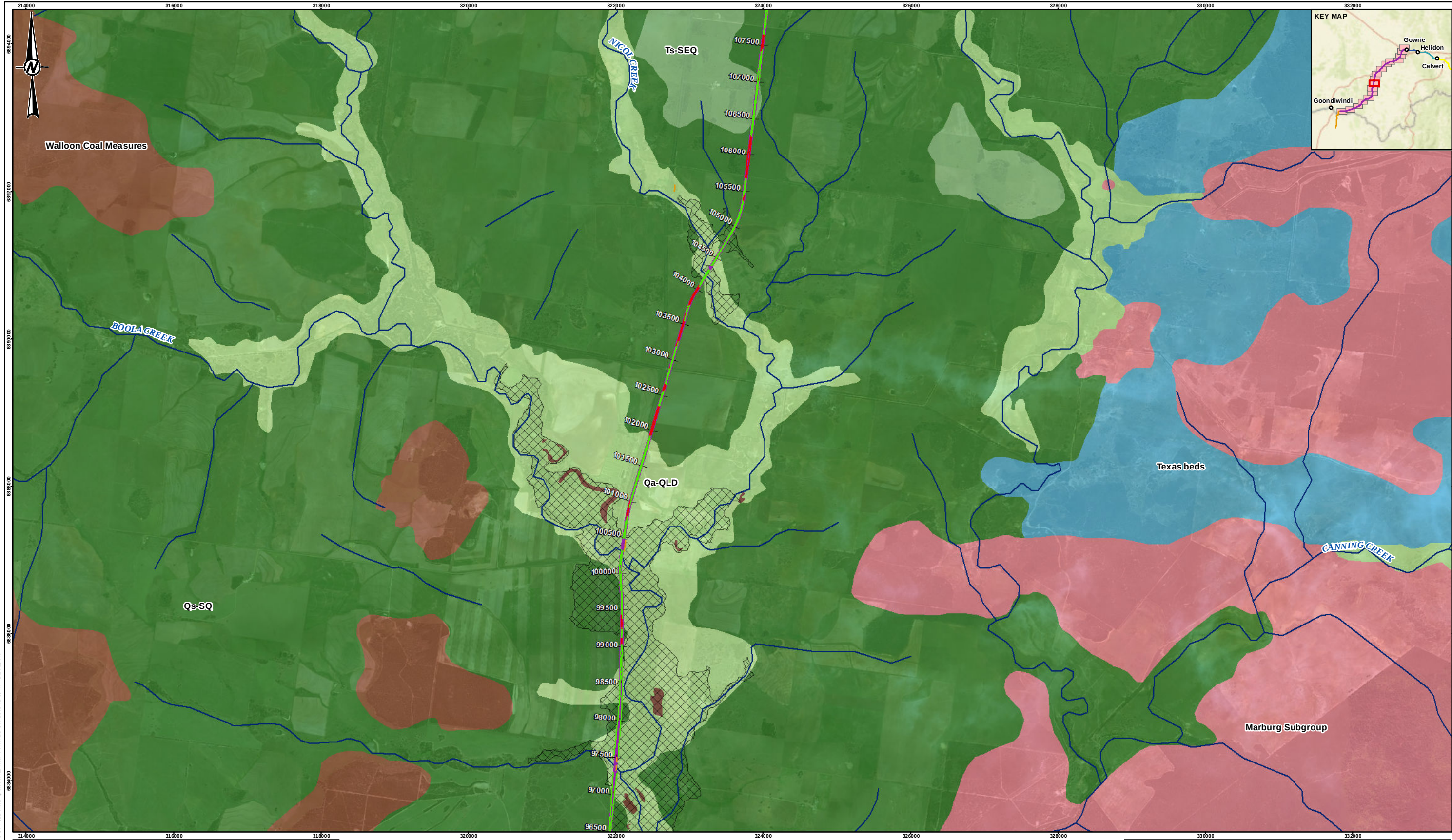
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO. 1897791 CONTROL 016 REV. 0

FIGURE 22-7

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Marburg Subgroup

Qa-QLD

QaI-SEQ

Qs-SQ

Texas beds

Ts-SEQ

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

NMC

PREPARED

NMC

REVIEWED

BG

APPROVED

DB

GOLDER

NOTE(S)

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REFERENCE(S)

1. Watercourses: Geoscience Australia

2. Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.

3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.

4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.

1897791

CONTROL

016

REV.

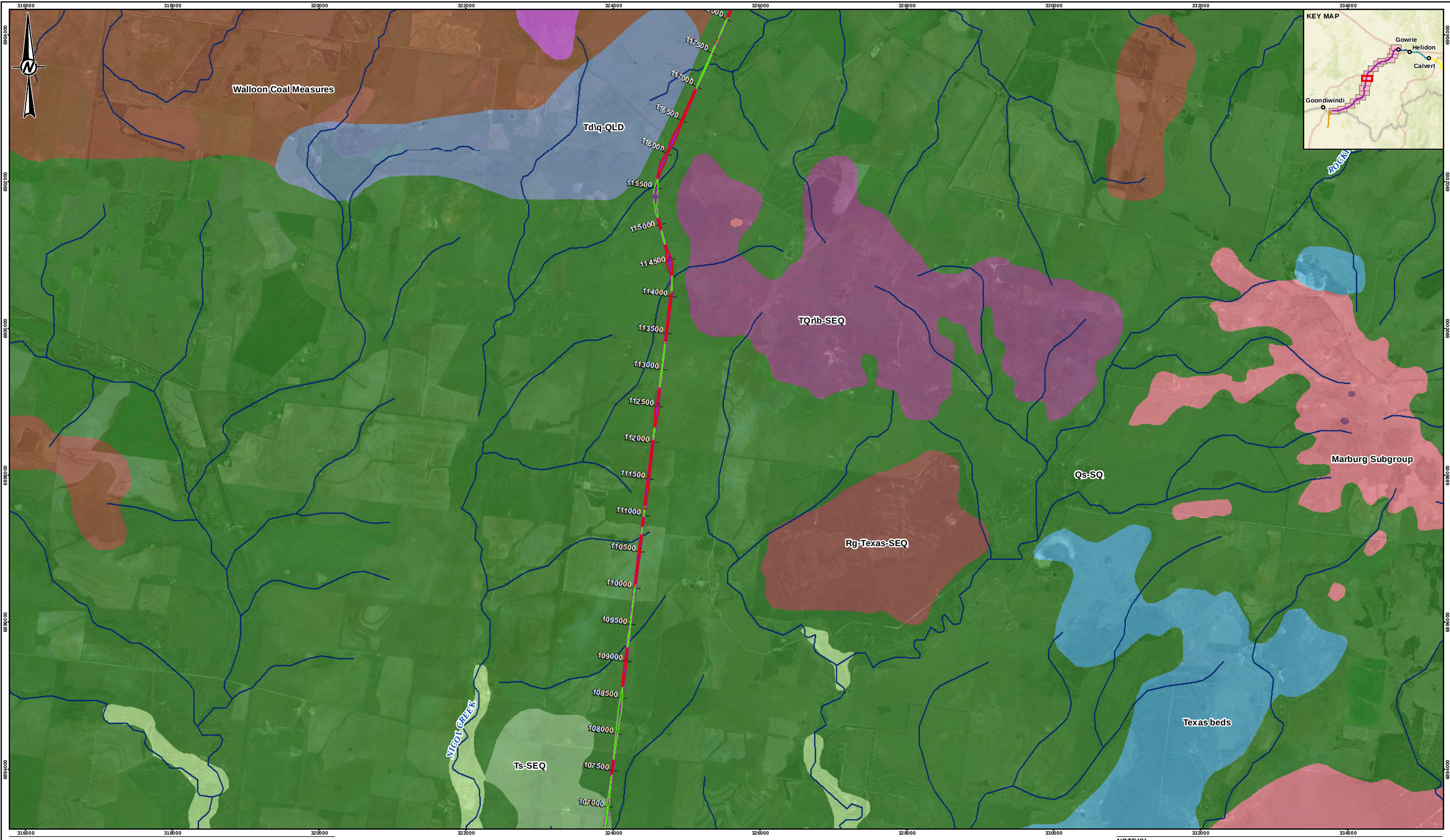
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FIGURE

22-8

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Inland Rail Alignment Section

B2G - Border to Gowrie

QLD Detailed Surface Geology

Main Range Volcanics

Marburg Subgroup

Qa-QLD

Qs-SQ

Rg-Texas-SEQ

TQ1b-SEQ

Td1q-QLD

Texas beds

Ts-SEQ

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3 METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	NMC
PREPARED	NMC
REVIEWED	BG
APPROVED	DB

NOTE(S)

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1. **Watercourses:** Geoscience Australia

2. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.

3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.

4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

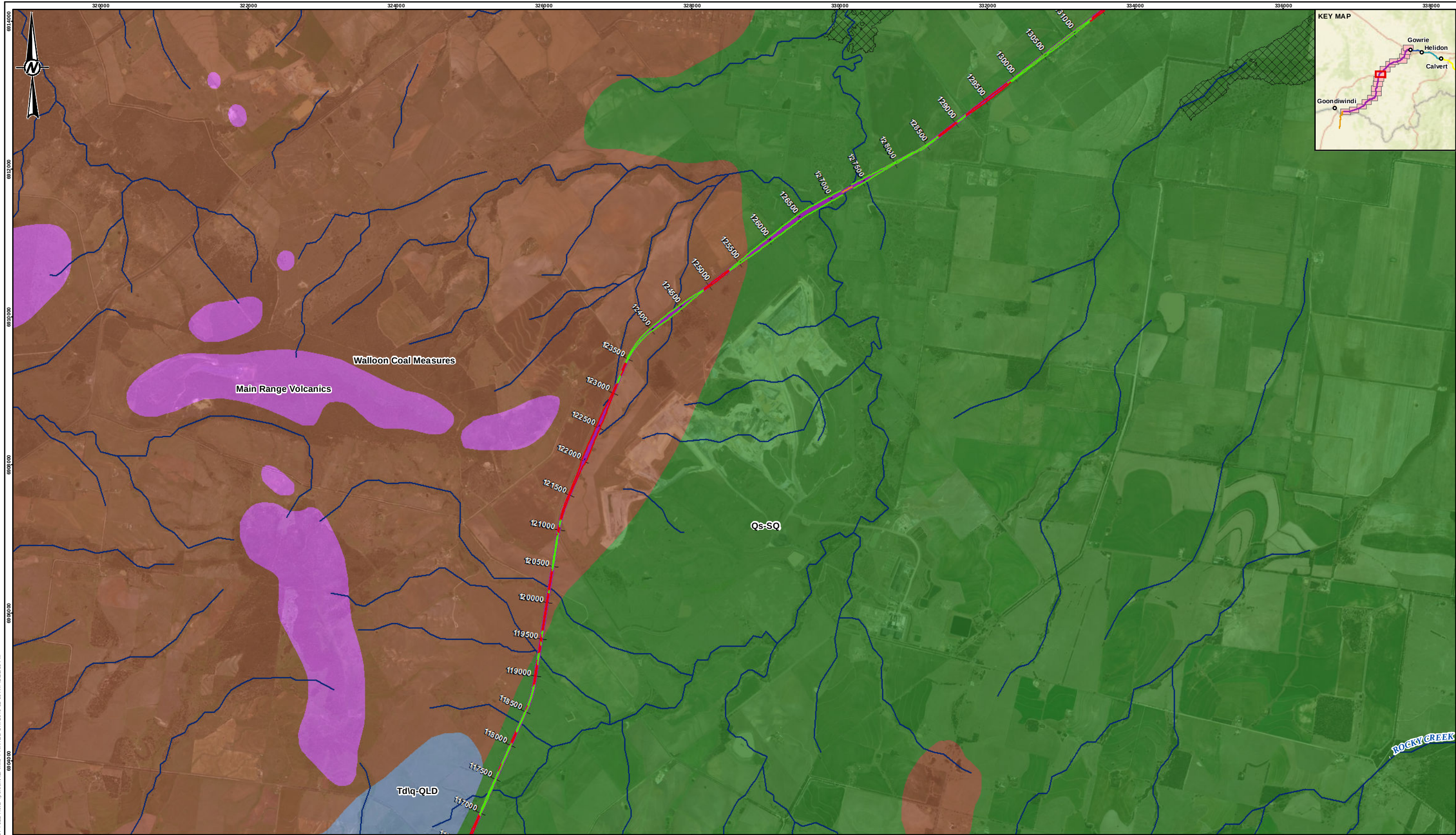
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FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-9

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Main Range Volcanics

Qs-SQ

Td\q-QLD

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000

1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	NMC
PREPARED	NMC
REVIEWED	BG
APPROVED	DB

NOTE(S)

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2. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.

3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.

4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

TITLE

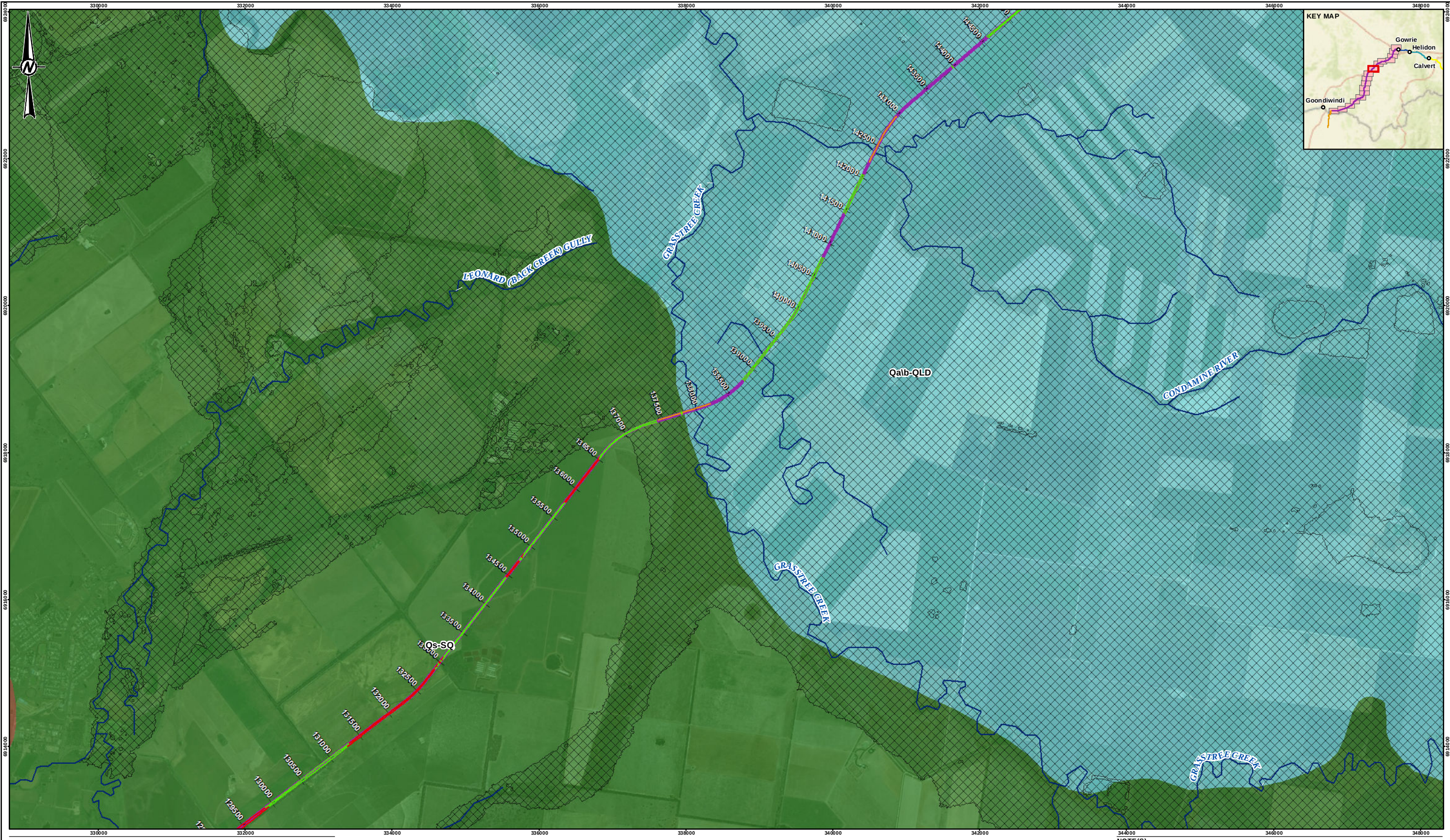
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO. 1897791 CONTROL 016 REV. 0

FIGURE 22-10

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Qalib-QLD

Qs-SQ

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

NMC

PREPARED

NMC

REVIEWED

BG

APPROVED

DB

GOLDER

NOTE(S)
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4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.
1897791

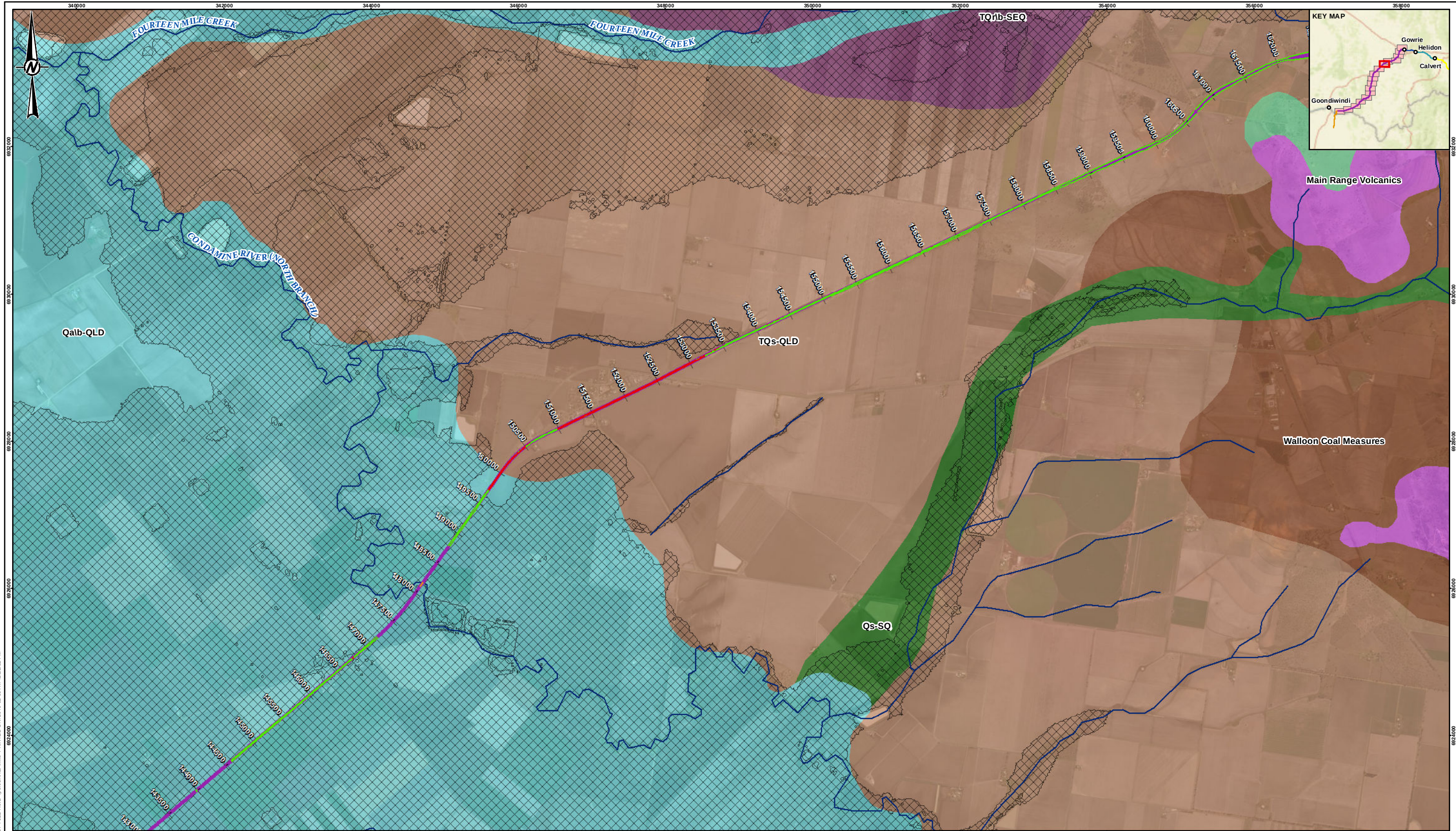
CONTROL
016

REV.
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FIGURE
22-11

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 297mm



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Main Range Volcanics

Qa/b-QLD

Qs-SQ

TQr/b-SEQ

TQs-QLD

TQs-QLD>Main Range Volcanics

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

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1:50,000@A3

METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

NMC

PREPARED

NMC

REVIEWED

BG

APPROVED

DB

GOLDER

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, incrementP Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

1. Watercourses: Geoscience Australia

2. Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.

3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.

4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.

1897791

CONTROL

016

REV.

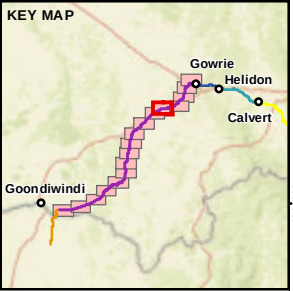
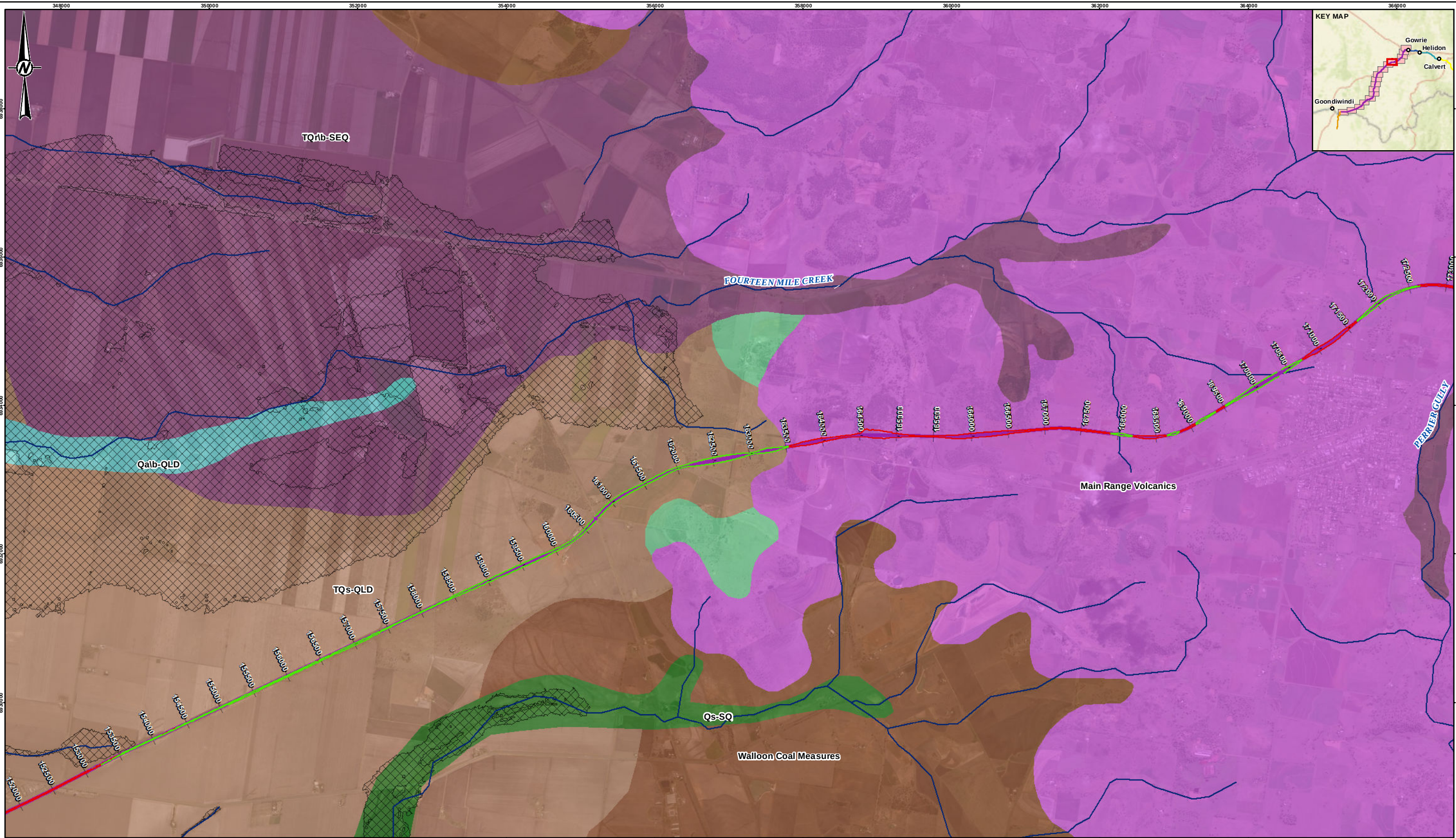
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FIGURE

22-12

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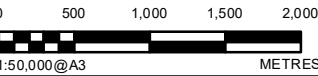
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- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Inland Rail Alignment Section**
 - B2G - Border to Gowrie
 - 1% Annual Exceedance Probability
 - QLD Detailed Surface Geology**
 - Main Range Volcanics
 - Qalb-QLD
 - Qs-SQ
 - TQrb-SEQ
 - TQs-QLD
 - TQs-QLD>Main Range Volcanics
 - Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994



CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	NMC
	PREPARED	NMC
	REVIEWED	BG
	APPROVED	DB



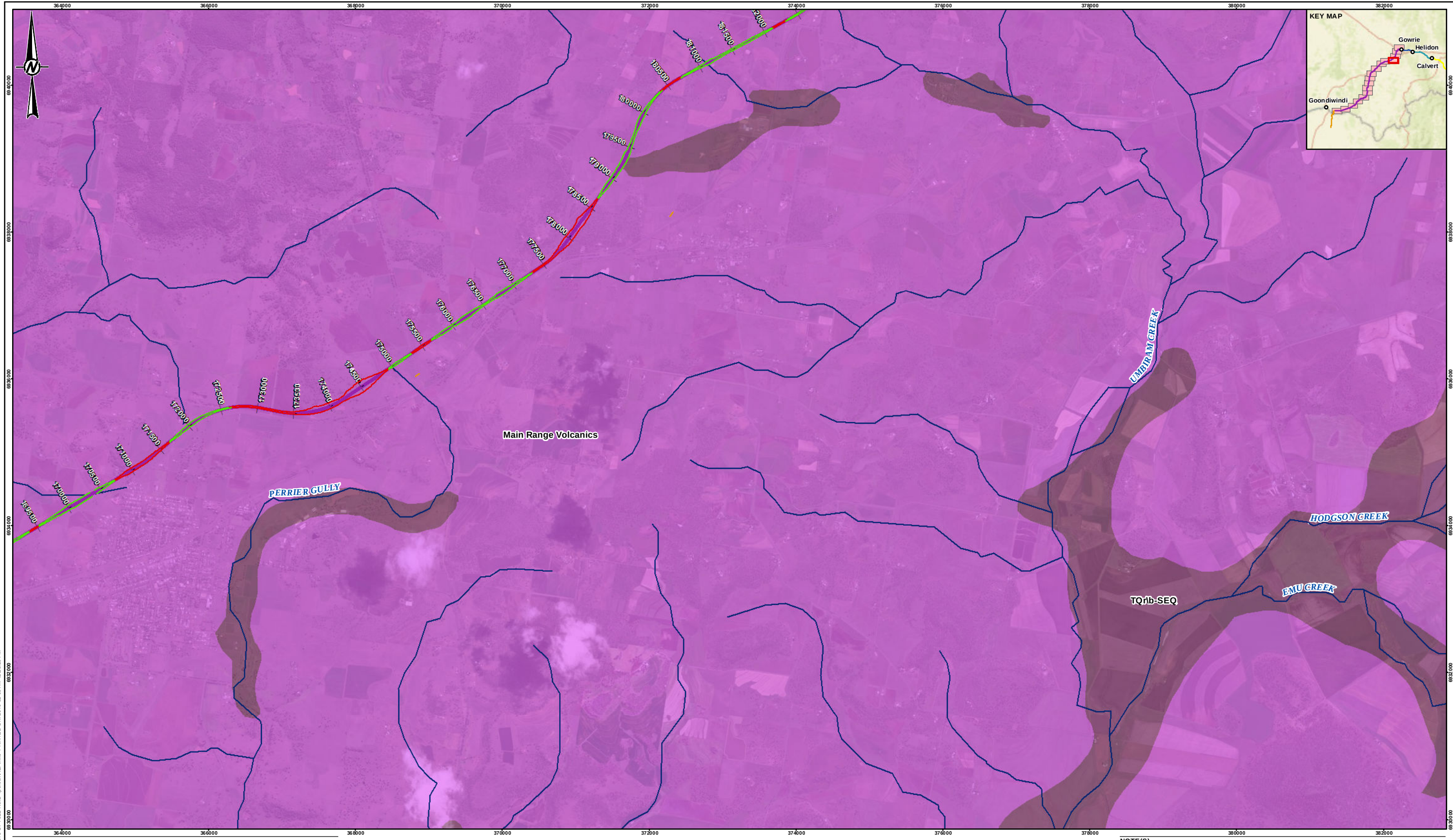
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- REFERENCE(S)**
- Watercourses: Geoscience Australia
 - Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.
 - 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.
 - Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-13



- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Bridge
 - Inland Rail Alignment Section**
 - B2G - Border to Gowrie
 - QLD Detailed Surface Geology**
 - Main Range Volcanics
 - TQrb-SEQ

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

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1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	NMC
	PREPARED	NMC
	REVIEWED	BG
	APPROVED	DB

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, incrementP Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. **Watercourses:** Geoscience Australia
2. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.
3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.
4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

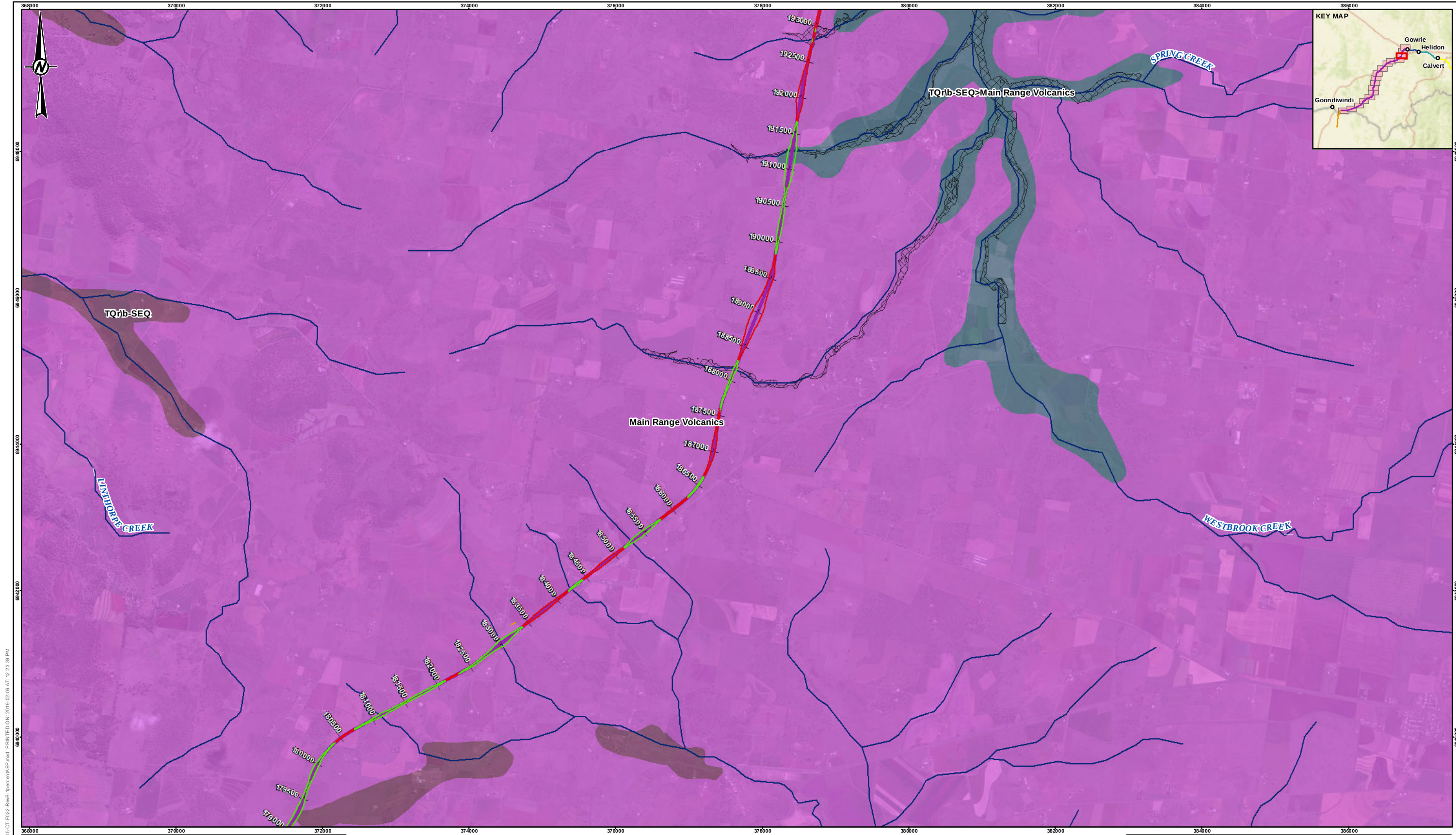
PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-14

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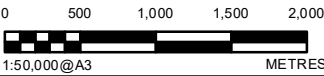
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- LEGEND**
- Watercourse
 - Type of Earth Works**
 - Cut
 - Fill
 - Bridge
 - Inland Rail Alignment Section**
 - B2G - Border to Gowrie
 - 1% Annual Exceedance Probability
 - QLD Detailed Surface Geology**
 - Main Range Volcanics
 - TQr/b-SEQ

FOR DISCUSSION PURPOSE ONLY
DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994



CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT	DD-MMM-YY	6/02/2019
	DESIGNED	NMC
	PREPARED	NMC
	REVIEWED	BG
	APPROVED	DB



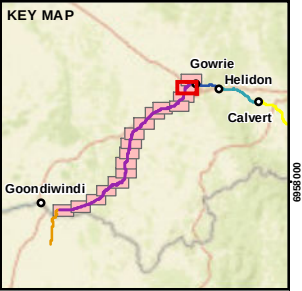
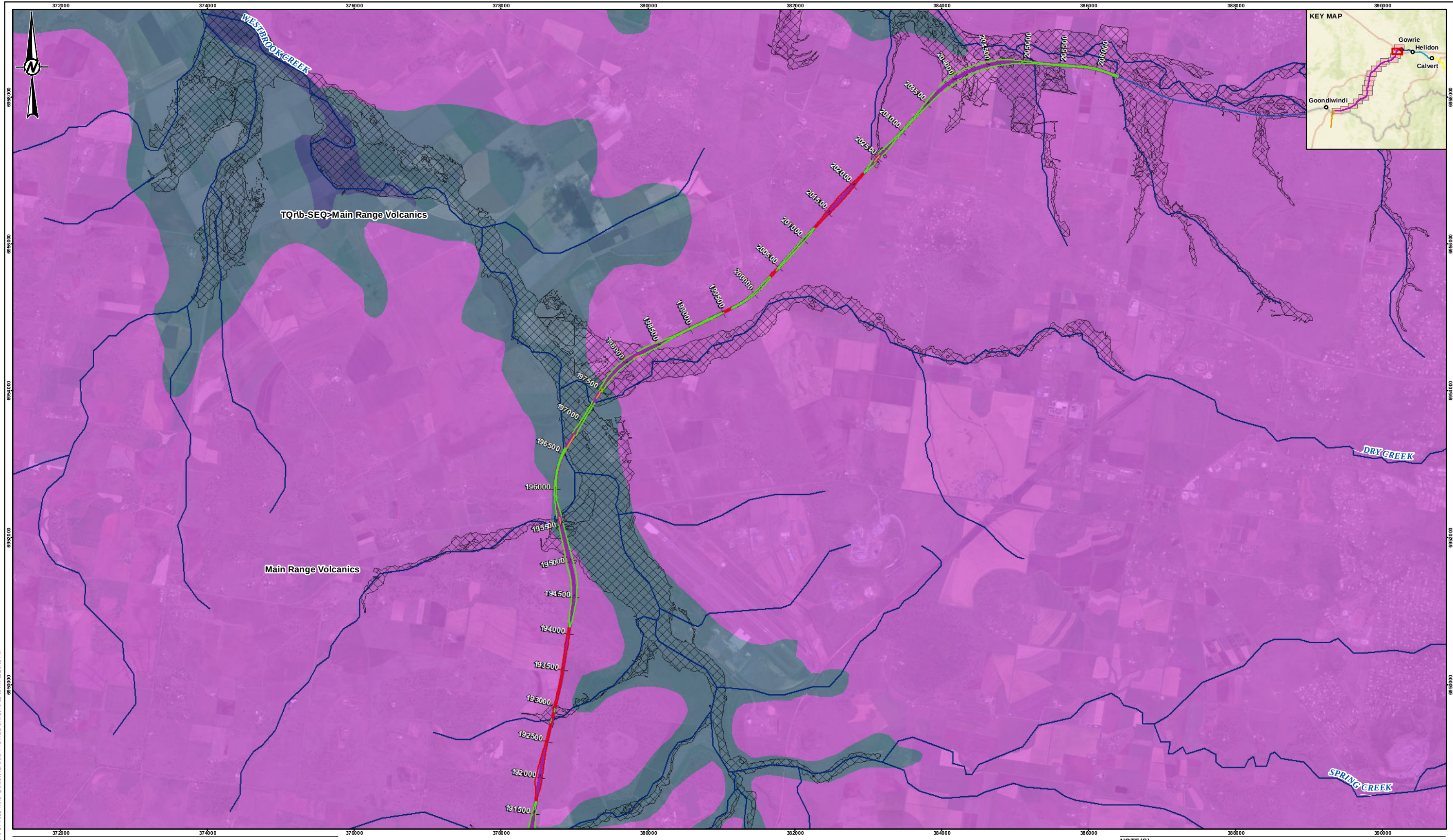
NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)
1. Watercourses: Geoscience Australia
2. Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.
3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.
4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT
INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN
SCOPE OF WORKS - HYDROGEOLOGY

TITLE
FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.	CONTROL	REV.	FIGURE
1897791	016	0	22-15



LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

G2H - Gowrie to Helidon

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Main Range Volcanics

Qa\Q-D>Main Range Volcanics

TQrb-SEQ>Main Range Volcanics

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

0 500 1,000 1,500 2,000
1:50,000@A3 METRES

CLIENT
FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY	6/02/2019
DESIGNED	NMC
PREPARED	NMC
REVIEWED	BG
APPROVED	DB

GOLDER

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

1. **Watercourses:** Geoscience Australia
2. **Alignment, Earth Works:** Provided by FFJV on 10th Jan 2019.
3. **1% AEP digital elevation data:** Provided by FFJV on 4th Dec 2018.
4. **Detailed Geology:** State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN SCOPE OF WORKS - HYDROGEOLOGY

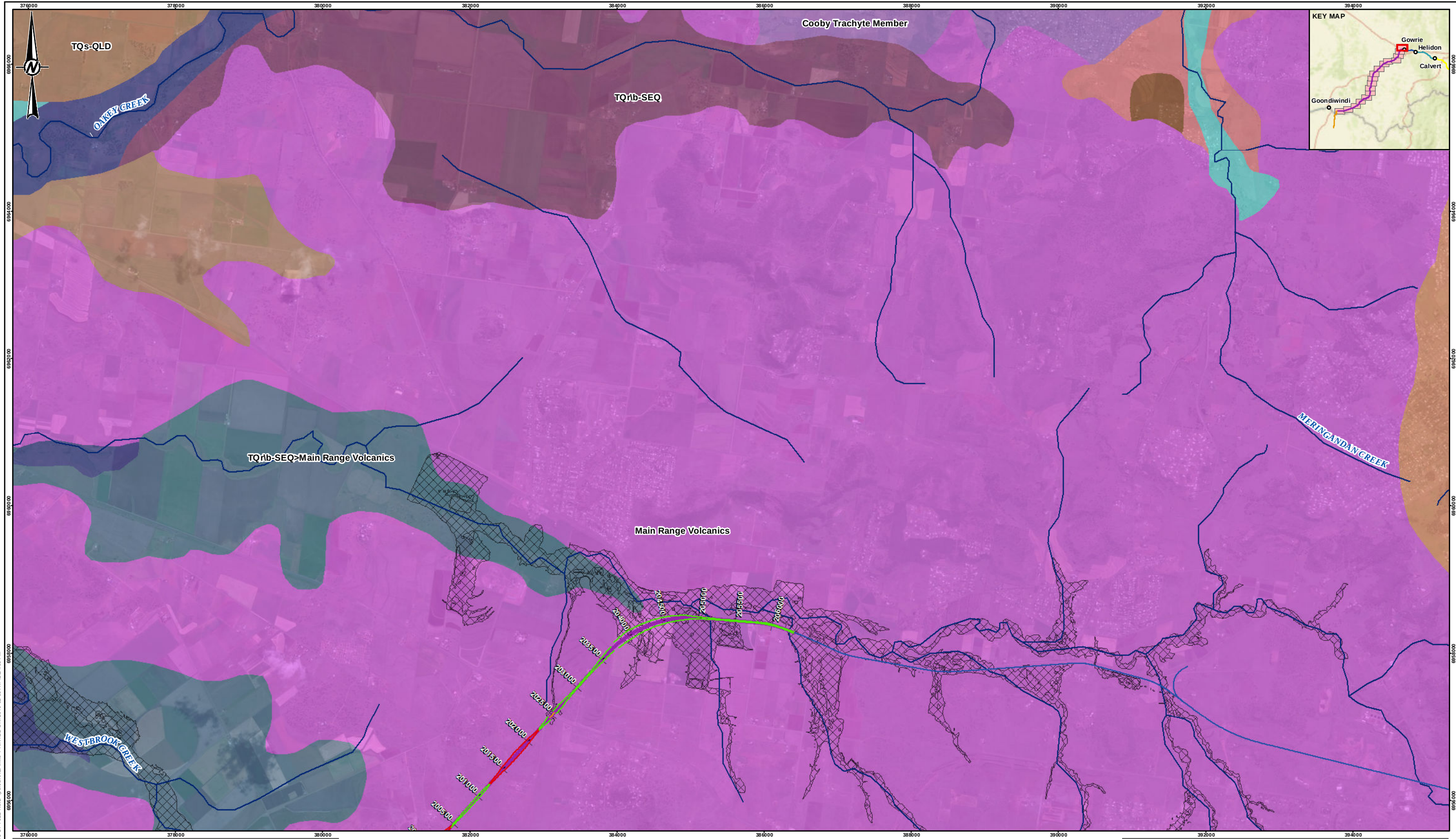
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LEGEND

Watercourse

Type of Earth Works

Cut

Fill

Bridge

Inland Rail Alignment Section

B2G - Border to Gowrie

G2H - Gowrie to Helidon

1% Annual Exceedance Probability

QLD Detailed Surface Geology

Cooby Trachyte Member

Main Range Volcanics

Marburg Subgroup

Qa'lb-QLD

Qa'lb-QLD>Main Range Volcanics

TQ'r'b-SEQ

TQ'r'b-SEQ>Main Range Volcanics

TQ'r'c-SEQ>Main Range Volcanics

TQ's-QLD

Td'r-QLD>Main Range Volcanics

Walloon Coal Measures

FOR DISCUSSION PURPOSE ONLY

DRAFT

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

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METRES

CLIENT

FUTURE FREIGHT JOINT VENTURE

CONSULTANT

DD-MMM-YY

6/02/2019

DESIGNED

NMC

PREPARED

NMC

REVIEWED

BG

APPROVED

DB

GOLDER

NOTE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

REFERENCE(S)

1. Watercourses: Geoscience Australia

2. Alignment, Earth Works: Provided by FFJV on 10th Jan 2019.

3. 1% AEP digital elevation data: Provided by FFJV on 4th Dec 2018.

4. Detailed Geology: State of Queensland (Department of Natural Resources, Mines and Energy) 2018

PROJECT

INLAND RAIL BORDER TO GOWRIE 100% FEASIBILITY DESIGN

SCOPE OF WORKS - HYDROGEOLOGY

TITLE

FLOOD EXTENT (1% ANNUAL EXCEEDANCE PROBABILITY)

PROJECT NO.

1897791

CONTROL

016

REV.

0

FIGURE

22-17

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Appendix A

Flood Inundation Map

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Flood Inundation Map

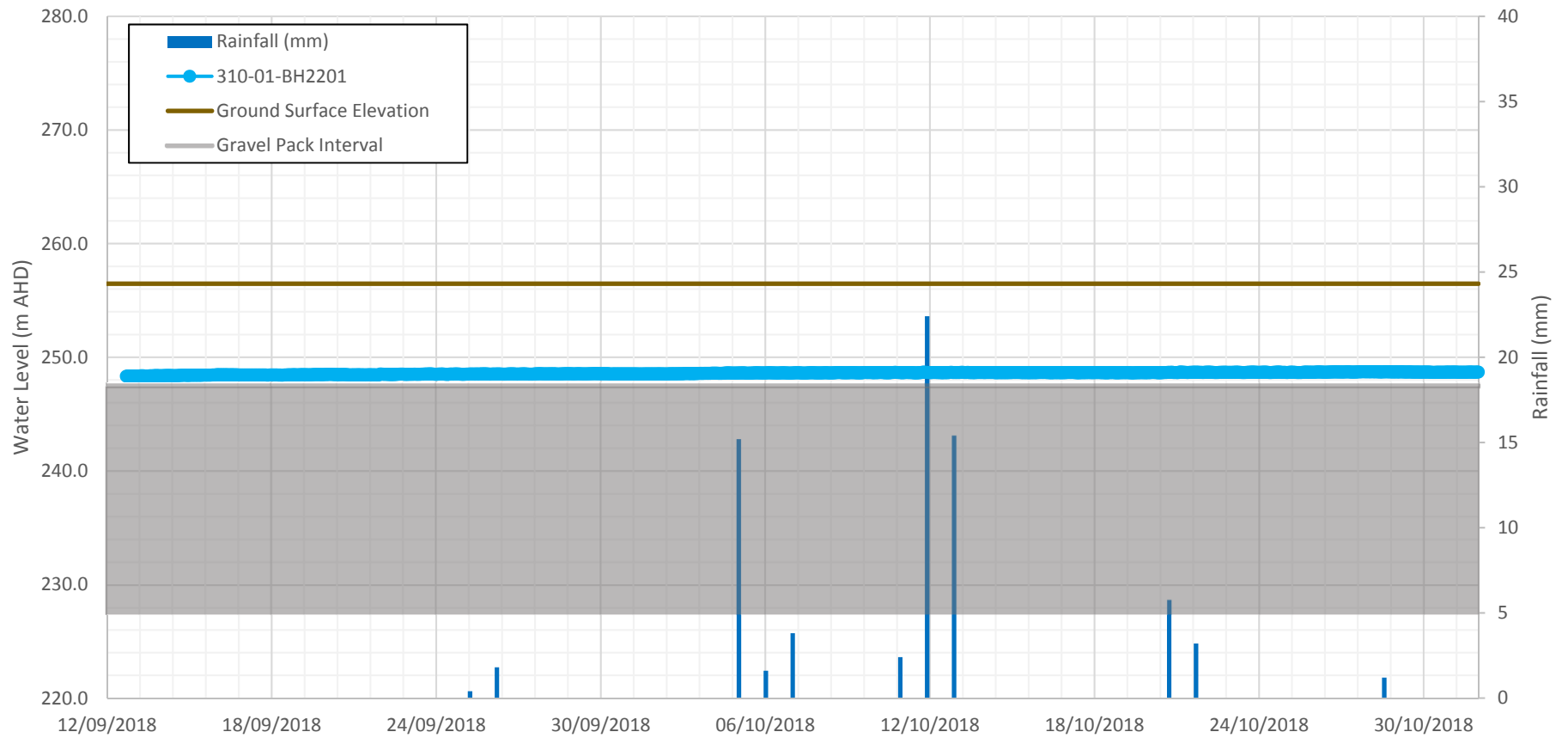
Appendix B

Phase Feasibility Geotechnical Investigation Hydrographs

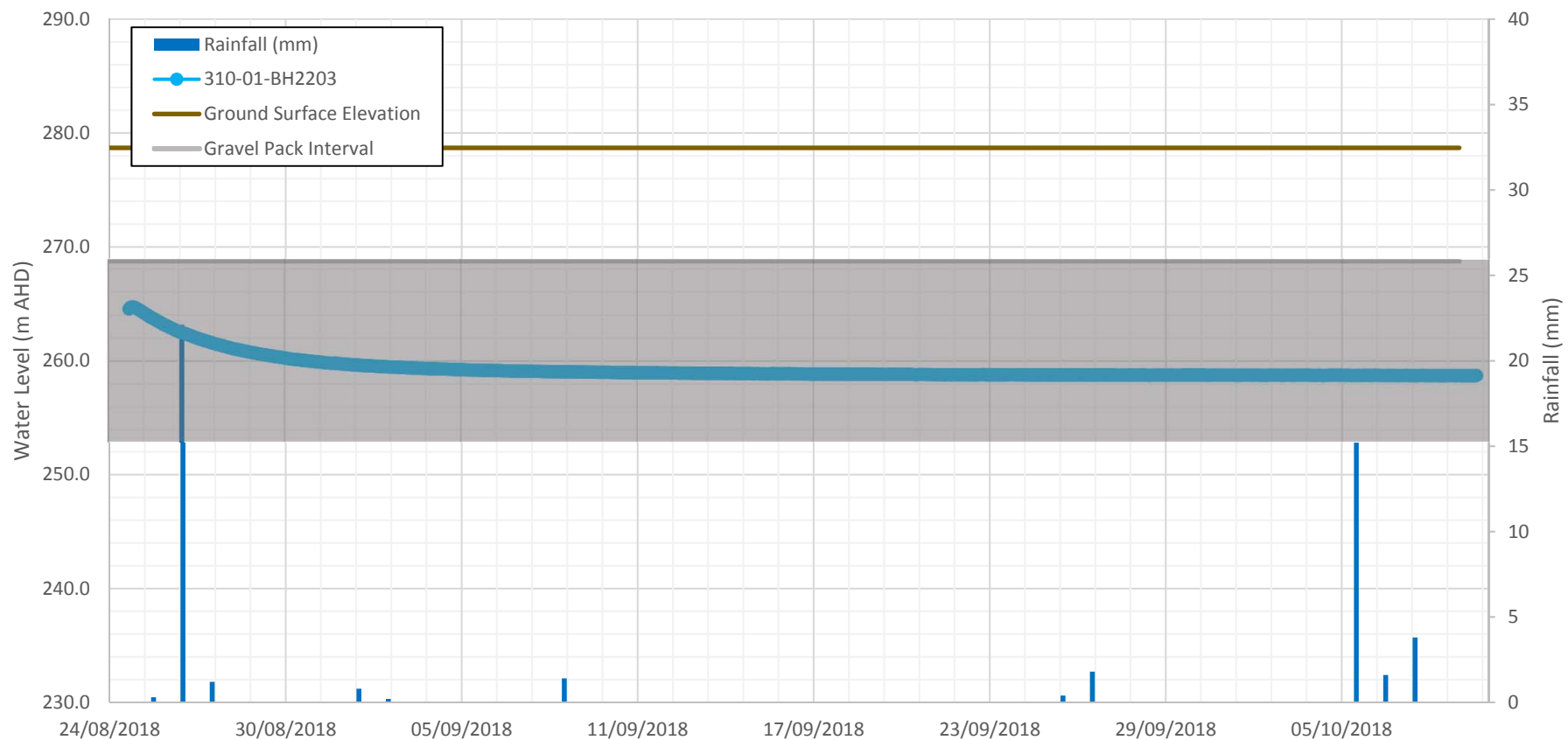
INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B

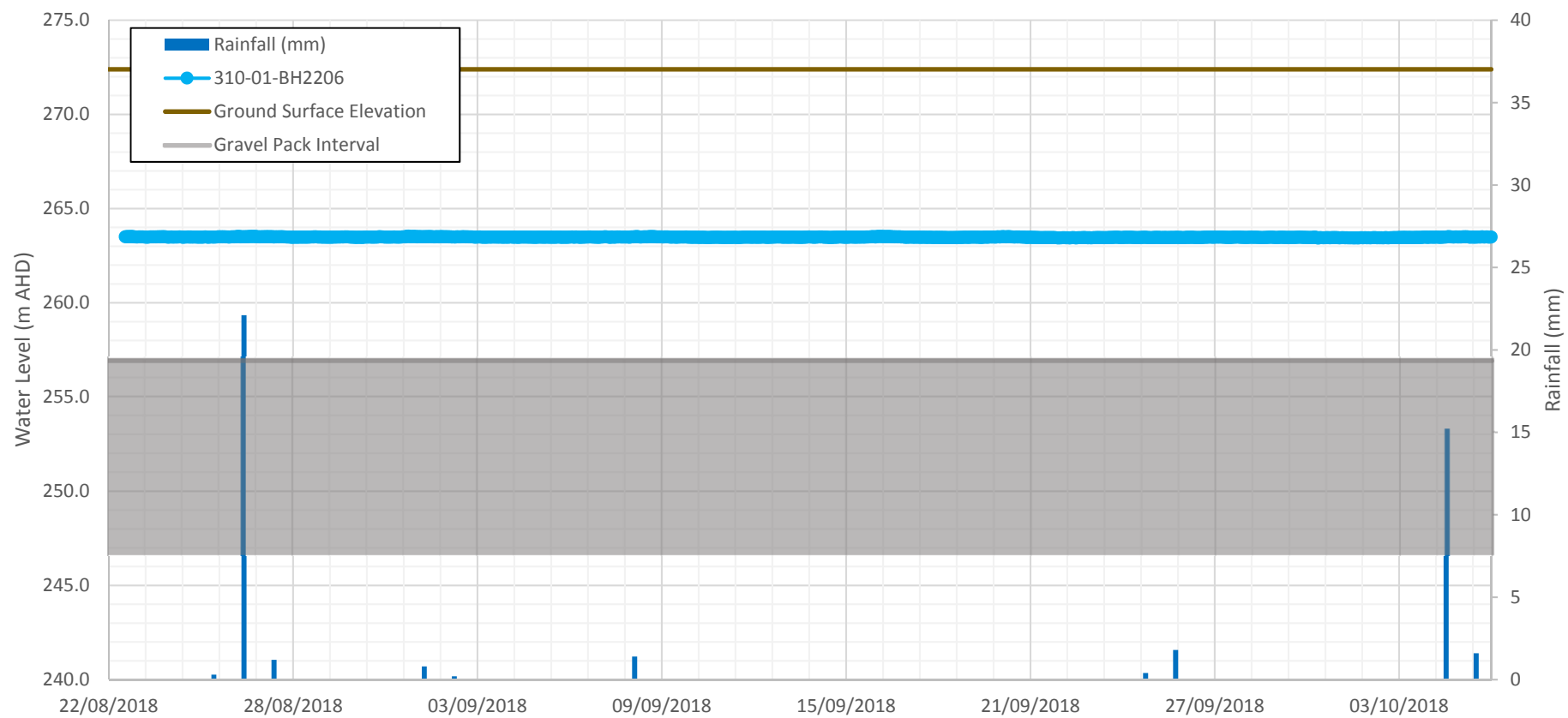
Phase Feasibility Geotechnical Investigation Hydrographs



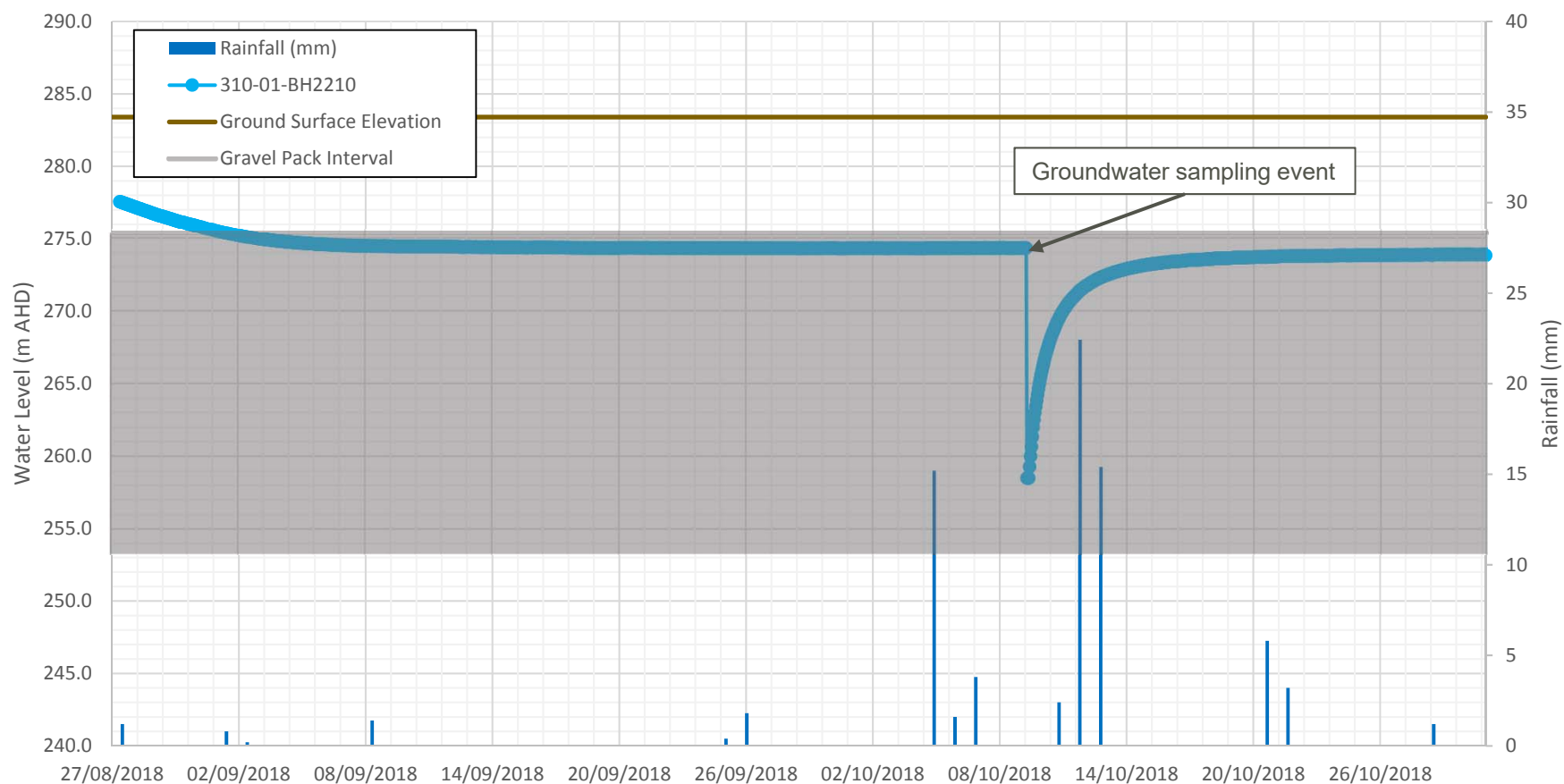
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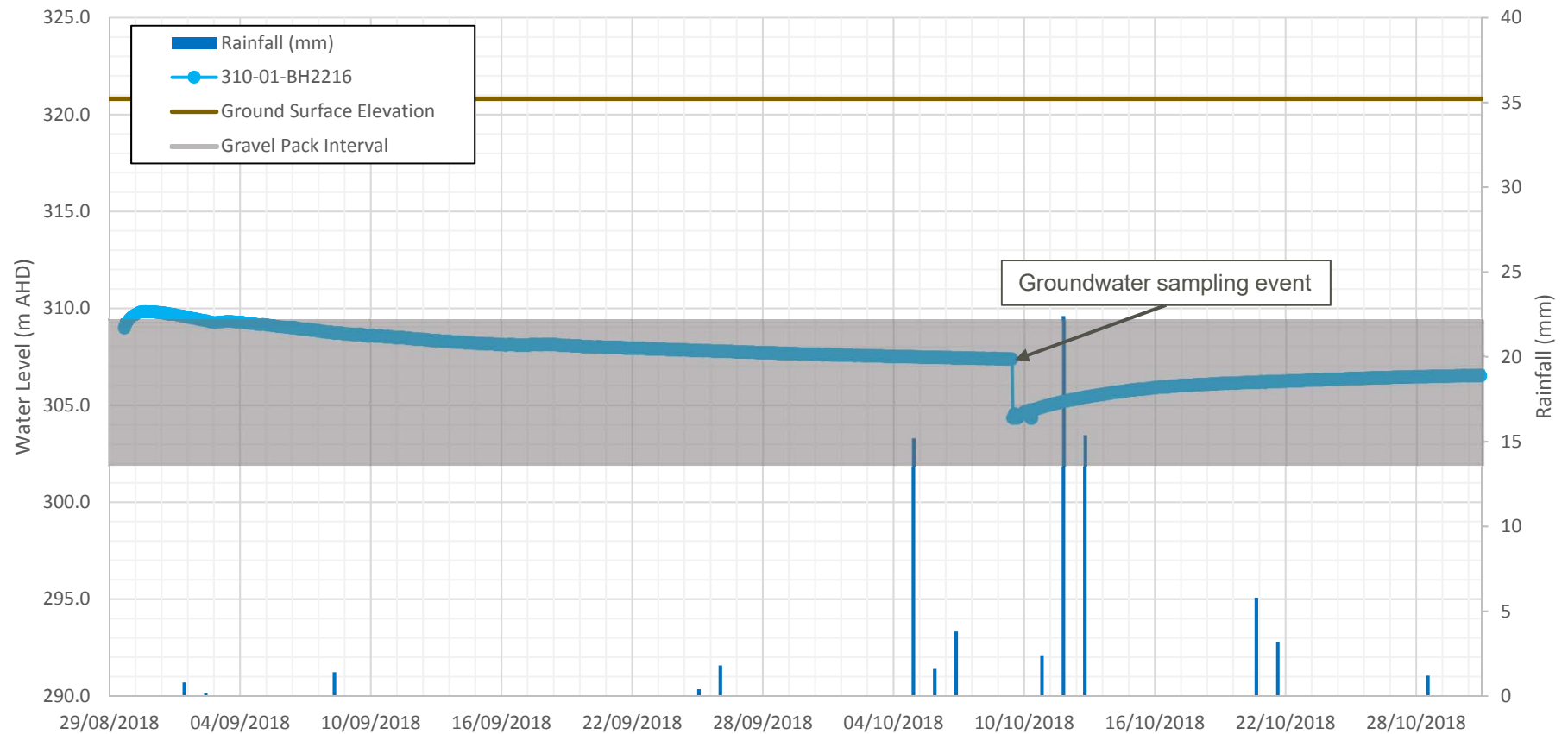


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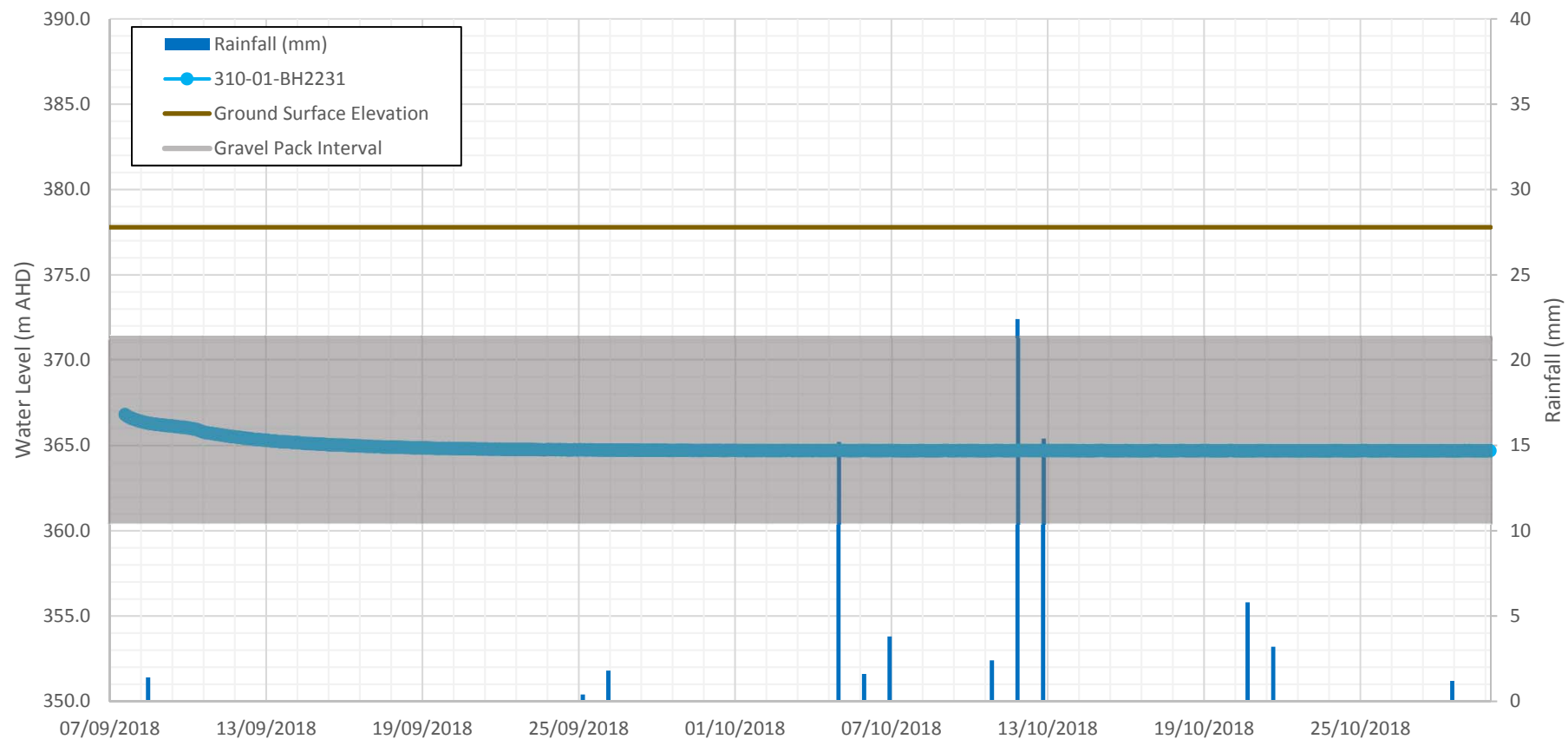


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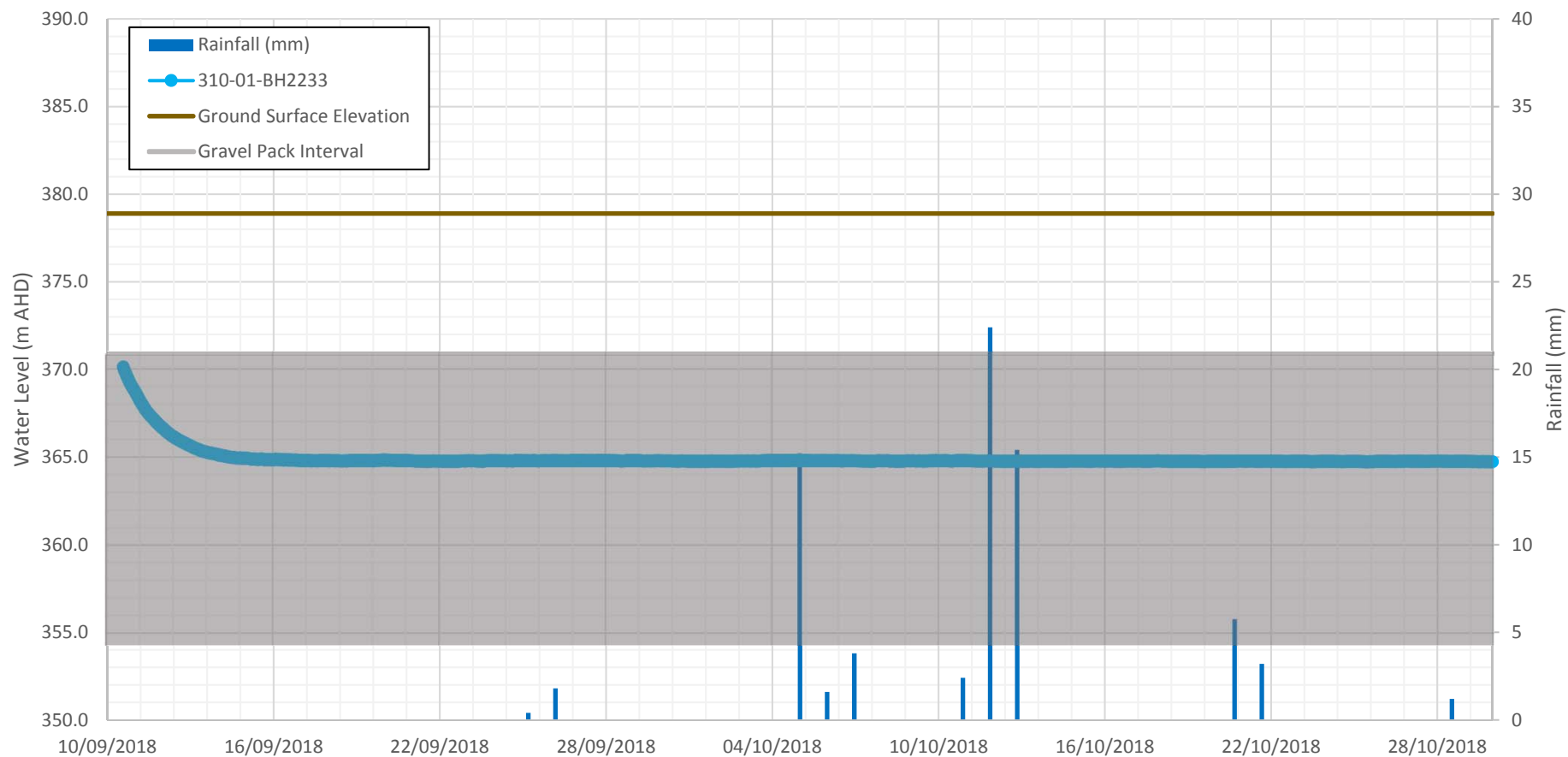




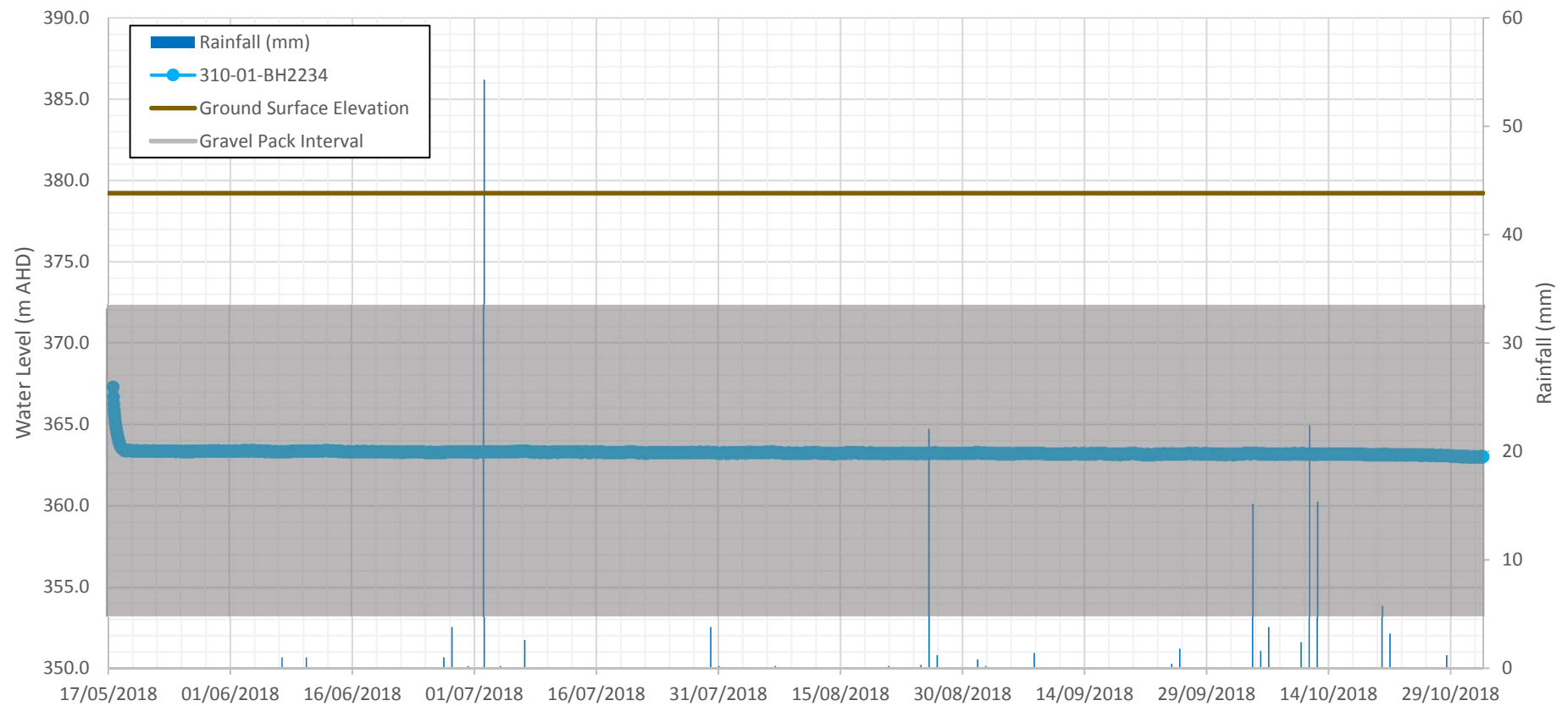
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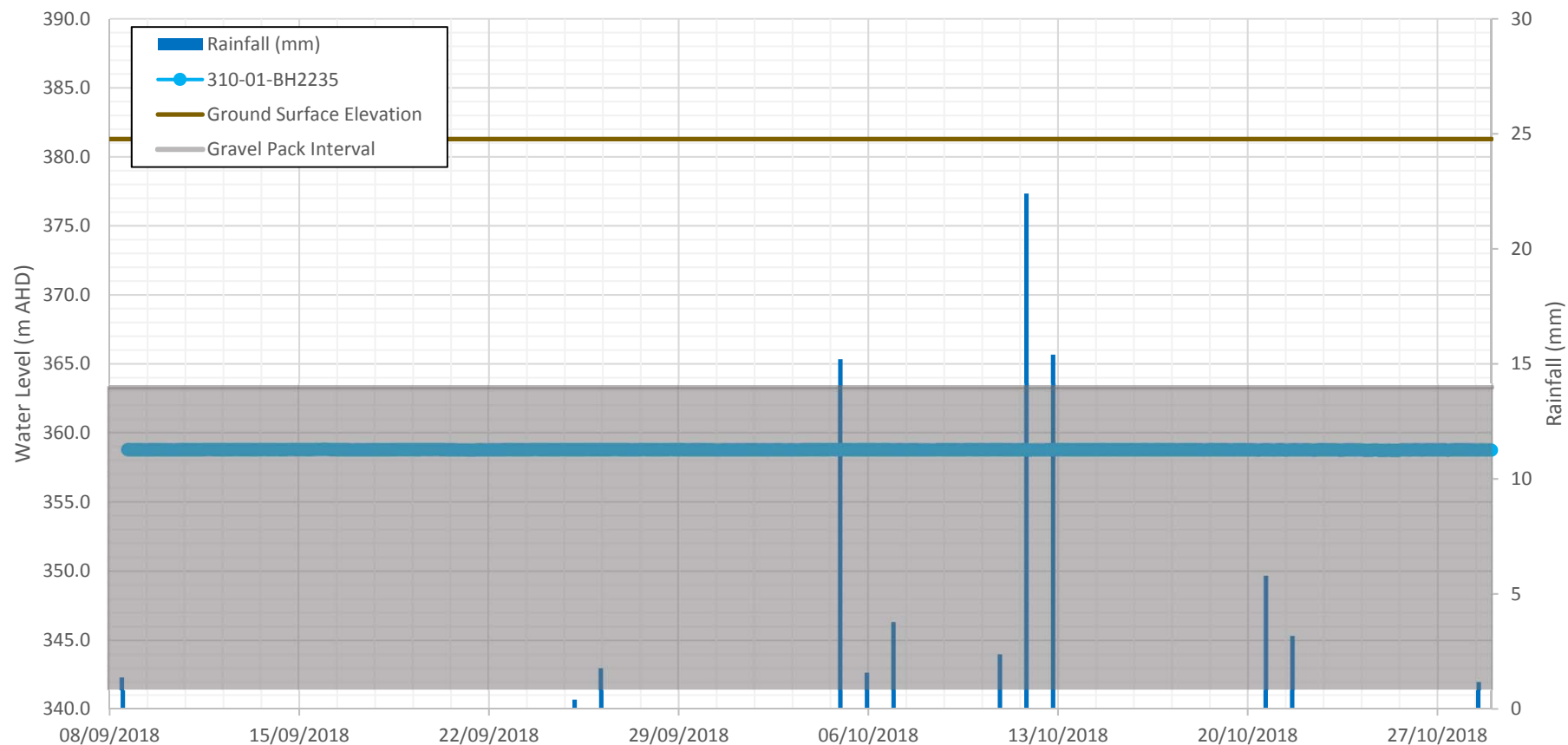
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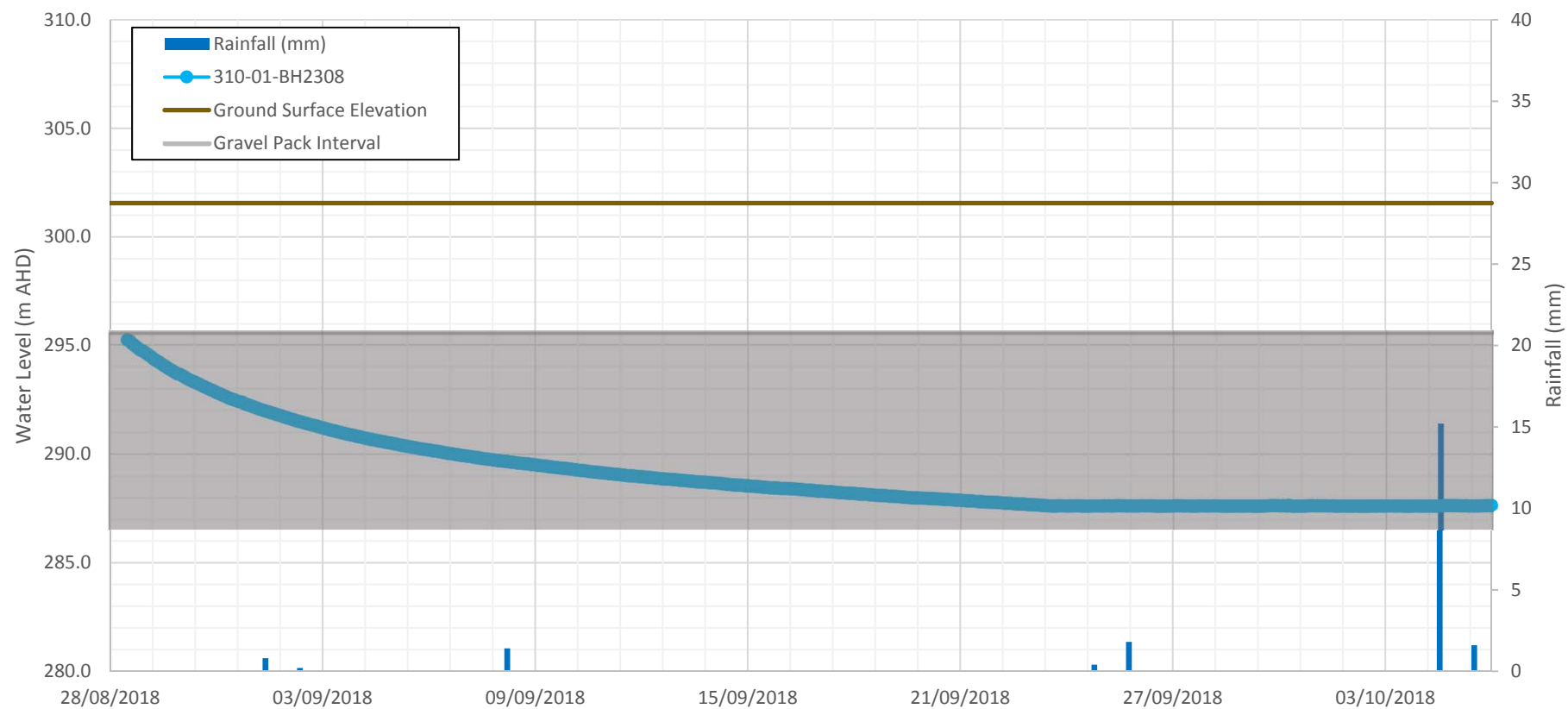
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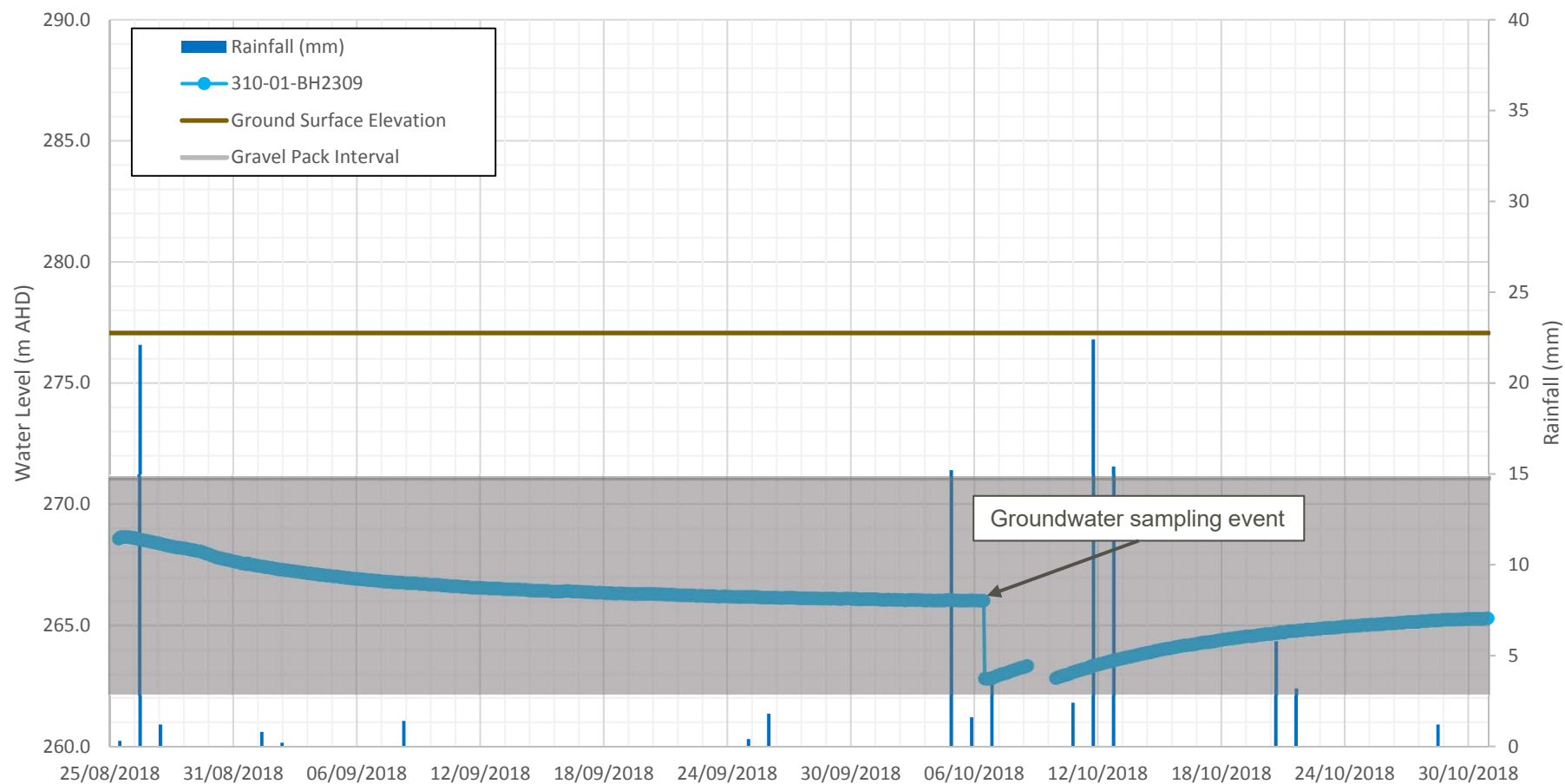
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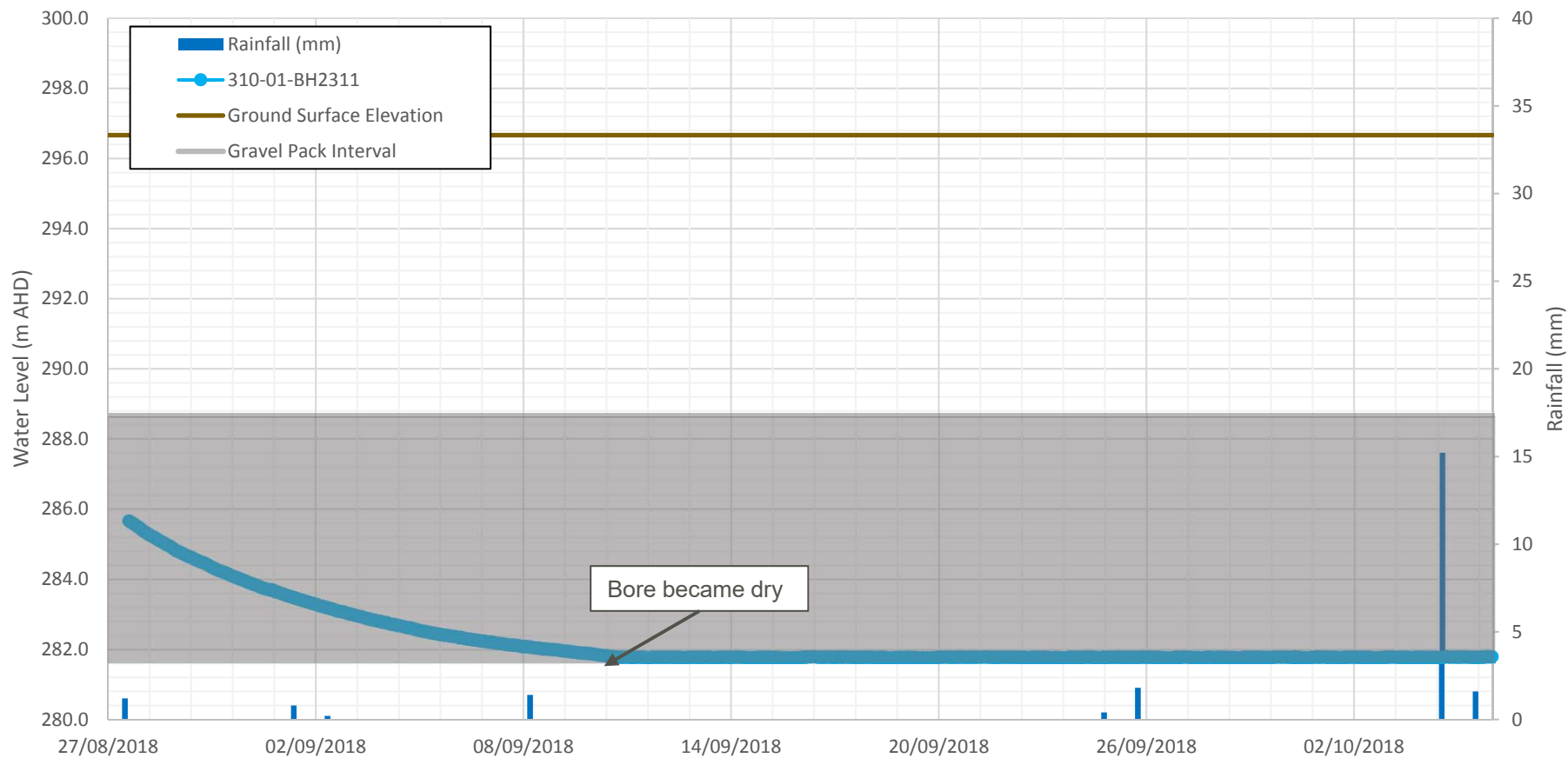
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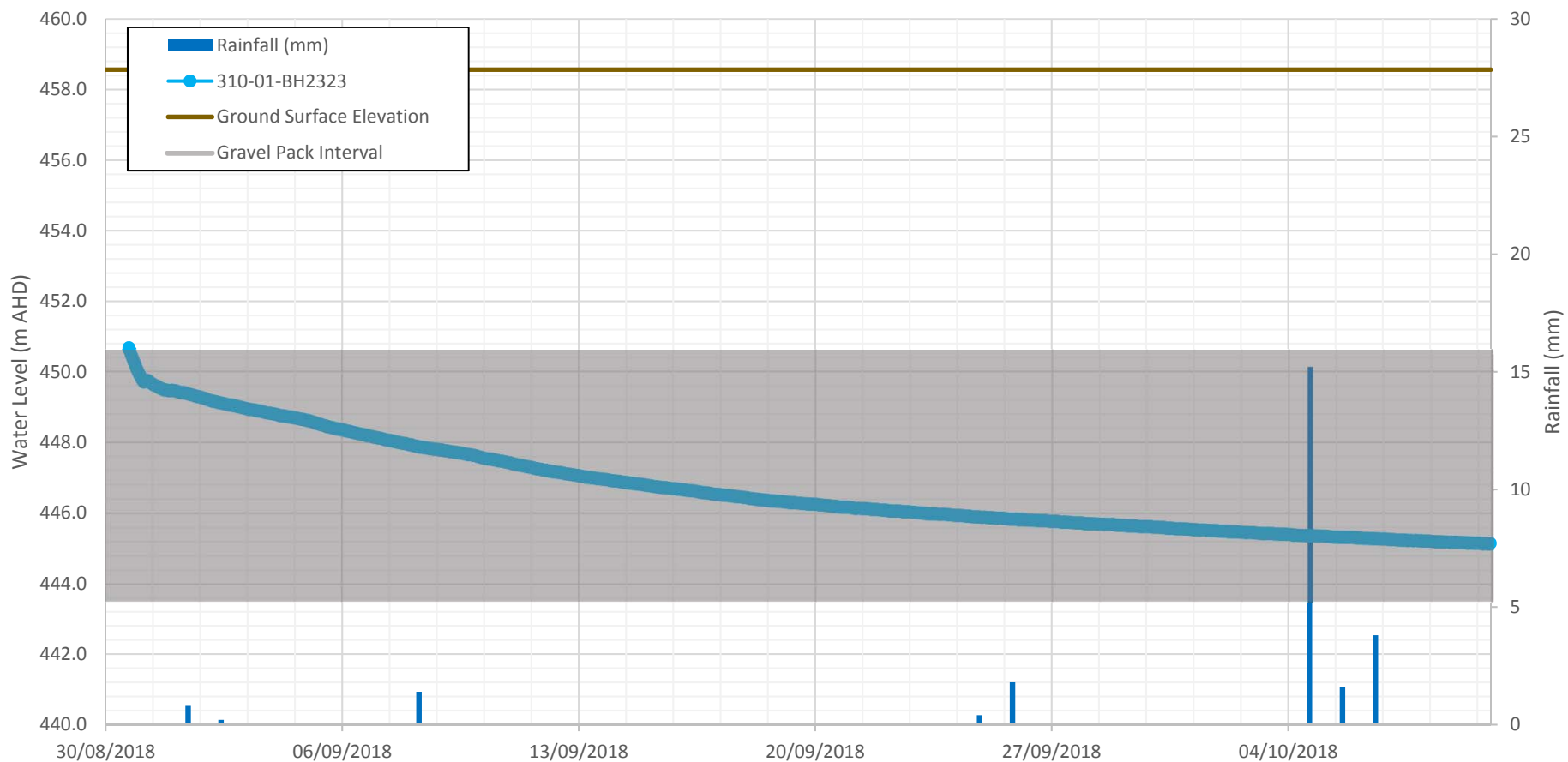
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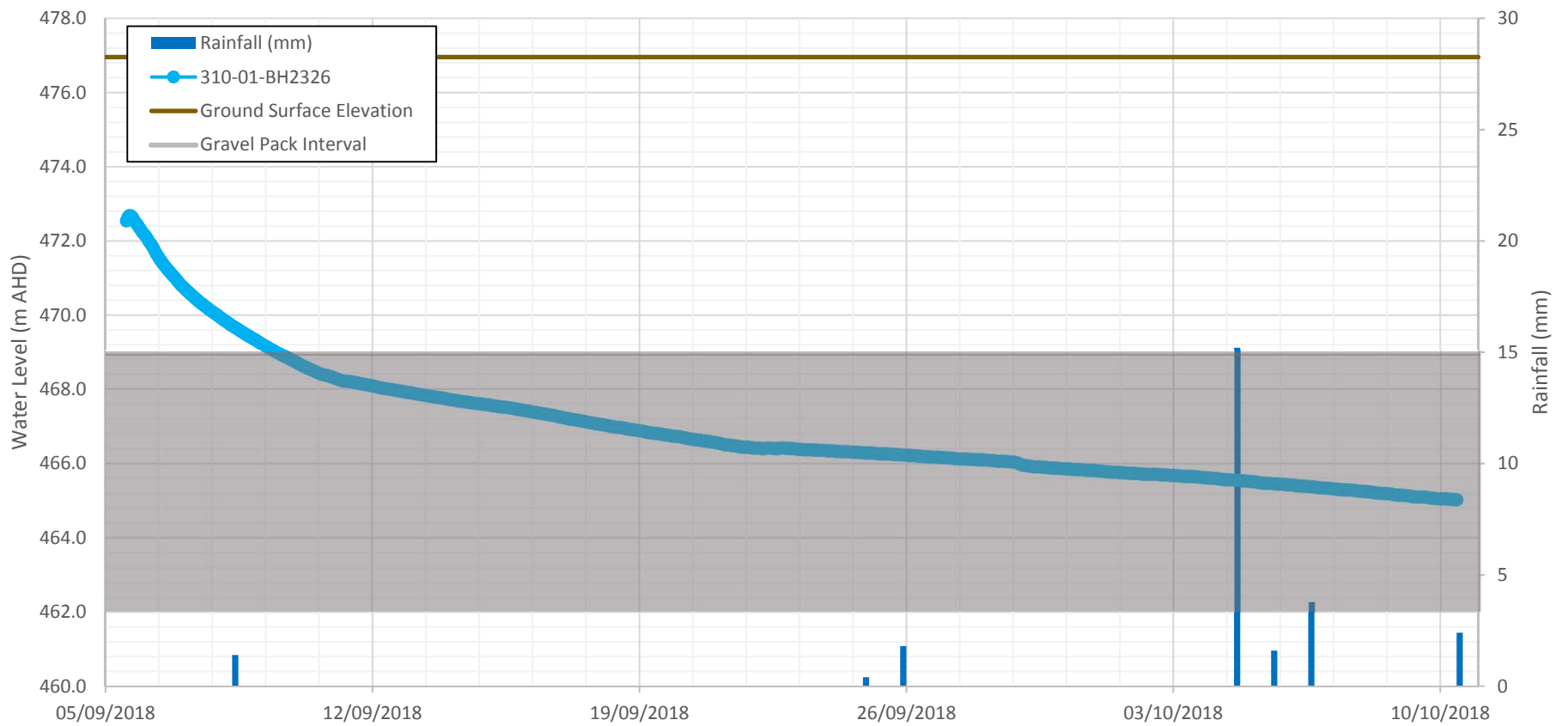
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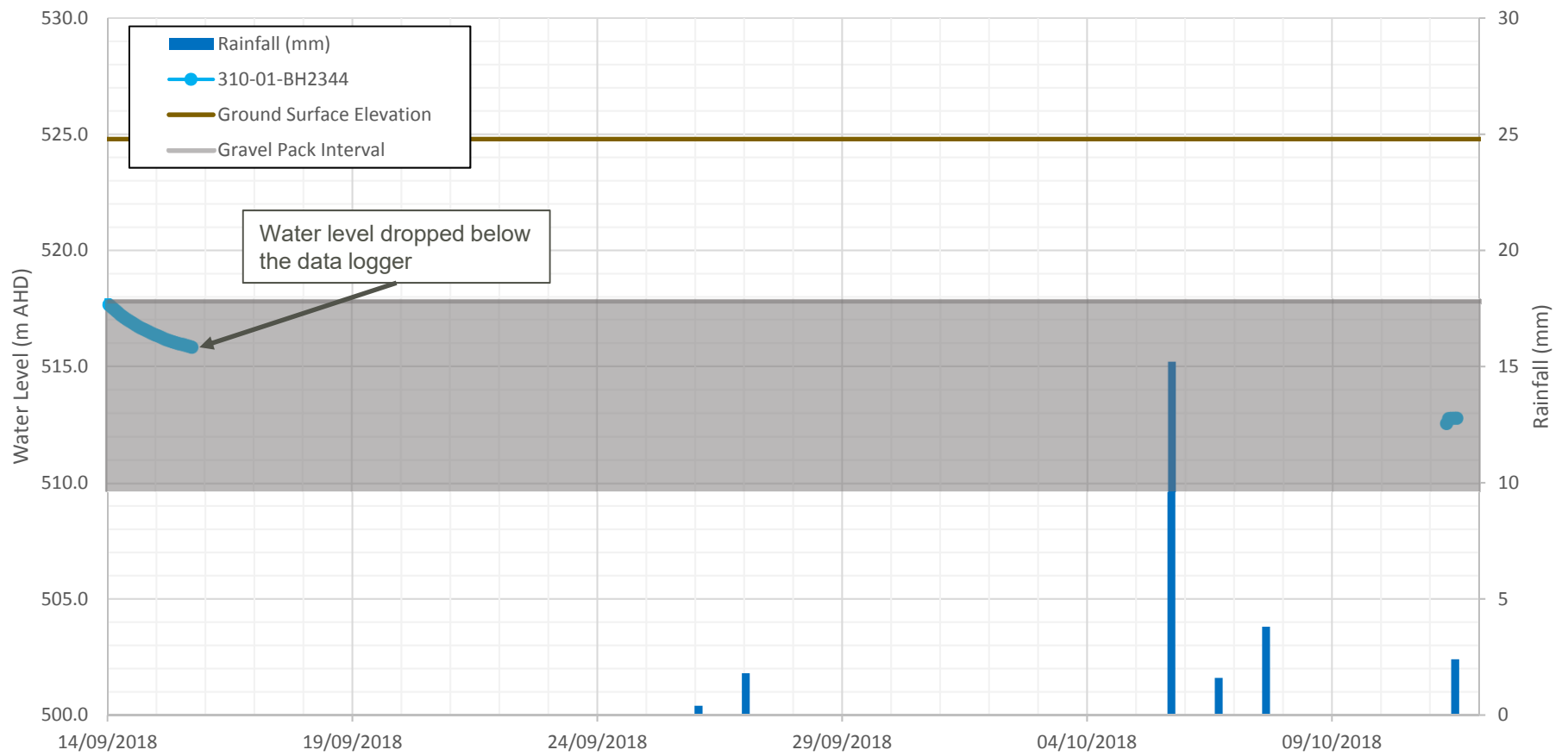
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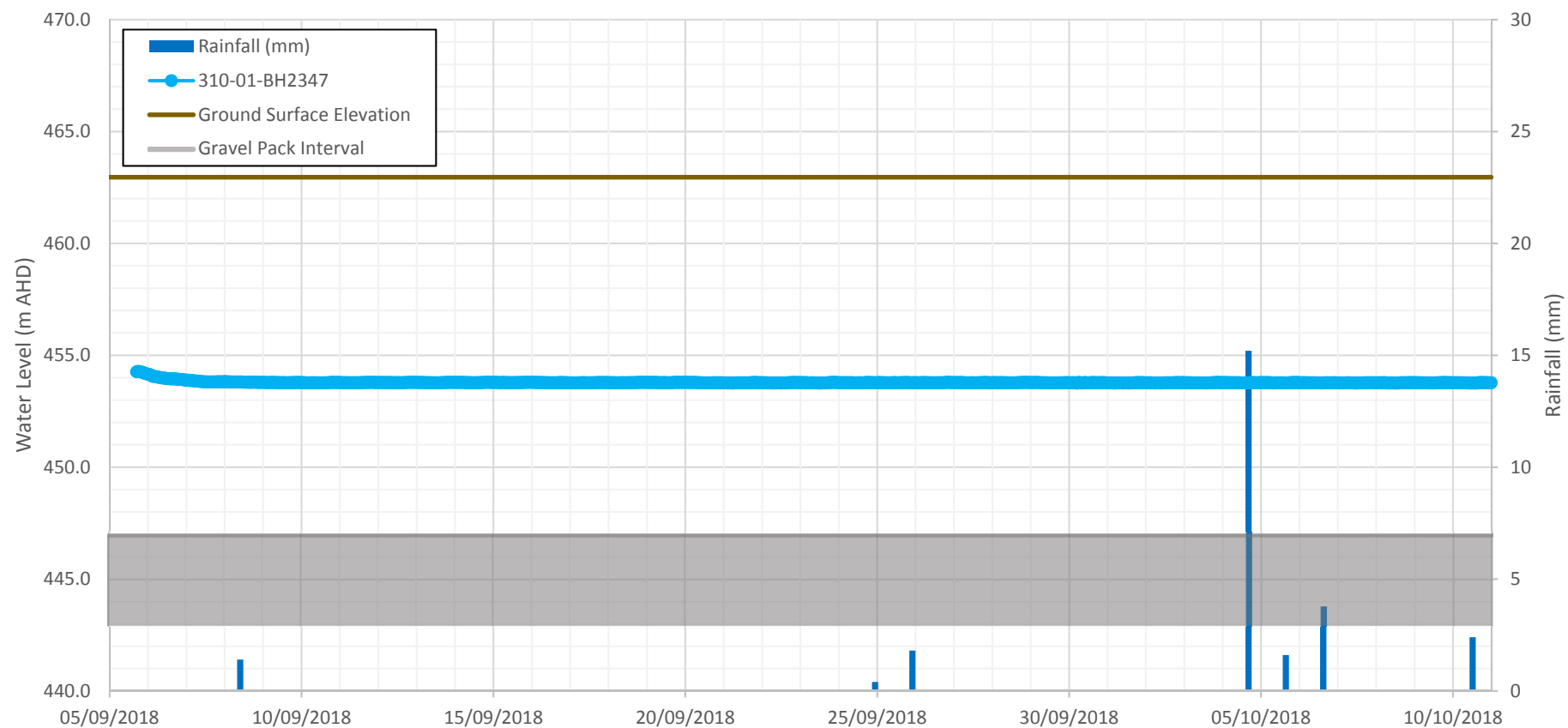
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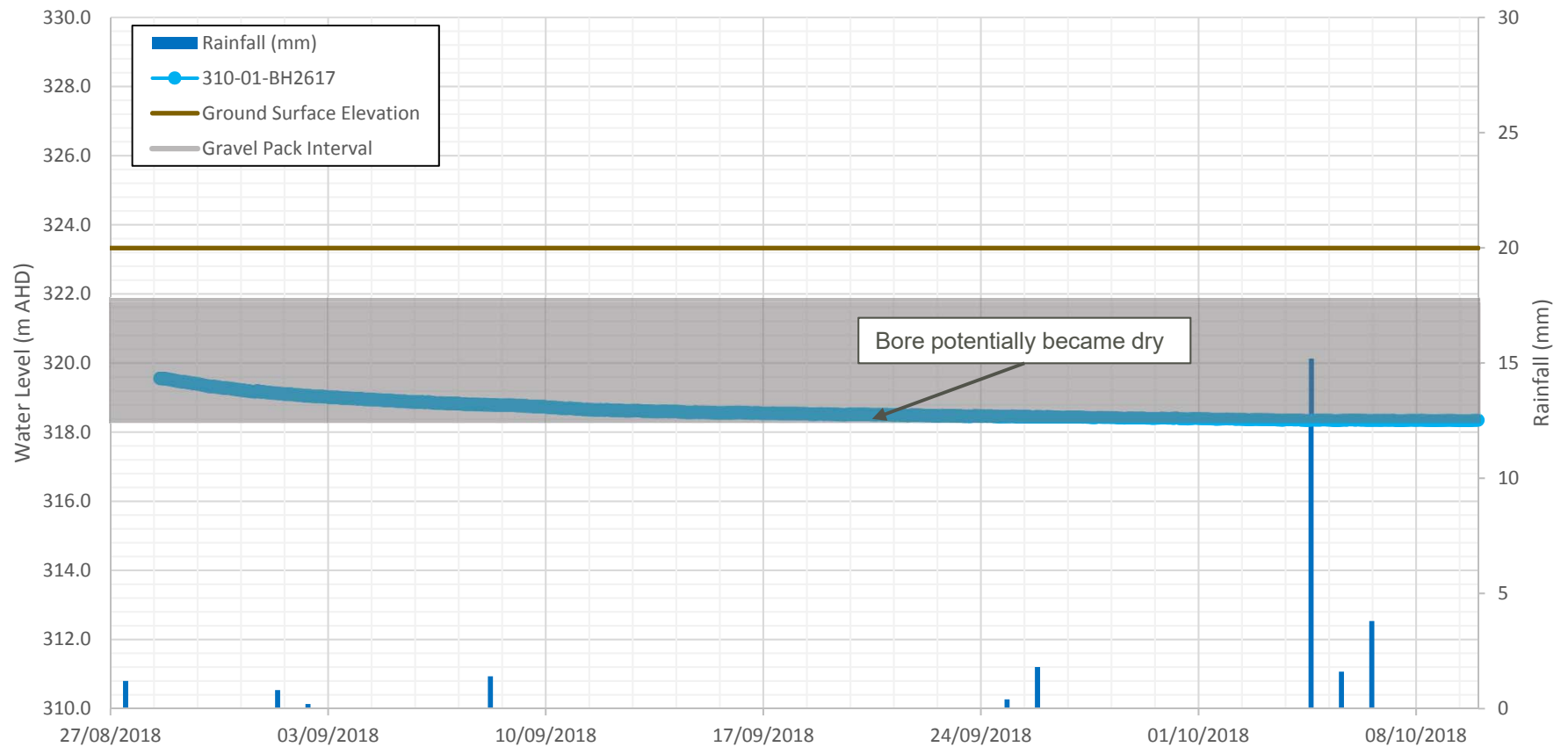
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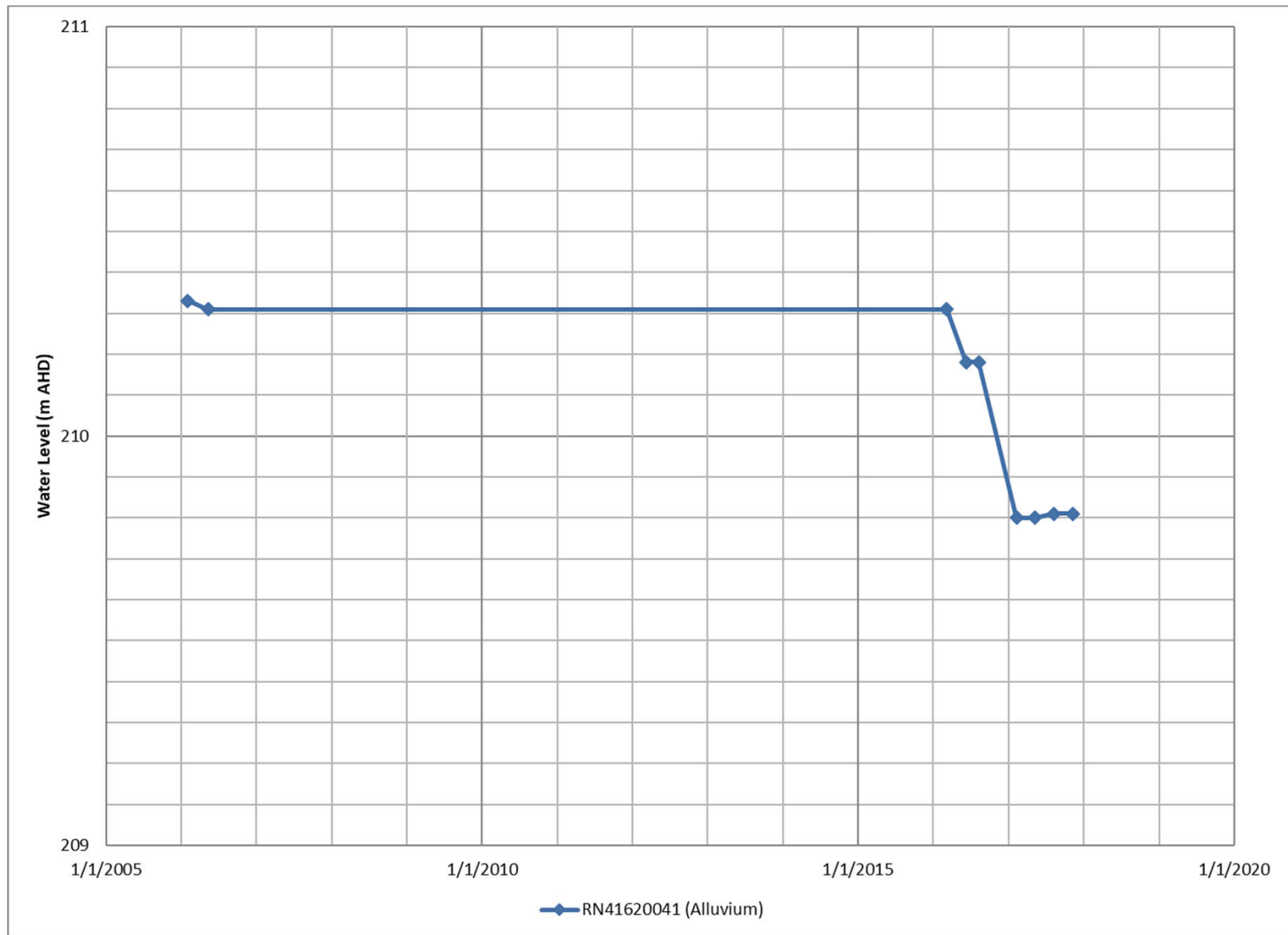
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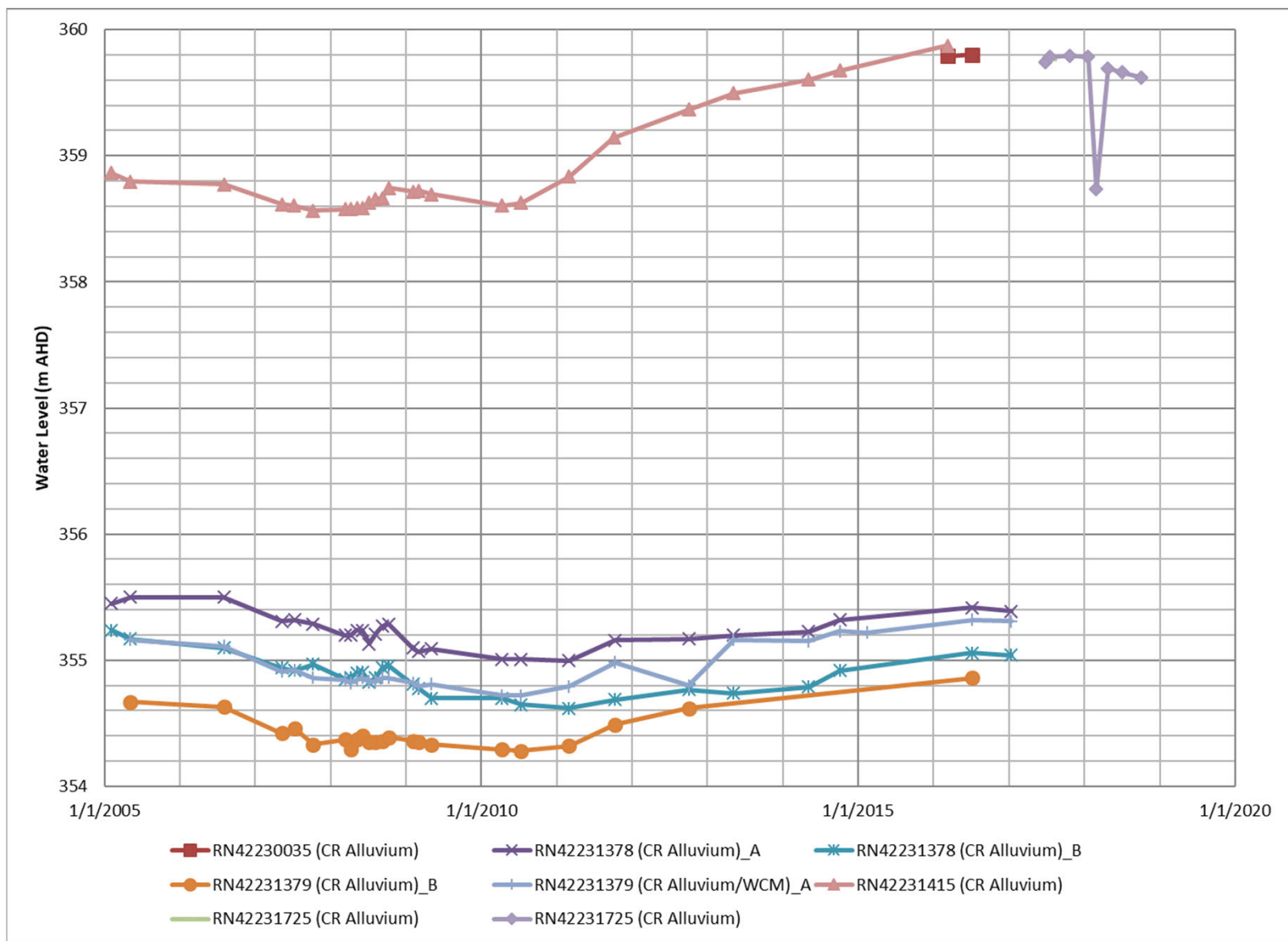
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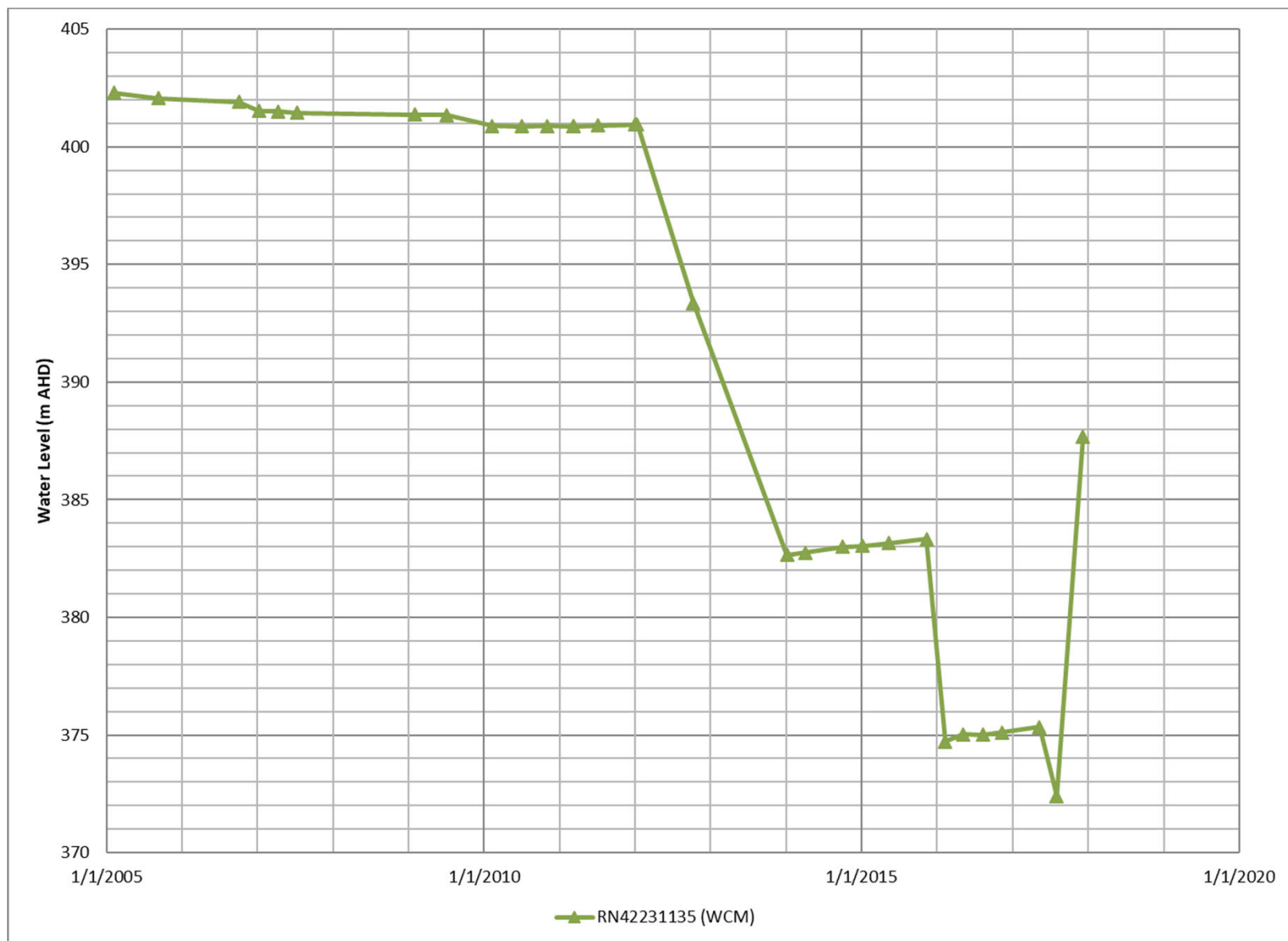
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CHECKED DB	DATE 26/11/18		
SCALE Not to Scale		PROJECT No 1897791	FIGURE No B1.17
		REV No 0	A4



CLIENT FFJV		PROJECT Inland Rail Border to Gowrie			
DRAWN SK	DATE 26/11/18	TITLE Registered bores installed within the Undifferentiated Alluvium			
CHECKED DB	DATE 26/11/18				
SCALE Not to Scale		PROJECT No 1897791	FIGURE No B1.18	REV No 0	A4



CLIENT FFJV		PROJECT Inland Rail Border to Gowrie		
DRAWN SK	DATE 26/11/18	TITLE Registered bores installed within the Comet River Alluvium		
CHECKED DB	DATE 26/11/18			
SCALE Not to Scale		PROJECT No 1897791	FIGURE No B1.19	REV No 0 A4



CLIENT FFJV		PROJECT Inland Rail Border to Gowrie		
DRAWN SK	DATE 26/11/18	TITLE Registered bores installed within the Walloon Coal Measures		
CHECKED DB	DATE 26/11/18			
SCALE Not to Scale		PROJECT No 1897791	FIGURE No B1.20	REV No 0 A4

Appendix C

Groundwater Level Summary

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

Groundwater Level Summary

Table C1: Groundwater levels statistics for Phase 2 Feasibility Design geotechnical investigation bores and registered groundwater bores (DNRME, 2018) within 500 m of the project alignment (post-2005)

Bore ID	Formation	Groundwater Level (m AHD)						
		Date From	Date To	Min	Max	Median	Mean	Count
310-01-BH2201	Pilliga Sandstone / Springbok Sandstone	9/12/2018	11/1/2018	248.3	248.7	248.6	248.6	1193
310-01-BH2203	Walloon Coal Measures	8/24/2018	10/9/2018	254.5	264.7	258.9	259.3	1110
310-01-BH2206	Walloon Coal Measures	8/22/2018	10/6/2018	263.4	263.5	263.5	263.5	1076
310-01-BH2210	Walloon Coal Measures	8/27/2018	10/31/2018	258.5	277.5	274.3	274.0	1561
310-01-BH2216	Walloon Coal Measures / Eurombah Formation	8/29/2018	10/31/2018	304.3	309.8	307.6	307.4	1512
310-01-BH2302	Walloon Coal Measures	8/24/2018	10/5/2018	Dry				1015
310-01-BH2304	Walloon Coal Measures	8/22/2018	10/5/2018	Dry				1055
310-01-BH2305	Walloon Coal Measures	8/25/2018	10/5/2018	Dry				991
310-01-BH2308	Walloon Coal Measures	8/28/2018	10/6/2018	287.6	295.3	288.3	289.1	938
310-01-BH2309	Walloon Coal Measures	8/25/2018	10/31/2018	262.8	268.6	266.1	265.9	1575
310-01-BH2311	Eurombah Formation	8/27/2018	10/6/2018	281.8	285.8	281.8	282.3	967
310-01-BH2323	Eurombah Formation	8/30/2018	10/10/2018	444.5	450.7	446.2	446.7	983
310-01-BH2326	Walloon Coal Measures	9/5/2018	10/11/2018	463.3	472.7	466.4	466.9	840

Bore ID	Formation	Groundwater Level (m AHD)						
		Date From	Date To	Min	Max	Median	Mean	Count
310-01-BH2344	Main Range Volcanics	9/13/2018	10/13/2018	512.6	518.5	516.5	516.4	60
310-01-BH2347	Main Range Volcanics	9/5/2018	10/11/2018	453.8	454.3	453.8	453.8	856
310-01-BH2617	Undifferentiated Alluvium	8/27/2018	10/10/2018	318.3	319.6	318.5	318.6	1049
310-01-BH2231	Tertiary Sediments	9/7/2018	10/30/2018	363.6	366.8	364.7	364.9	1271
310-01-BH2233	Alluvium / Tertiary Sediments	9/10/2018	10/30/2018	356.0	370.1	364.8	364.9	1195
310-01-BH2234	Alluvium / Tertiary Sediments	5/17/2018	11/2/2018	359.7	367.3	363.2	363.2	4051
310-01-BH2235	Tertiary Sediments / WCM	9/8/2018	10/29/2018	358.7	358.8	358.8	358.8	1218
310-01-BH2215	Walloon Coal Measures	NR	NR	NR	NR	NR	NR	NR
310-01-BH2214	Walloon Coal Measures	NR	NR	NR	NR	NR	NR	NR
RN41620041	Undifferentiated Alluvium	2/1/2006	11/8/2017	209.8	210.3	210.2	210.1	9
RN42230035	Condamine River Alluvium	7/7/2016	3/9/2016	359.8	359.8	359.8	359.8	2
RN42231135	Walloon Coal Measures	2/7/2005	5/9/2017	372.4	402.3	400.9	391.6	30
RN42231378A	Condamine River Alluvium	2/2/2005	1/11/2017	355.0	355.5	355.2	355.2	27
RN42231378B	Condamine River Alluvium	2/2/2005	1/11/2017	354.6	355.2	354.9	354.9	27
RN42231379A	Condamine River Alluvium	5/6/2005	1/11/2017	354.7	355.3	354.9	354.9	28
RN42231379B	Condamine River Alluvium	5/6/2005	7/7/2016	354.3	354.9	354.4	354.4	22

Bore ID	Formation	Groundwater Level (m AHD)						
		Date From	Date To	Min	Max	Median	Mean	Count
RN42231415	Condamine River Alluvium	2/2/2005	3/9/2016	358.6	359.9	358.7	358.9	26
RN42231725	Condamine River Alluvium	6/28/2017	10/3/2018	358.7	359.8	359.7	359.6	9

Note:

1 Surface elevations were used from LiDAR because survey data was not available at the time of reporting. Groundwater levels contain information available for the 70% Hydrogeological Design Report.

2 NR – information not available at the time of reporting

Appendix D

Groundwater Chemistry

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

APPENDIX D

Groundwater Chemistry

Unique Identifier ¹	Easting	Northing	Sample Date	Aquifer
11085	275246	6839928	14/02/1979	KUMBARILLA BEDS
11085	275246	6839928	15/11/1978	KUMBARILLA BEDS
11100	310291	6853853	06/03/1980	HUTTON SANDSTONE
11100	310291	6853853	22/11/1978	HUTTON SANDSTONE
11270	303076	6849931	04/07/1950	WALLOON COAL MEASURES
11288	272076	6837963	08/09/1981	KUMBARILLA BEDS
11395	305368	6851475	22/08/1978	MARBURG SUBGROUP
11395	305368	6851475	21/02/1978	MARBURG SUBGROUP
11880	302414	6851295	07/04/1953	WALLOON COAL MEASURES
11880	302414	6851295	22/02/1978	WALLOON COAL MEASURES
12022	277861	6840227	21/03/1980	KUMBARILLA BEDS
12095	276834	6836883	31/08/1979	TERTIARY
12132	265665	6833455	20/05/1987	<Null>
12225	267236	6832596	11/09/1953	KUMBARILLA BEDS
12225	267236	6832596	09/11/1954	KUMBARILLA BEDS
12225	267236	6832596	02/06/1987	KUMBARILLA BEDS
12226	269471	6833274	11/09/1953	KUMBARILLA BEDS
12524	281468	6842747	09/06/1993	KUMBARILLA BEDS
12553	284646	6836747	18/03/1987	KUMBARILLA BEDS
12649	263011	6833087	25/10/1990	KUMBARILLA BEDS
12649	263011	6833087	20/09/1978	KUMBARILLA BEDS
12649	263011	6833087	23/09/1997	KUMBARILLA BEDS
12864	272881	6831773	20/07/1991	KUMBARILLA BEDS
12864	272881	6831773	20/07/1991	KUMBARILLA BEDS
12864	272881	6831773	18/02/1955	KUMBARILLA BEDS
12864	272881	6831773	26/03/1956	KUMBARILLA BEDS
13196	286434	6843194	22/05/1956	KUMBARILLA BEDS
13300	257000	6830919	30/08/1989	KUMBARILLA BEDS
13300	257000	6830919	19/03/1987	KUMBARILLA BEDS
13300	257000	6830919	02/04/1973	KUMBARILLA BEDS
13963	284205	6843478	09/06/1993	KUMBARILLA BEDS
13989	263488	6830355	23/10/1990	KUMBARILLA BEDS
13989	263488	6830355	20/12/1978	KUMBARILLA BEDS
14379	316519	6865797	22/11/1978	WALLOON
15077	347220	6929105	23/09/1982	CONDAMINE RIVER ALLUVIUM
15208	346984	6928704	24/02/1967	CONDAMINE RIVER ALLUVIUM
15493	347386	6925302	02/08/1963	CONDAMINE RIVER ALLUVIUM
15592	253756	6832329	20/12/1990	KUMBARILLA BEDS
15592	253756	6832329	02/04/1985	KUMBARILLA BEDS
15592	253756	6832329	03/12/1997	KUMBARILLA BEDS
15624	250571	6833373	19/12/1990	KUMBARILLA BEDS
15624	250571	6833373	05/02/1992	KUMBARILLA BEDS
15624	250571	6833373	07/03/1985	KUMBARILLA BEDS
15624	250571	6833373	24/09/1997	KUMBARILLA BEDS
15624	250571	6833373	02/12/1972	KUMBARILLA BEDS
15624	250571	6833373	14/01/1970	KUMBARILLA BEDS
15763	357235	6937083	17/08/1964	WALLOON COAL MEASURES
15767	343329	6922667	10/06/1964	CONDAMINE RIVER ALLUVIUM
16200	319180	6861169	28/04/1978	CANNING CREEK ALLUVIUM
16250	342436	6926196	14/05/1965	CONDAMINE RIVER ALLUVIUM
16254	320321	6868215	01/09/1999	WALLOON
16254	320321	6868215	05/11/1997	WALLOON
16263	278662	6834112	12/07/1965	TERTIARY
16263	278662	6834112	18/03/1987	TERTIARY
16664	374017	6946917	08/02/1966	MAIN RANGE VOLCANICS
16672	378221	6947880	21/04/1966	MAIN RANGE VOLCANICS
16732	379927	6946479	13/04/1966	MAIN RANGE VOLCANICS
16778	367120	6934309	21/01/1966	MAIN RANGE VOLCANICS
16778	367120	6934309	28/02/1966	MAIN RANGE VOLCANICS
16983	383600	6962782	15/09/1966	MAIN RANGE VOLCANICS
16997	372554	6935937	21/09/1966	MAIN RANGE VOLCANICS
16997	372554	6935937	19/10/1966	MAIN RANGE VOLCANICS
17006	328143	6904787	20/08/1966	MARBURG SUBGROUP
17090	385309	6960691	19/06/1967	MAIN RANGE VOLCANICS
17090	385309	6960691	14/05/1969	MAIN RANGE VOLCANICS
17090	385309	6960691	04/11/1991	MAIN RANGE VOLCANICS
17111	388377	6953053	12/01/1967	MAIN RANGE VOLCANICS
17207	369659	6932496	10/03/1967	MAIN RANGE VOLCANICS
17207	369659	6932496	10/03/1967	MAIN RANGE VOLCANICS
17290	386448	6960307	08/03/1967	WALLOON COAL MEASURES
17290	386448	6960307	09/03/1967	WALLOON COAL MEASURES

Unique Identifier ¹	Easting	Northing	Sample Date	Aquifer
17291	369673	6933338	11/08/1967	MAIN RANGE VOLCANICS
17341	376118	6956076	22/06/1967	MAIN RANGE VOLCANICS
17353	369002	6933641	17/02/1967	MAIN RANGE VOLCANICS
17384	322591	6900278	16/05/1967	WALLOON COAL MEASURES
17393	378510	6956996	20/04/1967	MAIN RANGE VOLCANICS
17393	378510	6956996	25/07/1967	MAIN RANGE VOLCANICS
17393	378510	6956996	03/08/1967	MAIN RANGE VOLCANICS
17393	378510	6956996	08/08/1967	MAIN RANGE VOLCANICS
17393	378510	6956996	21/09/1967	MAIN RANGE VOLCANICS
17393	378510	6956996	22/09/1967	MAIN RANGE VOLCANICS
17403	378642	6956488	04/08/1967	MAIN RANGE VOLCANICS
17403	378642	6956488	04/08/1967	MAIN RANGE VOLCANICS
17403	378642	6956488	07/08/1967	MAIN RANGE VOLCANICS
17403	378642	6956488	21/08/1967	MAIN RANGE VOLCANICS
17403	378642	6956488	21/08/1967	MAIN RANGE VOLCANICS
17403	378642	6956488	23/08/1967	MAIN RANGE VOLCANICS
17459	361216	6931315	31/08/1967	MAIN RANGE VOLCANICS
17459	361216	6931315	10/07/1979	MAIN RANGE VOLCANICS
17488	381570	6955190	05/08/1968	MAIN RANGE VOLCANICS
17627	379610	6955912	31/08/1967	MAIN RANGE VOLCANICS
17627	379610	6955912	31/08/1967	MAIN RANGE VOLCANICS
17896	380106	6959872	22/09/1968	MAIN RANGE VOLCANICS
17953	363274	6928689	19/04/1968	MAIN RANGE VOLCANICS
18018	381311	6945378	21/04/1968	MAIN RANGE VOLCANICS
18071	383004	6960324	02/08/1968	MAIN RANGE VOLCANICS
18087	352642	6926478	28/02/1968	CONDAMINE RIVER ALLUVIUM
18127	376914	6946292	10/03/1970	MAIN RANGE VOLCANICS
18164	384142	6962977	07/02/1969	MAIN RANGE VOLCANICS
18164	384142	6962977	11/07/1969	MAIN RANGE VOLCANICS
18170	370682	6943791	08/10/1968	MAIN RANGE VOLCANICS
18174	384151	6963259	18/10/1965	MAIN RANGE VOLCANICS
18209	378314	6957364	05/02/1969	MAIN RANGE VOLCANICS
18209	378314	6957364	05/02/1969	MAIN RANGE VOLCANICS
18209	378314	6957364	06/02/1969	MAIN RANGE VOLCANICS
18210	378062	6957854	10/02/1969	MAIN RANGE VOLCANICS
18210	378062	6957854	13/02/1969	MAIN RANGE VOLCANICS
18211	378716	6956664	18/10/1967	MAIN RANGE VOLCANICS
18211	378716	6956664	06/12/1967	MAIN RANGE VOLCANICS
18211	378716	6956664	17/01/1968	MAIN RANGE VOLCANICS
18211	378716	6956664	17/01/1968	MAIN RANGE VOLCANICS
18287	384639	6954081	13/10/1970	MAIN RANGE VOLCANICS
18294	350328	6926574	01/04/1967	CONDAMINE RIVER ALLUVIUM
18294	350328	6926574	04/04/1967	CONDAMINE RIVER ALLUVIUM
18294	350328	6926574	11/04/1967	CONDAMINE RIVER ALLUVIUM
18294	350328	6926574	11/04/1967	CONDAMINE RIVER ALLUVIUM
18294	350328	6926574	12/03/1983	CONDAMINE RIVER ALLUVIUM
18304	383074	6955004	02/02/1965	MAIN RANGE VOLCANICS
18367	377927	6942139	21/09/1972	MAIN RANGE VOLCANICS
18379	342117	6927574	24/03/1983	CONDAMINE RIVER ALLUVIUM
18436	342544	6918460	12/03/1983	CONDAMINE RIVER ALLUVIUM
19102	387387	6962645	06/05/1965	MAIN RANGE VOLCANICS
19205	385558	6961435	28/05/1965	GOWRIE CREEK ALLUVIUM
19246	374501	6951341	05/12/1963	MAIN RANGE VOLCANICS
19271	384481	6962470	26/05/1965	MAIN RANGE VOLCANICS
19271	384481	6962470	21/01/1970	MAIN RANGE VOLCANICS
19271	384481	6962470	21/01/1970	MAIN RANGE VOLCANICS
19271	384481	6962470	20/08/1986	MAIN RANGE VOLCANICS
19281	384599	6960720	04/06/1965	MAIN RANGE VOLCANICS
19320	384075	6963196	22/06/1965	MAIN RANGE VOLCANICS
19321	383516	6962884	25/06/1975	MAIN RANGE VOLCANICS
19352	384648	6963338	05/08/1969	MAIN RANGE VOLCANICS
19367	374809	6939476	22/03/1965	MAIN RANGE VOLCANICS
19467	380268	6954482	04/09/1970	WESTBROOK CREEK ALLUVIUM
19467	380268	6954482	05/02/1965	WESTBROOK CREEK ALLUVIUM
19467	380268	6954482	07/07/1965	WESTBROOK CREEK ALLUVIUM
19648	383390	6948857	22/11/1963	MARBURG SUBGROUP
19923	387225	6959554	16/12/1965	MARBURG SUBGROUP
24115	345416	6928359	17/04/1962	CONDAMINE RIVER ALLUVIUM
26111	378192	6956076	04/09/1962	MAIN RANGE VOLCANICS
26111	378192	6956076	20/03/1963	MAIN RANGE VOLCANICS
26111	378192	6956076	14/04/1965	MAIN RANGE VOLCANICS

Unique Identifier ¹	Easting	Northing	Sample Date	Aquifer
30052	378887	6952048	05/09/1975	WALLOON COAL MEASURES
30052	378887	6952048	01/06/1975	WALLOON COAL MEASURES
30127	363302	6932789	01/05/1968	MAIN RANGE VOLCANICS
30133	355197	6926906	03/04/1968	WALLOON COAL MEASURES
30192	380062	6952028	05/09/1975	WALLOON COAL MEASURES
30192	380062	6952028	21/03/1968	WALLOON COAL MEASURES
30192	380062	6952028	22/03/1968	WALLOON COAL MEASURES
30192	380062	6952028	08/10/1971	WALLOON COAL MEASURES
30192	380062	6952028	01/06/1975	WALLOON COAL MEASURES
30335	362849	6928913	21/06/1968	MAIN RANGE VOLCANICS
30480	343943	6930697	11/12/1974	CONDAMINE RIVER ALLUVIUM
30480	343943	6930697	12/12/1974	CONDAMINE RIVER ALLUVIUM
30588	380798	6942354	07/07/1972	MAIN RANGE VOLCANICS
30588	380798	6942354	21/07/1972	MAIN RANGE VOLCANICS
30781	381156	6946882	07/10/1980	MAIN RANGE VOLCANICS
31245	380393	6961950	18/05/1993	WALLOON COAL MEASURES
31504	345561	6924157	22/11/1982	CONDAMINE RIVER ALLUVIUM
31504	345561	6924157	07/12/1988	CONDAMINE RIVER ALLUVIUM
31523	381573	6962821	08/03/1966	MARBURG SUBGROUP
31797	379788	6960525	27/02/1989	MAIN RANGE VOLCANICS
31820	378930	6960164	27/02/1989	GOWRIE CREEK ALLUVIUM
31864	376709	6956567	11/09/1969	MAIN RANGE VOLCANICS
31864	376709	6956567	15/09/1969	MAIN RANGE VOLCANICS
31864	376709	6956567	17/09/1969	MAIN RANGE VOLCANICS
31864	376709	6956567	18/09/1969	MAIN RANGE VOLCANICS
31864	376709	6956567	27/02/1989	MAIN RANGE VOLCANICS
31938	386021	6958818	10/06/1970	MAIN RANGE VOLCANICS
32163	360800	6933647	22/04/1969	MAIN RANGE VOLCANICS
32270	378406	6957617	20/07/1971	MAIN RANGE VOLCANICS
32270	378406	6957617	20/07/1971	MAIN RANGE VOLCANICS
32271	378517	6958366	20/08/1970	MAIN RANGE VOLCANICS
32271	378517	6958366	21/08/1970	MAIN RANGE VOLCANICS
32290	378272	6952012	21/04/1966	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	21/04/1966	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32290	378272	6952012	10/04/1973	FOUR MILE CREEK ALLUVIUM
32471	383347	6948775	28/09/1994	MAIN RANGE VOLCANICS
32471	383347	6948775	27/11/1969	MAIN RANGE VOLCANICS
32787	389865	6954356	01/08/1969	MAIN RANGE VOLCANICS
32944	356726	6936847	27/08/1969	WALLOON COAL MEASURES
32944	356726	6936847	01/06/1982	WALLOON COAL MEASURES
33219	342811	6927370	01/11/1969	CONDAMINE RIVER ALLUVIUM
33219	342811	6927370	04/11/1969	CONDAMINE RIVER ALLUVIUM
33219	342811	6927370	07/01/1970	CONDAMINE RIVER ALLUVIUM
33219	342811	6927370	24/03/1983	CONDAMINE RIVER ALLUVIUM
33232	345747	6925438	21/07/1970	CONDAMINE RIVER ALLUVIUM
33232	345747	6925438	29/06/1982	CONDAMINE RIVER ALLUVIUM
33232	345747	6925438	20/02/1986	CONDAMINE RIVER ALLUVIUM
33232	345747	6925438	07/12/1988	CONDAMINE RIVER ALLUVIUM
33293	366661	6933658	26/09/1969	MAIN RANGE VOLCANICS
33523	366550	6933780	02/08/1966	MAIN RANGE VOLCANICS
33523	366550	6933780	24/09/1968	MAIN RANGE VOLCANICS
33523	366550	6933780	29/09/1969	MAIN RANGE VOLCANICS
33523	366550	6933780	30/09/1969	MAIN RANGE VOLCANICS
33663	340387	6925161	29/04/1971	CONDAMINE RIVER ALLUVIUM
33663	340387	6925161	22/11/1982	CONDAMINE RIVER ALLUVIUM
33663	340387	6925161	07/12/1988	CONDAMINE RIVER ALLUVIUM
33794	349164	6926912	11/08/1970	CONDAMINE RIVER ALLUVIUM
34000	285123	6843553	16/12/1975	KUMBARILLA BEDS
34646	340429	6925630	24/04/1971	CONDAMINE RIVER ALLUVIUM
34646	340429	6925630	22/11/1982	CONDAMINE RIVER ALLUVIUM
34646	340429	6925630	07/12/1988	CONDAMINE RIVER ALLUVIUM
34671	341012	6923386	14/07/1970	CONDAMINE RIVER ALLUVIUM
34729	388647	6957389	24/01/1970	MAIN RANGE VOLCANICS
34769	385776	6952444	01/03/1970	MAIN RANGE VOLCANICS
34769	385776	6952444	01/03/1970	MAIN RANGE VOLCANICS
34849	368122	6939971	10/10/1990	MAIN RANGE VOLCANICS

Unique Identifier ¹	Easting	Northing	Sample Date	Aquifer
34866	346297	6928658	28/08/1979	CONDAMINE RIVER ALLUVIUM
34866	346297	6928658	08/12/1988	CONDAMINE RIVER ALLUVIUM
34970	371848	6942060	12/03/1970	MAIN RANGE VOLCANICS
35001	346489	6924942	09/05/1972	CONDAMINE RIVER ALLUVIUM
35001	346489	6924942	09/05/1972	CONDAMINE RIVER ALLUVIUM
35001	346489	6924942	12/03/1983	CONDAMINE RIVER ALLUVIUM
35001	346489	6924942	07/12/1988	CONDAMINE RIVER ALLUVIUM
35029	345966	6924512	22/11/1982	CONDAMINE RIVER ALLUVIUM
35029	345966	6924512	07/12/1988	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	18/05/1971	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	18/05/1971	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	18/05/1971	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	16/03/1972	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	28/08/1979	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	07/05/1981	CONDAMINE RIVER ALLUVIUM
35030	347892	6934114	05/01/1984	CONDAMINE RIVER ALLUVIUM
35241	380259	6954643	27/08/1970	MAIN RANGE VOLCANICS
35413	378736	6945162	07/07/1970	MAIN RANGE VOLCANICS
35601	382123	6949435	05/09/1975	WALLOON COAL MEASURES
35601	382123	6949435	05/07/1973	WALLOON COAL MEASURES
35601	382123	6949435	01/06/1975	WALLOON COAL MEASURES
35851	379460	6960355	27/02/1989	GOWRIE CREEK ALLUVIUM
35898	379768	6960200	01/03/1973	MAIN RANGE VOLCANICS
35926	379415	6954328	22/11/1971	MAIN RANGE VOLCANICS
35926	379415	6954328	22/11/1971	MAIN RANGE VOLCANICS
36232	380127	6954828	25/05/1971	MAIN RANGE VOLCANICS
36316	345968	6921548	21/07/1979	CONDAMINE RIVER ALLUVIUM
36356	383328	6955126	25/02/1971	MAIN RANGE VOLCANICS
36356	383328	6955126	16/04/1974	MAIN RANGE VOLCANICS
36356	383328	6955126	18/08/1980	MAIN RANGE VOLCANICS
36356	383328	6955126	22/08/1980	MAIN RANGE VOLCANICS
36434	379188	6955988	07/04/1971	MAIN RANGE VOLCANICS
36446	377355	6948062	24/06/1971	MAIN RANGE VOLCANICS
36605	380303	6942205	06/02/1971	MAIN RANGE VOLCANICS
36605	380303	6942205	06/02/1971	MAIN RANGE VOLCANICS
37002	377537	6956708	21/03/1972	MAIN RANGE VOLCANICS
37026	378834	6955102	24/07/1972	MAIN RANGE VOLCANICS
37148	387105	6954599	02/08/1971	MAIN RANGE VOLCANICS
37205	383581	6960268	03/09/1971	MAIN RANGE VOLCANICS
37306	386853	6961707	01/11/1971	MARBURG SUBGROUP
37306	386853	6961707	01/11/1971	MARBURG SUBGROUP
37306	386853	6961707	06/01/1972	MARBURG SUBGROUP
37306	386853	6961707	30/11/1989	MARBURG SUBGROUP
37311	378620	6943435	12/01/1973	MAIN RANGE VOLCANICS
37485	387699	6954463	08/02/1972	MAIN RANGE VOLCANICS
37485	387699	6954463	10/02/1972	MAIN RANGE VOLCANICS
37622	387378	6954519	27/02/1972	MAIN RANGE VOLCANICS
37631	383379	6954960	16/04/1974	MAIN RANGE VOLCANICS
37637	386517	6952624	16/02/1972	MAIN RANGE VOLCANICS
37830	388969	6958855	21/03/1991	MAIN RANGE VOLCANICS
38215	367648	6940392	30/05/1972	MAIN RANGE VOLCANICS
38290	360229	6929471	18/07/1972	WALLOON COAL MEASURES
38358	380311	6952235	05/10/1972	MAIN RANGE VOLCANICS
38358	380311	6952235	01/06/1975	MAIN RANGE VOLCANICS
38358	380311	6952235	05/09/1975	MAIN RANGE VOLCANICS
38444	380157	6948079	22/08/1972	MAIN RANGE VOLCANICS
38460	388694	6953305	11/05/1975	WALLOON COAL MEASURES
38797	380677	6950474	05/07/1973	WESTBROOK CREEK ALLUVIUM
38797	380677	6950474	01/06/1975	WESTBROOK CREEK ALLUVIUM
38798	382036	6950786	05/09/1975	WALLOON COAL MEASURES
38798	382036	6950786	05/07/1973	WALLOON COAL MEASURES
38798	382036	6950786	01/06/1975	WALLOON COAL MEASURES
43148	266307	6831920	13/01/1982	KUMBARILLA BEDS
43642	356536	6937401	07/08/1973	WALLOON COAL MEASURES
43642	356536	6937401	06/04/1984	WALLOON COAL MEASURES
43843	342120	6917980	22/05/1979	CONDAMINE RIVER ALLUVIUM
44460	375936	6946206	21/11/1973	MAIN RANGE VOLCANICS
48011	331582	6905717	12/03/1974	WALLOON COAL MEASURES
48011	331582	6905717	22/05/1979	WALLOON COAL MEASURES
48013	331863	6914217	18/09/1974	WALLOON COAL MEASURES
48013	331863	6914217	22/05/1979	WALLOON COAL MEASURES

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48060	323260	6899934	07/11/1974	MARBURG SUBGROUP
48060	323260	6899934	07/11/1974	MARBURG SUBGROUP
48060	323260	6899934	10/07/1974	MARBURG SUBGROUP
48060	323260	6899934	10/07/1974	MARBURG SUBGROUP
48060	323260	6899934	07/11/1974	MARBURG SUBGROUP
48060	323260	6899934	07/11/1974	MARBURG SUBGROUP
48062	343845	6931707	19/06/1974	CONDAMINE RIVER ALLUVIUM
48066	386297	6956906	18/02/1975	MAIN RANGE VOLCANICS
48071	359917	6930015	13/06/1974	MARBURG SUBGROUP
48071	359917	6930015	13/06/1974	MARBURG SUBGROUP
48071	359917	6930015	29/11/1974	MARBURG SUBGROUP
48071	359917	6930015	29/11/1974	MARBURG SUBGROUP
48082	389863	6957331	28/05/1975	MAIN RANGE VOLCANICS
48088	383601	6950420	26/09/1974	WALLOON COAL MEASURES
48136	347265	6928173	22/09/1974	CONDAMINE RIVER ALLUVIUM
48175	381312	6945217	26/11/1974	MAIN RANGE VOLCANICS
48179	376188	6956646	13/08/1969	MAIN RANGE VOLCANICS
48192	382887	6960701	10/01/1975	MAIN RANGE VOLCANICS
48192	382887	6960701	10/01/1975	MAIN RANGE VOLCANICS
48192	382887	6960701	10/01/1975	MAIN RANGE VOLCANICS
48205	387970	6958757	29/03/1975	MAIN RANGE VOLCANICS
48213	389263	6953218	08/03/1977	MAIN RANGE VOLCANICS
48253	390691	6955887	21/07/1975	MAIN RANGE VOLCANICS
48309	344434	6929858	16/06/1977	CONDAMINE RIVER ALLUVIUM
48309	344434	6929858	21/06/1977	CONDAMINE RIVER ALLUVIUM
48309	344434	6929858	23/06/1977	CONDAMINE RIVER ALLUVIUM
48309	344434	6929858	24/06/1977	CONDAMINE RIVER ALLUVIUM
48309	344434	6929858	29/06/1977	CONDAMINE RIVER ALLUVIUM
48323	368416	6932889	16/02/1976	MAIN RANGE VOLCANICS
48325	388983	6958050	12/09/1980	Oakey Creek Alluvium
48325	388983	6958050	13/09/1980	Oakey Creek Alluvium
48378	390610	6953815	10/12/1975	MAIN RANGE VOLCANICS
48388	392110	6959548	27/01/1976	MAIN RANGE VOLCANICS
48461	390800	6954087	26/08/1974	MAIN RANGE VOLCANICS
48461	390800	6954087	18/02/1976	MAIN RANGE VOLCANICS
48478	380894	6946482	09/03/1976	MAIN RANGE VOLCANICS
48490	388722	6959031	24/03/1976	MAIN RANGE VOLCANICS
48491	388669	6959146	23/03/1976	MAIN RANGE VOLCANICS
48492	377611	6946549	03/12/1976	MAIN RANGE VOLCANICS
48505	390958	6960146	30/11/1976	MARBURG SUBGROUP
48514	372112	6937813	05/05/1976	MAIN RANGE VOLCANICS
48514	372112	6937813	05/05/1976	MAIN RANGE VOLCANICS
48544	381493	6946205	30/06/1976	MAIN RANGE VOLCANICS
48546	345688	6922835	07/09/1976	CONDAMINE RIVER ALLUVIUM
48590	343139	6931364	01/02/1989	CONDAMINE RIVER ALLUVIUM
48594	388848	6957841	11/04/1977	MAIN RANGE VOLCANICS
48594	388848	6957841	12/09/1980	MAIN RANGE VOLCANICS
48594	388848	6957841	13/09/1980	MAIN RANGE VOLCANICS
48761	289929	6839934	16/10/1974	MACINTYRE BROOK ALLUVIUM
48791	307482	6857223	11/02/1975	HUTTON SANDSTONE
48791	307482	6857223	13/09/1978	HUTTON SANDSTONE
48791	307482	6857223	17/02/2011	HUTTON SANDSTONE
52128	314582	6859306	06/02/1976	CANNING CREEK ALLUVIUM
52208	276319	6831016	12/11/1976	MACINTYRE RIVER ALLUVIUM
52510	379087	6945483	06/05/1980	MAIN RANGE VOLCANICS
52510	379087	6945483	07/05/1980	MAIN RANGE VOLCANICS
52514	386210	6955696	13/01/1977	MAIN RANGE VOLCANICS
52514	386210	6955696	13/01/1977	MAIN RANGE VOLCANICS
52517	390742	6953983	21/01/1976	MAIN RANGE VOLCANICS
52517	390742	6953983	06/10/1976	MAIN RANGE VOLCANICS
52673	384489	6958977	27/02/1978	MAIN RANGE VOLCANICS
52715	383665	6960053	06/08/1976	MAIN RANGE VOLCANICS
52719	383613	6955130	02/11/1977	MAIN RANGE VOLCANICS
52772	373293	6937904	30/11/1982	MAIN RANGE VOLCANICS
52782	389022	6954168	05/11/1976	MAIN RANGE VOLCANICS
52816	390659	6958751	09/02/1978	MARBURG SUBGROUP
52846	375874	6939720	30/10/1977	MAIN RANGE VOLCANICS
52865	358312	6937972	14/07/1961	WALLOON COAL MEASURES
52886	383390	6960143	01/11/1981	MAIN RANGE VOLCANICS
52886	383390	6960143	01/11/1981	MAIN RANGE VOLCANICS
52970	381872	6944623	13/08/1980	MAIN RANGE VOLCANICS

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52970	381872	6944623	14/08/1980	MAIN RANGE VOLCANICS
52975	347387	6922160	29/01/1982	CONDAMINE RIVER ALLUVIUM
52975	347387	6922160	18/02/1986	CONDAMINE RIVER ALLUVIUM
52975	347387	6922160	06/12/1988	CONDAMINE RIVER ALLUVIUM
52975	347387	6922160	30/03/1979	CONDAMINE RIVER ALLUVIUM
52996	343217	6931938	21/03/1978	CONDAMINE RIVER ALLUVIUM
55026	387196	6962334	04/04/1978	WALLOON COAL MEASURES
55111	377429	6939416	22/02/1978	MAIN RANGE VOLCANICS
55201	387692	6958644	16/03/1979	MAIN RANGE VOLCANICS
55338	375665	6940191	01/10/1979	MAIN RANGE VOLCANICS
56004	367189	6932060	23/01/1979	MAIN RANGE VOLCANICS
56023	381542	6955814	05/02/1965	MAIN RANGE VOLCANICS
56023	381542	6955814	08/02/1979	MAIN RANGE VOLCANICS
56032	373108	6937974	17/12/1979	MAIN RANGE VOLCANICS
56076	389194	6958689	01/02/1979	MAIN RANGE VOLCANICS
56076	389194	6958689	16/06/1981	MAIN RANGE VOLCANICS
56079	374398	6940534	01/09/1983	MAIN RANGE VOLCANICS
56138	378074	6939415	30/01/1979	MAIN RANGE VOLCANICS
56563	386093	6952460	24/09/1979	MAIN RANGE VOLCANICS
56564	366138	6934524	25/01/1980	MAIN RANGE VOLCANICS
56573	374446	6940407	22/05/1980	MAIN RANGE VOLCANICS
56576	365437	6933631	22/12/1964	MAIN RANGE VOLCANICS
56606	362781	6935790	27/12/1979	MAIN RANGE VOLCANICS
56640	365325	6933151	02/04/1980	MAIN RANGE VOLCANICS
56695	364948	6933124	22/01/1981	MAIN RANGE VOLCANICS
56708	391286	6954598	26/03/1980	MAIN RANGE VOLCANICS
56718	379562	6960966	25/11/1981	MAIN RANGE VOLCANICS
56758	332070	6920380	09/05/1980	WALLOON COAL MEASURES
56758	332070	6920380	11/08/1980	WALLOON COAL MEASURES
56778	374278	6939660	18/07/1984	MAIN RANGE VOLCANICS
56778	374278	6939660	13/10/1986	MAIN RANGE VOLCANICS
56783	390098	6957938	19/01/1980	MAIN RANGE VOLCANICS
56795	377823	6938723	21/04/1981	MAIN RANGE VOLCANICS
56795	377823	6938723	22/04/1981	MAIN RANGE VOLCANICS
56798	343499	6925921	04/03/1981	CONDAMINE RIVER ALLUVIUM
56881	317190	6860490	14/03/1980	MARBURG SUBGROUP
56902	311899	6855531	17/03/1980	MACINTYRE BROOK ALLUVIUM
61004	378178	6958086	29/10/1981	MAIN RANGE VOLCANICS
61004	378178	6958086	30/10/1981	MAIN RANGE VOLCANICS
61005	390302	6953980	27/07/1971	MAIN RANGE VOLCANICS
61025	365769	6933679	19/08/1968	MAIN RANGE VOLCANICS
61027	341191	6926789	16/01/1981	CONDAMINE RIVER ALLUVIUM
61027	341191	6926789	07/12/1988	CONDAMINE RIVER ALLUVIUM
61151	377560	6938200	06/04/1981	MAIN RANGE VOLCANICS
61151	377560	6938200	06/04/1981	MAIN RANGE VOLCANICS
61232	387120	6961173	05/11/1980	MAIN RANGE VOLCANICS
61232	387120	6961173	05/11/1980	MAIN RANGE VOLCANICS
61232	387120	6961173	01/11/1982	MAIN RANGE VOLCANICS
61232	387120	6961173	17/10/1986	MAIN RANGE VOLCANICS
61232	387120	6961173	16/03/1988	MAIN RANGE VOLCANICS
61258	392258	6959548	23/10/2008	MAIN RANGE VOLCANICS
61258	392258	6959548	18/12/1980	MAIN RANGE VOLCANICS
61301	373637	6939765	31/05/1982	MAIN RANGE VOLCANICS
61302	373578	6940084	31/05/1982	MAIN RANGE VOLCANICS
61302	373578	6940084	01/06/1982	MAIN RANGE VOLCANICS
61324	374138	6949836	13/12/1980	MAIN RANGE VOLCANICS
61426	374371	6935142	21/01/1981	MAIN RANGE VOLCANICS
61456	387364	6955929	30/03/1981	MAIN RANGE VOLCANICS
61456	387364	6955929	08/03/1984	MAIN RANGE VOLCANICS
61456	387364	6955929	08/03/1984	MAIN RANGE VOLCANICS
61503	378747	6945227	03/08/1981	MAIN RANGE VOLCANICS
61504	388840	6958409	06/05/1981	MAIN RANGE VOLCANICS
61549	379723	6953480	22/06/1981	MAIN RANGE VOLCANICS
61549	379723	6953480	23/06/1981	MAIN RANGE VOLCANICS
61575	375964	6947898	30/09/1981	MAIN RANGE VOLCANICS
61575	375964	6947898	01/10/1981	MAIN RANGE VOLCANICS
61575	375964	6947898	07/04/1982	MAIN RANGE VOLCANICS
61575	375964	6947898	08/04/1982	MAIN RANGE VOLCANICS
61618	382025	6957590	15/07/1985	MAIN RANGE VOLCANICS
61630	365682	6932650	19/02/1982	MAIN RANGE VOLCANICS
61677	387881	6959156	13/11/1981	MAIN RANGE VOLCANICS

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61683	378317	6950742	13/01/1982	WALLOON COAL MEASURES
61683	378317	6950742	22/01/1982	WALLOON COAL MEASURES
61683	378317	6950742	22/01/1982	WALLOON COAL MEASURES
64075	390883	6958272	04/10/1983	MARBURG SUBGROUP
64090	377557	6939736	01/07/1983	MAIN RANGE VOLCANICS
64090	377557	6939736	03/07/1983	MAIN RANGE VOLCANICS
64091	376379	6939996	09/07/1980	MAIN RANGE VOLCANICS
64091	376379	6939996	12/10/1982	MAIN RANGE VOLCANICS
64091	376379	6939996	13/10/1982	MAIN RANGE VOLCANICS
64091	376379	6939996	06/07/1983	MAIN RANGE VOLCANICS
64129	375183	6952091	05/06/1984	MAIN RANGE VOLCANICS
64129	375183	6952091	06/06/1984	MAIN RANGE VOLCANICS
64157	384811	6957666	03/05/1982	MAIN RANGE VOLCANICS
64232	359281	6930377	24/01/1983	WALLOON COAL MEASURES
64235	375971	6948013	22/06/1982	MAIN RANGE VOLCANICS
64235	375971	6948013	22/06/1982	MAIN RANGE VOLCANICS
64235	375971	6948013	06/10/1983	MAIN RANGE VOLCANICS
64272	377657	6951501	01/08/1982	MAIN RANGE VOLCANICS
64276	375332	6952370	01/02/1983	MAIN RANGE VOLCANICS
64283	385087	6958577	21/04/1983	MAIN RANGE VOLCANICS
64287	377011	6951801	01/10/1982	MAIN RANGE VOLCANICS
64303	381099	6962304	13/03/1984	WALLOON COAL MEASURES
64345	320949	6905718	27/11/1972	KUMBARILLA BEDS
64397	373218	6937883	08/10/1984	MAIN RANGE VOLCANICS
64444	392028	6956261	25/01/1983	MAIN RANGE VOLCANICS
64479	374977	6947266	28/11/1963	MAIN RANGE VOLCANICS
64485	374916	6950926	01/01/1984	MAIN RANGE VOLCANICS
64493	364894	6934900	01/03/1983	MAIN RANGE VOLCANICS
64536	311961	6855070	03/05/1982	MACINTYRE BROOK ALLUVIUM
64555	318686	6869122	11/06/1982	MARBURG SUBGROUP
64555	318686	6869122	24/06/1982	MARBURG SUBGROUP
64555	318686	6869122	06/07/1982	MARBURG SUBGROUP
64555	318686	6869122	12/07/1982	MARBURG SUBGROUP
64555	318686	6869122	21/09/1988	MARBURG SUBGROUP
64804	375034	6934089	06/05/1983	MAIN RANGE VOLCANICS
64804	375034	6934089	06/06/1983	MAIN RANGE VOLCANICS
64832	356443	6937503	08/03/1983	WALLOON COAL MEASURES
64832	356443	6937503	10/03/1983	WALLOON COAL MEASURES
64832	356443	6937503	12/03/1983	WALLOON COAL MEASURES
64884	381171	6954855	10/04/1983	MAIN RANGE VOLCANICS
64900	356499	6930714	01/09/1983	WALLOON COAL MEASURES
64910	364670	6939456	11/08/1983	MAIN RANGE VOLCANICS
64911	363907	6939904	11/08/1983	MAIN RANGE VOLCANICS
64930	375923	6951716	20/08/1983	MAIN RANGE VOLCANICS
64941	382981	6960030	16/08/1983	MAIN RANGE VOLCANICS
64941	382981	6960030	27/09/1983	MAIN RANGE VOLCANICS
64941	382981	6960030	27/09/1983	MAIN RANGE VOLCANICS
64941	382981	6960030	27/09/1983	MAIN RANGE VOLCANICS
64942	382784	6959603	17/08/1983	GOWRIE CREEK ALLUVIUM
64942	382784	6959603	18/08/1983	GOWRIE CREEK ALLUVIUM
64942	382784	6959603	23/08/1983	GOWRIE CREEK ALLUVIUM
64942	382784	6959603	23/08/1983	GOWRIE CREEK ALLUVIUM
66257	363804	6939651	11/08/1983	MAIN RANGE VOLCANICS
66261	374393	6941342	24/08/1983	MAIN RANGE VOLCANICS
66425	374710	6940496	01/09/1983	MAIN RANGE VOLCANICS
66497	391558	6957601	24/11/1983	MARBURG SUBGROUP
66532	384137	6962397	20/03/1994	MAIN RANGE VOLCANICS
66533	376917	6939389	18/05/1984	MAIN RANGE VOLCANICS
66613	390447	6958911	28/03/1984	MARBURG SUBGROUP
66652	378887	6952048	14/04/1986	MAIN RANGE VOLCANICS
66652	378887	6952048	15/04/1986	MAIN RANGE VOLCANICS
66652	378887	6952048	15/04/1986	MAIN RANGE VOLCANICS
66652	378887	6952048	15/04/1986	MAIN RANGE VOLCANICS
66652	378887	6952048	15/04/1986	MAIN RANGE VOLCANICS
66652	378887	6952048	15/04/1986	MAIN RANGE VOLCANICS
66727	364871	6934329	13/08/1984	MAIN RANGE VOLCANICS
66763	360500	6932889	05/08/1964	MAIN RANGE VOLCANICS
66763	360500	6932889	09/06/1988	MAIN RANGE VOLCANICS
71013	380758	6958262	03/12/1990	MAIN RANGE VOLCANICS
71032	375074	6942371	09/10/1987	MAIN RANGE VOLCANICS
71039	387430	6959596	27/07/1984	MAIN RANGE VOLCANICS

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71039	387430	6959596	28/02/1986	MAIN RANGE VOLCANICS
71044	378112	6943119	12/02/1989	MAIN RANGE VOLCANICS
71104	378440	6945464	20/08/1987	MAIN RANGE VOLCANICS
71129	387767	6960876	13/11/1985	WALLOON COAL MEASURES
71159	382760	6949998	08/05/1985	WALLOON COAL MEASURES
71262	383324	6961649	09/10/1985	MAIN RANGE VOLCANICS
71372	386693	6961919	20/12/1985	MARBURG SUBGROUP
71449	383976	6960154	06/03/1986	MARBURG SUBGROUP
71449	383976	6960154	10/03/1986	MARBURG SUBGROUP
71499	346432	6928947	18/05/1988	CONDAMINE RIVER ALLUVIUM
71538	364952	6932875	07/07/1986	MAIN RANGE VOLCANICS
71593	382492	6946556	14/07/1986	MAIN RANGE VOLCANICS
71615	284781	6840592	09/06/1993	KUMBARILLA BEDS
71637	271594	6839318	06/05/1986	KUMBARILLA BEDS
71785	319777	6856550	29/05/1986	MARBURG SUBGROUP
71984	284013	6843833	11/12/1987	KUMBARILLA BEDS
77390	252986	6827772	07/02/2007	MACINTYRE RIVER ALLUVIUM
77390	252986	6827772	07/02/2007	MACINTYRE RIVER ALLUVIUM
80167	317183	6886518	11/08/1994	MARBURG SUBGROUP
80898	322032	6888342	01/12/1997	MARBURG SUBGROUP
83108	389849	6958429	23/01/1987	WALLOON COAL MEASURES
83112	340655	6923986	20/06/1989	CONDAMINE RIVER ALLUVIUM
83132	381358	6958293	27/02/1987	MAIN RANGE VOLCANICS
83152	388944	6959047	21/03/1991	MAIN RANGE VOLCANICS
83153	388948	6958955	17/10/1983	MAIN RANGE VOLCANICS
83161	379577	6944977	22/07/1988	MAIN RANGE VOLCANICS
83266	387557	6959765	15/07/1987	MARBURG SUBGROUP
83279	376913	6952185	31/08/1987	MAIN RANGE VOLCANICS
83298	385489	6959175	20/03/1991	MAIN RANGE VOLCANICS
83445	390493	6958810	04/12/1987	MAIN RANGE VOLCANICS
83462	372926	6937461	20/07/1985	MAIN RANGE VOLCANICS
83462	372926	6937461	25/07/1986	MAIN RANGE VOLCANICS
83473	372859	6937808	29/02/1988	MAIN RANGE VOLCANICS
83494	387167	6955378	29/09/1988	MAIN RANGE VOLCANICS
83519	354926	6932070	06/07/1964	WALLOON COAL MEASURES
83519	354926	6932070	25/05/1988	WALLOON COAL MEASURES
83649	365542	6933674	10/08/1988	MAIN RANGE VOLCANICS
83651	378593	6939651	02/11/1988	MAIN RANGE VOLCANICS
83696	391123	6960291	22/01/1989	MAIN RANGE VOLCANICS
83737	368527	6933591	28/04/1989	MAIN RANGE VOLCANICS
83740	391589	6955392	23/04/1989	MAIN RANGE VOLCANICS
83741	376883	6946182	26/01/1989	MAIN RANGE VOLCANICS
86034	319089	6869498	21/09/1988	MARBURG SUBGROUP
86089	318525	6860099	06/03/1989	WALLOON
86553	368123	6938507	25/02/1989	MAIN RANGE VOLCANICS
86569	387225	6955709	01/06/1989	MAIN RANGE VOLCANICS
86589	375223	6937093	14/12/1987	MAIN RANGE VOLCANICS
86616	342185	6922605	20/06/1989	CONDAMINE RIVER ALLUVIUM
86626	361614	6938354	06/12/1989	MAIN RANGE VOLCANICS
86710	381948	6957040	10/10/1990	MAIN RANGE VOLCANICS
86719	374886	6937236	27/11/1990	MAIN RANGE VOLCANICS
86819	385801	6956740	01/06/1990	MAIN RANGE VOLCANICS
86821	381304	6944939	15/05/1990	MAIN RANGE VOLCANICS
86895	375788	6945500	15/01/1999	MAIN RANGE VOLCANICS
86912	386580	6959417	04/06/1991	MARBURG SUBGROUP
87063	389269	6958509	16/01/1994	MAIN RANGE VOLCANICS
87063	389269	6958509	06/01/1994	MAIN RANGE VOLCANICS
87273	384866	6962910	29/06/1994	MAIN RANGE VOLCANICS
87274	384018	6963448	29/06/1994	MAIN RANGE VOLCANICS
87420	377300	6946104	30/11/1993	MAIN RANGE VOLCANICS
87536	364487	6937665	10/01/1995	MAIN RANGE VOLCANICS
87550	392181	6959152	14/08/1992	BASALT DETRITUS
87642	385919	6954596	12/04/1994	MAIN RANGE VOLCANICS
87746	371391	6934938	09/10/1993	MAIN RANGE VOLCANICS
87767	386034	6959881	15/05/1993	MARBURG SUBGROUP
87818	390052	6958386	01/07/1994	MARBURG SUBGROUP
94087	383426	6949294	06/01/1995	MAIN RANGE VOLCANICS
94102	382094	6961206	14/11/1994	MARBURG SUBGROUP
94156	381045	6945777	07/12/1995	MAIN RANGE VOLCANICS
94176	386301	6952830	04/02/1995	MAIN RANGE VOLCANICS
94302	336837	6920300	17/08/1998	WALLOON COAL MEASURES

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94424	340481	6916535	17/06/1998	MARBURG SUBGROUP
94434	335321	6920243	25/05/1998	MARBURG SUBGROUP
94559	388111	6958709	29/09/1994	MAIN RANGE VOLCANICS
107140	381220	6945352	04/09/1998	MAIN RANGE VOLCANICS
41640003	278727	6832162	21/07/1995	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	07/07/1995	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	21/06/1985	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	18/12/1986	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	21/06/1985	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	18/12/1986	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	16/02/2015	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	16/02/2015	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	22/07/1995	MACINTYRE RIVER ALLUVIUM
41640003	278727	6832162	22/07/1995	MACINTYRE RIVER ALLUVIUM
41640004	278730	6832174	10/09/1985	MACINTYRE RIVER ALLUVIUM
41640004	278730	6832174	30/10/1985	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	25/11/2003	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	23/11/2004	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	05/08/2002	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	13/11/2007	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	29/11/2005	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	10/10/2006	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	18/12/1986	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	18/12/1986	MACINTYRE RIVER ALLUVIUM
41640005	260485	6828735	09/12/2011	MACINTYRE RIVER ALLUVIUM
41640038	296844	6843727	12/10/2011	MACINTYRE BROOK ALLUVIUM
41640038	296844	6843727	24/06/2014	MACINTYRE BROOK ALLUVIUM
41640038	296844	6843727	05/12/2016	MACINTYRE BROOK ALLUVIUM
41640039	284234	6834938	12/10/2011	MACINTYRE BROOK ALLUVIUM
41640039	284234	6834938	09/12/2011	MACINTYRE BROOK ALLUVIUM
41640039	284234	6834938	16/02/2015	MACINTYRE BROOK ALLUVIUM
41640040	284234	6834938	12/10/2011	MACINTYRE BROOK ALLUVIUM
42230024	347610	6922314	15/09/1972	CONDAMINE RIVER ALLUVIUM
42230024	347610	6922314	13/10/1978	CONDAMINE RIVER ALLUVIUM
42230024	347610	6922314	22/05/1979	CONDAMINE RIVER ALLUVIUM
42230024	347610	6922314	29/06/1984	CONDAMINE RIVER ALLUVIUM
42230024	347610	6922314	07/08/1988	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	15/04/2009	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	16/04/2009	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	16/04/2009	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	28/02/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	04/03/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	05/03/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	07/03/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	13/03/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	13/05/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	01/10/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	01/10/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	01/10/1969	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	13/12/1971	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	13/12/1971	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	13/12/1971	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	11/09/1978	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	29/09/1978	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	29/09/1978	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	23/03/1979	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	23/03/1979	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	23/03/1979	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	21/05/1979	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	05/07/1984	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	05/07/1984	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	05/07/1984	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	02/09/1988	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	07/09/1988	CONDAMINE RIVER ALLUVIUM
42230025	351905	6925750	07/09/1988	CONDAMINE RIVER ALLUVIUM
42230030	339510	6923374	08/11/1946	CONDAMINE RIVER ALLUVIUM
42230031	340326	6923742	21/07/1947	CONDAMINE RIVER ALLUVIUM
42230031	340326	6923742	22/07/1947	CONDAMINE RIVER ALLUVIUM
42230031	340326	6923742	09/07/1970	CONDAMINE RIVER ALLUVIUM
42230032	341071	6924022	30/10/1946	CONDAMINE RIVER ALLUVIUM
42230033	342098	6924538	10/11/2008	CONDAMINE RIVER ALLUVIUM

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42230033	342098	6924538	01/01/1947	CONDAMINE RIVER ALLUVIUM
42230033	342098	6924538	09/07/1970	CONDAMINE RIVER ALLUVIUM
42230034	343040	6924795	16/10/1946	CONDAMINE RIVER ALLUVIUM
42230035	343776	6924905	09/10/1946	CONDAMINE RIVER ALLUVIUM
42230035	343776	6924905	09/07/1970	CONDAMINE RIVER ALLUVIUM
42230036	344379	6925699	05/09/1946	CONDAMINE RIVER ALLUVIUM
42230036	344379	6925699	09/09/1946	CONDAMINE RIVER ALLUVIUM
42230036	344379	6925699	16/09/1946	CONDAMINE RIVER ALLUVIUM
42230037	344690	6926121	30/09/1971	CONDAMINE RIVER ALLUVIUM
42230037	344690	6926121	30/10/1971	CONDAMINE RIVER ALLUVIUM
42230037	344690	6926121	29/09/1978	CONDAMINE RIVER ALLUVIUM
42230037	344690	6926121	25/05/1979	CONDAMINE RIVER ALLUVIUM
42230037	344690	6926121	03/06/1988	CONDAMINE RIVER ALLUVIUM
42230041	344818	6926041	22/09/1972	CONDAMINE RIVER ALLUVIUM
42230041	344818	6926041	13/10/1972	CONDAMINE RIVER ALLUVIUM
42230042	345745	6928243	12/08/1946	CONDAMINE RIVER ALLUVIUM
42230042	345745	6928243	13/08/1946	CONDAMINE RIVER ALLUVIUM
42230042	345745	6928243	21/08/1946	CONDAMINE RIVER ALLUVIUM
42230042	345745	6928243	09/07/1970	CONDAMINE RIVER ALLUVIUM
42230042	345745	6928243	22/11/1978	CONDAMINE RIVER ALLUVIUM
42230043	348392	6928800	06/06/1947	CONDAMINE RIVER ALLUVIUM
42230043	348392	6928800	09/07/1970	CONDAMINE RIVER ALLUVIUM
42230044	351996	6928827	10/07/1947	WALLOON COAL MEASURES
42230047	346198	6933100	14/04/2010	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	09/07/1969	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	10/07/1969	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	16/07/1969	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	28/07/1969	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	13/12/1971	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	08/09/1976	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	09/09/1976	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	05/01/1979	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	17/05/1979	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	22/06/1984	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	25/08/1988	CONDAMINE RIVER ALLUVIUM
42230047	346198	6933100	25/08/1988	CONDAMINE RIVER ALLUVIUM
42230295	343817	6930667	22/11/1978	CONDAMINE RIVER ALLUVIUM
42230295	343817	6930667	10/08/1988	CONDAMINE RIVER ALLUVIUM
42230374	342957	6930204	21/06/1984	CONDAMINE RIVER ALLUVIUM
42230954	382751	6960185	18/08/1975	MAIN RANGE VOLCANICS
42230954	382751	6960185	19/08/1975	MAIN RANGE VOLCANICS
42230954	382751	6960185	05/07/1983	MAIN RANGE VOLCANICS
42230954	382751	6960185	02/10/1985	MAIN RANGE VOLCANICS
42230955	389880	6959566	21/10/2003	MAIN RANGE VOLCANICS
42230955	389880	6959566	29/10/2007	MAIN RANGE VOLCANICS
42230955	389880	6959566	31/10/2005	MAIN RANGE VOLCANICS
42230955	389880	6959566	06/09/2006	MAIN RANGE VOLCANICS
42230955	389880	6959566	06/09/2006	MAIN RANGE VOLCANICS
42230955	389880	6959566	02/11/2004	MAIN RANGE VOLCANICS
42230955	389880	6959566	22/08/1975	MAIN RANGE VOLCANICS
42230955	389880	6959566	05/07/1983	MAIN RANGE VOLCANICS
42230955	389880	6959566	02/10/1985	MAIN RANGE VOLCANICS
42230955	389880	6959566	29/03/1989	MAIN RANGE VOLCANICS
42230957	376147	6951745	18/05/2011	MAIN RANGE VOLCANICS
42230957	376147	6951745	23/04/2009	MAIN RANGE VOLCANICS
42230957	376147	6951745	16/08/1975	MAIN RANGE VOLCANICS
42230957	376147	6951745	26/08/1975	MAIN RANGE VOLCANICS
42230957	376147	6951745	28/07/1983	MAIN RANGE VOLCANICS
42230957	376147	6951745	25/09/1985	MAIN RANGE VOLCANICS
42230957	376147	6951745	12/04/1989	MAIN RANGE VOLCANICS
42230959	383456	6952673	23/08/1975	MAIN RANGE VOLCANICS
42230959	383456	6952673	26/08/1975	MAIN RANGE VOLCANICS
42230959	383456	6952673	26/08/1975	MAIN RANGE VOLCANICS
42230962	379644	6944698	27/09/1975	MAIN RANGE VOLCANICS
42230962	379644	6944698	06/10/1975	MAIN RANGE VOLCANICS
42230962	379644	6944698	07/10/1975	MAIN RANGE VOLCANICS
42230962	379644	6944698	15/06/1983	MAIN RANGE VOLCANICS
42230962	379644	6944698	15/06/1983	MAIN RANGE VOLCANICS
42230962	379644	6944698	01/10/1985	MAIN RANGE VOLCANICS
42230962	379644	6944698	01/10/1985	MAIN RANGE VOLCANICS
42230962	379644	6944698	22/03/1989	MAIN RANGE VOLCANICS

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42230962	379644	6944698	22/03/1989	MAIN RANGE VOLCANICS
42230963	382550	6945535	21/10/2003	MAIN RANGE VOLCANICS
42230963	382550	6945535	31/10/2007	MAIN RANGE VOLCANICS
42230963	382550	6945535	02/11/2004	MAIN RANGE VOLCANICS
42230963	382550	6945535	31/10/2005	MAIN RANGE VOLCANICS
42230963	382550	6945535	06/09/2006	MAIN RANGE VOLCANICS
42230963	382550	6945535	02/10/2008	MAIN RANGE VOLCANICS
42230963	382550	6945535	07/05/2009	MAIN RANGE VOLCANICS
42230963	382550	6945535	23/03/2009	MAIN RANGE VOLCANICS
42230963	382550	6945535	05/09/1975	MAIN RANGE VOLCANICS
42230963	382550	6945535	05/09/1975	MAIN RANGE VOLCANICS
42230963	382550	6945535	16/06/1983	MAIN RANGE VOLCANICS
42230963	382550	6945535	16/06/1983	MAIN RANGE VOLCANICS
42230963	382550	6945535	16/06/1983	MAIN RANGE VOLCANICS
42230963	382550	6945535	01/10/1985	MAIN RANGE VOLCANICS
42230963	382550	6945535	01/10/1985	MAIN RANGE VOLCANICS
42230963	382550	6945535	01/10/1985	MAIN RANGE VOLCANICS
42230963	382550	6945535	22/03/1989	MAIN RANGE VOLCANICS
42230963	382550	6945535	22/03/1989	MAIN RANGE VOLCANICS
42230963	382550	6945535	22/05/1989	MAIN RANGE VOLCANICS
42230967	378041	6939555	09/03/2006	TOOWOOMBA VOLCANICS
42230967	378041	6939555	29/10/2013	TOOWOOMBA VOLCANICS
42230967	378041	6939555	29/10/2013	TOOWOOMBA VOLCANICS
42230967	378041	6939555	01/03/2006	TOOWOOMBA VOLCANICS
42230967	378041	6939555	11/09/1975	TOOWOOMBA VOLCANICS
42230967	378041	6939555	13/09/1975	TOOWOOMBA VOLCANICS
42230967	378041	6939555	17/06/1983	TOOWOOMBA VOLCANICS
42230967	378041	6939555	29/06/1983	TOOWOOMBA VOLCANICS
42230967	378041	6939555	29/06/1983	TOOWOOMBA VOLCANICS
42230967	378041	6939555	24/09/1985	TOOWOOMBA VOLCANICS
42230967	378041	6939555	24/09/1985	TOOWOOMBA VOLCANICS
42230967	378041	6939555	24/09/1985	TOOWOOMBA VOLCANICS
42230967	378041	6939555	28/02/1989	TOOWOOMBA VOLCANICS
42230967	378041	6939555	28/02/1989	TOOWOOMBA VOLCANICS
42230967	378041	6939555	28/02/1989	TOOWOOMBA VOLCANICS
42230967	378041	6939555	24/05/2017	TOOWOOMBA VOLCANICS
42230967	378041	6939555	15/06/2017	TOOWOOMBA VOLCANICS
42231049	338737	6923005	05/01/1979	CONDAMINE RIVER ALLUVIUM
42231049	338737	6923005	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231050	338807	6923038	05/01/1979	CONDAMINE RIVER ALLUVIUM
42231050	338807	6923038	27/06/1984	CONDAMINE RIVER ALLUVIUM
42231051	338922	6923097	12/04/1976	CONDAMINE RIVER ALLUVIUM
42231051	338922	6923097	05/01/1979	CONDAMINE RIVER ALLUVIUM
42231051	338922	6923097	22/05/1979	CONDAMINE RIVER ALLUVIUM
42231051	338922	6923097	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231051	338922	6923097	11/08/1988	CONDAMINE RIVER ALLUVIUM
42231080	340156	6922441	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231081	340102	6922440	29/06/1984	CONDAMINE RIVER ALLUVIUM
42231084	339746	6922466	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231087	339278	6922614	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231089	338799	6922879	22/03/1979	CONDAMINE RIVER ALLUVIUM
42231089	338799	6922879	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231089	338799	6922879	11/08/1988	CONDAMINE RIVER ALLUVIUM
42231090	339270	6923229	12/03/1979	CONDAMINE RIVER ALLUVIUM
42231110	339361	6922584	29/06/1984	CONDAMINE RIVER ALLUVIUM
42231115	339443	6922554	06/08/1976	CONDAMINE RIVER ALLUVIUM
42231115	339443	6922554	06/08/1976	CONDAMINE RIVER ALLUVIUM
42231123	339443	6922554	28/06/1984	CONDAMINE RIVER ALLUVIUM
42231135	379061	6951845	12/04/1989	WALLOON COAL MEASURES
42231136	344461	6929977	22/11/1978	CONDAMINE RIVER ALLUVIUM
42231136	344461	6929977	22/06/1984	CONDAMINE RIVER ALLUVIUM
42231136	344461	6929977	10/08/1988	CONDAMINE RIVER ALLUVIUM
42231164	339743	6922651	22/05/1979	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	24/07/2002	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	03/11/2003	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	15/11/2007	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	05/10/2006	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	13/12/2005	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	31/03/2015	CONDAMINE RIVER ALLUVIUM
42231169	342196	6918102	02/09/1988	CONDAMINE RIVER ALLUVIUM
42231378	348392	6928800	27/04/2009	CONDAMINE RIVER ALLUVIUM

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42231378	348392	6928800	03/06/1988	CONDAMINE RIVER ALLUVIUM
42231378	348392	6928800	03/06/1988	CONDAMINE RIVER ALLUVIUM
42231378	348392	6928800	27/04/2017	CONDAMINE RIVER ALLUVIUM
42231378	348392	6928800	27/04/2017	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	29/05/2013	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	19/03/2010	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	22/03/2010	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	23/04/1987	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	23/04/1987	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	31/07/1987	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	31/07/1987	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	03/08/1988	CONDAMINE RIVER ALLUVIUM
42231379	345681	6928205	03/08/1988	CONDAMINE RIVER ALLUVIUM
42231412	347917	6923853	29/06/1990	CONDAMINE RIVER ALLUVIUM
42231413	343500	6920908	31/05/1990	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	24/07/2002	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	03/11/2003	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	09/11/2004	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	08/11/2007	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	03/11/2005	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	05/10/2006	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	18/02/2015	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	09/03/2016	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	16/02/2009	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	16/04/2010	CONDAMINE RIVER ALLUVIUM
42231414	345212	6923069	31/05/1990	CONDAMINE RIVER ALLUVIUM
42231415	343763	6925098	30/05/1990	CONDAMINE RIVER ALLUVIUM
42231416	341201	6924116	25/11/2013	CONDAMINE RIVER ALLUVIUM
42231416	341201	6924116	18/02/2015	CONDAMINE RIVER ALLUVIUM
42231416	341201	6924116	29/05/1990	CONDAMINE RIVER ALLUVIUM
42231416	341201	6924116	28/04/2017	CONDAMINE RIVER ALLUVIUM
42231432	348168	6925872	19/11/2004	CONDAMINE RIVER ALLUVIUM
42231432	348168	6925872	19/08/2008	CONDAMINE RIVER ALLUVIUM
42231432	348168	6925872	18/02/2015	CONDAMINE RIVER ALLUVIUM
42231432	348168	6925872	29/06/1990	CONDAMINE RIVER ALLUVIUM
42231600	380266	6939824	07/03/2006	TOOWOOMBA VOLCANICS
42231600	380266	6939824	01/03/2006	TOOWOOMBA VOLCANICS
42231668	383460	6952690	22/11/2011	MAIN RANGE VOLCANICS
42231668	383460	6952690	21/11/2013	MAIN RANGE VOLCANICS
42231668	383460	6952690	29/05/2017	MAIN RANGE VOLCANICS
42231670	381909	6957513	27/06/2016	MAIN RANGE VOLCANICS
42231671	346208	6933096	14/04/2010	CONDAMINE RIVER ALLUVIUM
310-01-BH 2206	302299	6853323	18/12/1980	WALLOON COAL MEASURES
310-01-BH 2210	311744	6857672	18/12/1980	PILLIGA SANDSTONE
310-01-BH2201	288447	6840636	18/12/1980	SPRINGBOK SANDSTONE
310-01-BH2203	300144	6852564	18/12/1980	MARBURG SUBGROUP
310-01-BH2216	321182	6880902	18/12/1980	WALLOON COAL MEASURES
310-01-BH2231	338076	6918598	18/12/1980	KUMBARILLA BEDS
310-01-BH2233	340530	6922012	18/12/1980	TERTIARY
310-01-BH2234	340696	6922345	18/12/1980	TERTIARY
310-01-BH2235	344710	6926073	18/12/1980	TERTIARY
310-01-BH2309	309357	6857528	18/12/1980	PILLIGA SANDSTONE
310-01-BH2344	377527	6944383	18/12/1980	MAIN RANGE VOLCANICS
310-01-BH2347	379008	6950198	18/12/1980	MAIN RANGE VOLCANICS

¹Note: Unique identifier refers to the registered borehole ID as determined by the QLD Registered Bores Groundwater Database (DNRME, 2019), boreholes preceded with "310-01" refer to a Phase 2 Feasibility Design Geotechnical Investigation Groundwater Monitoring Bore

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
11085	298	1100	8.1		12	9	559		1070.1	743.57	310	1.5	3.5	0			666	8	70	0.6	0.5	10						
11085	188	1100	8.2		11	17	552		31.6	1056.1	732.64	300	1.5	6	0.5		658	7.4	72	0.3	0.4	10						
11100	90	58	6.3		12	54	475		30.8	1646	1367.25	520	4.5	10	7		572	3.3	525	1.4	0.8	2						
11100		1600	8		15	174	475		14.7	1607	1333.29	445	3	40	18		568	5.4	480	0.4	2.2	45						
11270	103	265	6.6			4	62		21.6	256.8	0	101.1		1.5	0.1		0	37.1	114.9	2.1		0						
11288		0			16	12	572		38.8	1104.2	774.05	304	1.5	3	1		681	8.1	72	0.6	3	30						
11395	159	3000	8.3		10	33	615		49.8	2003.8	1645.28	660	3	10	2		725	12	590	1.8	0	0						
11395		2950	8.2		14	30	599		52.2	2003.8	1653.35	655	3	7	3		717	6.9	600	1.8	0.1	10						
11880	101	0				120	912		36.4	2355	0	915.2		24.3	14.3		0	546.3	850.9	4		0						
11880		0			7	42	60		2.1	173.6	143.49	31	5.5	11	3.6		73	0	28	0.2	6.3	15						
12022	126	1100	8.6		14	16	550		34.3	1087.6	767.14	313	1.5	3	2		658	6.1	90	0.7	1.3	12						
12095		0			15	13	600		36.9	1105.9	762.55	305	1.5	5	0.1		705	13	70	0.5	0.8	5						
12132	0	1270	8.6		14	7	474		43.9	954.23	688.66	270	1.3	2.7	0.1	0.03	0	550	14	105	0.6	0	10.5				0	
12225	235	1320	8.4			13	492		37.1	749.8	0	307.5		2.9	1.4		0	294.6	120.1	0.4		22.9						
12225	235					9	506		45	760	0	314.6		1.4	1.4		0	303.2	117.3	0.6		21.5						
12225	0	1400	8.3		13	7	475		43.3	990	720	280	1.3	3	0.1	0.03	0	560	11.5	110	0.6	0	24				0	
12226	300	1300	8.5			7	492		49.7	744.3	0	307.5		2.9	0		0	294.6	120.1	0.6		18.6						
12524	80	1300	8.3		15	15	465		38.5	1128.23	864.46	345.7	1.7	5.3	0.5	0	0	547.9	9.5	216.3	0.37	0.9	0					
12553	0	1489	8.4		15	10	270		36.5	860	710	270	1.3	3.8	0.2	0	0	320	5.4	260	0.2	0	0				0	
12649	274	1309	8.6		14	5	458		55.2	966.22	700.66	295	1.6	2	0.1	0.01	0.01	550	4.2	100	0.7	0.6	12					
12649		1200	8.4		17	13	460		33.6	965.2	702.13	277	1.5	3.5	1		551	4.7	110	0.4	2.1	14						
12649		1250	8.6	0.2	15	5	468		52.2	951.15	692.78	281.3	1.2	2.2	0	0.01	0.01	538.4	15.7	99.7	0.58	0	12	0	0.01	0.1	0.01	
12864	162	1200	8.5		14	6	522		53.8	1073.64	767.41	315	1.8	2.1	0.3	0.02	0.02	630	3.2	100	0.7	0.5	20					
12864	162	1119	8.1		14	6	518		53.6	1066.37	762.37	313.4	1.8	2.1	0.3	0	0	625	3.2	99.7	0.73	0	20.1					
12864	253	1150	8.3			15	542		34.4	748.4	748.4	310.3		1.4	2.9		0	324.6	97.2	0.6		11.4						
12864	162	1129	8.3			40	540		22.1	816.75	816.75	323.2		4.3	7.2		0	323.2	111.5	0.15		47.2						
13196	85	944	7.5			53	210		11.4	525	0	191.6		14.3	4.3		0	125.8	180.2	0.2		8.6						
13300	300	1150	8.1		15	5	430		47	910	670	260	1.5	2.3	0.1	0.01	0.01	495	13.5	90	0.6	1.2	40.5					
13300	0	1200	8.4		15	6	445		44.1	930	680	265	1.4	2.4	0.2	0.24	0	520	11	93	0.6	0.6	38.5				0	
13300		1450	8.8			10	426		36.6	851.85	650.05	268		1.6	1.5		397	60	105	0.75	1	17						
13963	179	1350	8.1		20	19	238		24.7	785.9	662.75	250.8	1.7	7.3	0.3	0.01	0.01	281.2	4.5	234.4	0.26	1.6	3.8					
13989		1300	8.6		14	6	441		51.9	957.03	701.63	290	1.9	2.2	0.1	0.02	0.01	530	4	93	0.7	0.6	34.5					
13989		1250	8.6		13	11	445		36.8	944.6	691.76	278	1.5	3.5	0.5		523	9.5	90	0.6	0	38						
14379		2600	7.9			131	355		17.8	1499	0	467		16	22		433	0	561			0						
15077		990	7.8		36	283	382		2.2	733.3	532.95	86	1.3	62	31		465	0.3	82	0	0.7	5						
15208	27					283	380		2.8	765.1	0	107		64	30		464		80	0.1		20						
15493	31	880	8.2			271	366		2	664.4	0	74		74	21		446		43	0.4		6						
15592		760	8.2		16	7	446		50.3	970.1	714.23	296	1.8	2.3	0.2	0	0	534.5	4.7	96.6	0.7	0	33.3					
15592	371	780	8		14	5	447		51.6	929.72	674.33	265	1.4	2		0.01	0.01	530	7.2	88	0.6	0.5	35					
15592		449	7.2	0.3	16	6	449		50.8	946.46	692.26	279.7	1.4	2.3	0	0	0	531.4	7.9	89.6	0.59	0	33.5	0	0.01	0.1	0	
15624		427	7.2		16	8	462		45.1	989.79	723.33	299	1.8	2.5	0.5	0	0	555.7	3.9	97.6	0.69	0	28.1					
15624		432	7.2		15	8	449		44.8	938.96	690.15	284	1.1	2.8	0.2	0.16	0.01	518.8	14.1	89.5	0.61	0	27.8					
15624	366	1127	8.2		15	5	461		54.4	947.51	682.95	270	1.4	1.7	0.1	0.1	0.01	550	6.2	88	0.5	0.5	29					
15624		1130	8.2	0.4	16	5	461		53.5	940.24	694.27	281.3	1.3	2.1	0	0.07	0	516.2	22.3	88.2	0.59	0	28.2	0	0.01	0.1	0	
15624		717	8.5			5	465			946.6	695.5	289		2	0		494	36	100	0.6		25						
15624	366	492	7.5			5	465			989.45	701.24	291		2			567		105	0.45		24						
15763	31	610	7.5			133	310		5.9	502.1	502.1	155.9		27.2	15.7		0	185.9	117.3	0.1		0						
15767		1050	7.8			277	396		3.2	559.2	0	123		61.5	30		0	237.4	107.3			0						
16200	40	2650	8.2		11	450	699		24.6	3832.8	3410.23	1200	16	32	90		853	0	1540	1.8	0	100						
16250	24	1200	8.3			289	428		3.6	865.15	0	141		68	29		522		100	0.15		5						
16254		2450	8.2	3.9	10	132	359		21.3	1751.79	1550.13	563.5	4.6	23.6	17.9	0	0	416	10.6	712.5	1.6	1.4	0	0.02	0	0.3	0	
16254		2360	8.2	0.5	12	142	363		21.3	1799.87	1599.83	582.5	5.4	25.5	19	0	0	417.9	12.1	735.7	1.69	0	0	0.01	0.01	0.3	0.01	
16263		1117	8			23	740			1037.33	1037.33	430.4		0	5.7		0	443.3	157.3	0.63		0						
16263	0	1186	8.6		10	11	700		55.3	1410	1010	420	1.3	2.4	1.2	0	0	820	18.5	140	0.6	0	10.5				0	
16664	107	850	8.3		590	416	332		1.5	795.1	1179.24	72		108.8	35		405		164	0.3		10						
16672	27	2340	8.3			40	276		12.1	635.3	0	176		16	0		337		100	0.3		6						
16732	49	660	8			88	253		7.2	619.15	0	155		22	8		308		114	0.15		12						
16778		2325	8.3			653	553		1.8	1221.3	0	104		128	81		674		224	0.3		10						
16778		840	8.4			658	590		2.2	1301.85	0	128		120	87		720		236	0.85		10						
16983	13	0				308	272		2.5	719.4	0	99		74	30		332		160	0.4								

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	μ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16997	12	1150	7.9	7.9			831	328	2.4	1396.3	0	162	69	160			386	7	592	0.3		20						
17006	75	2920	7.9	7.9			357	340	1.6	1334.1	0	70	100	26			415		644	0.1		79						
17090	31	5025	7.2	7.2			890	30	11.6	3065.35	0	794	292	39			37		1630	0.35		273						
17090	31	480	8	8			503	24	15	2555.2	0	773	155	28			29		1420	0.2	0	150						
17090	29	845	8.2	8.2	19		1999	62	10.6	4950.35	4931.4	1088	7.7	568.7	141	0	0	74.1	0.5	2703	0.06	0.9	366.4					
17111		1200	8.3	8.3			26	75	9.8	353.2	0	114	2	5			92		130	0.2		10						
17207	76	880	7.8	7.8			13	185	16	452.1	0	134	2	2			226		80	0.1		8						
17207	76	890	8.1	8.1			22	194	12.3	465.1	0	134	4	3			237		80	0.1		7						
17290	65	1670	8.4	8.4			506	84	7.3	1588.15	0	378	171	19	6		102		812	0.15		100						
17290	85	4110	8	8			495	140	7.4	1576.2	0	376	160	23	0		171		795	0.2		51						
17291		940	8.2	8.2			274	205	2.1	584.4	457.32	81	24	52			250		165	0.4		12						
17341	50	780	7.8	7.8			40	535	136.1	5351	0	1975.7	12	2.4			652.7		2698	0.2		10						
17353	93	900	8.3	8.3			36	200	11	524.1	0	152	8	4			244		116	0.1		0						
17384	91	2500	7.9	7.9			207	300	48.1	4454.4	0	1590	58	15			366		2250	0.4		175						
17393	10	2000	7.7	7.7			679	305	1.7	1117.35	0	100	112	97			372		380	0.35		56						
17393	30	1950	7.6	7.6			691	317	1.3	1069.3	0	77	112	100			386		356	0.3		38						
17393	30	1850	7.8	7.8			685	320	1.7	1131.3	0	103	106	102			390		385	0.3		45						
17393	27	1830					694	320	1.8	1166.3	0	106	156	74			390		400	0.3		40						
17393	30	510	8.5	8.5			499	305	1	801.3	0	53	76	75			372		210	0.3		15						
17393	30	1860	7.4	7.4			536	290	1.4	883.2	0	73	86	78			354		270	0.2		22						
17403	16	1640	7.8	7.8			578	375	2.3	1094.3	0	127	60	104			457		320	0.3		26						
17403	16	1000	8	8			543	375	2.4	1064.3	0	127	66	92			457		300	0.3		22						
17403	16	1640	7.8	7.8			543	375	2.4	1064.3	0	127	66	92			457		300	0.3		22						
17403	29	685	7.3	7.3			899	350	2.6	1538.3	0	177	108	153			427		630	0.3		43						
17403	29	1050	8.1	8.1			899	350	2.6	1538.3	0	177	108	153			427		630	0.3		43						
17403	288	650	8	8			899	350	2.6	1538.3	0	177	108	153	0		427	0	630	0.3		43						
17459	9	1610	7.7	7.7			794	652	1.8	1421.5	1017.4	114	120	120			795		255	0.5		17						
17459	9	1600	8.1	8.1	68		657	610	1.7	1246.7	944.15	101	0	85	108		729	7.3	180	0.4	16	20						
17488		788	8.2	8.2			9	870	74.5	1763.45	1224.14	517	2	1			1061		180	2.45		0						
17627	35	2070	8	8			214	473	14.4	1319.75	0	485	3.2	50			156	206.4	416	0.15		3						
17627	37	1910	8.1	8.1			313	340	2.1	711.2	0	85	51	45			415		100	0.2		15						
17896	49	2230	8.1	8.1			461	295	0.9	719.5	0	46	20	100			360		177	0.5	1	15						
17953	9	1509	7.7	7.7			691	595	2	1343.3	0	120	140	83			726		220	0.3	44	10						
18018	50	790	7.4	7.4			431	384	2.6	951.4	0	122	82	55	0		468	0	220	0.4		4						
18071	47	1250	7	7			67	221	8.2	584.3	0	154	22	3			270		104	0.3		31						
18087	68	950	8.5	8.5			580	330	10.9	2333.4	0	605	112	73			403		1025	0.4		115						
18127	91	1250	7.3	7.3			10	101	15.6	340.05	0	113	4	0			95	14	100	0.05		14						
18164	34	1720	7.5	7.5			2339	315	2.8	3314.6	0	308	215	438			384		1745	0.6		224						
18164		520					1045	365	2.2	1649.5	0	161	112	186			445		690	0.5		55						
18170	67	980	8.1	8.1			600	510	1.1	1032.03	0	64.3	92	89.9			622.3		163.1			0						

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
19205	12	1100					2699	152	1	3170.5	0	120	112	588			185		1920	0.5		245						
19246		345	7.7				842	534	0.9	1281.1	0	61	128	127		0	651		305	0.1		9						
19271	21	1450	7.8				744	453	2.1	1325.35	0	132	92	125			552		372	0.35		52						
19271	62	618	8.8				925	285	2.7	1568.25	0	186	92	169			347		660	0.25	4	110						
19271	41	610	8.1				863	198	2.9	1465.25	0	195	34	189			242		686	0.25	4	115						
19271	0	875	8.1		45		1300	455	1.9	1910	1680	155	2	165	215	0.09	0.02	540	5.3	710	0.2	43	69					0
19281	12	940	8				587	55	2.3	587.1	553.04	129	72	99			67		156	0.1		64						
19320	12	1060	7.2				912	340	2.5	1574.4	0	174	174	116			415		640	0.4		55						
19321	44	2900	8				243	260	2.8	658.44	0	100	9.2	48	30			314	1.4	135	0.44		20.4					
19352	88						550	321	2.7	1094.65	0	143	80	85			391		350	0.65		45						
19367	23	510	8.4				34	150	8.6	409.4	0	116	12	1			183		95	0.4		2						
19467		490	8.6				15	120	16.3	443.6	369.39	144	1	3			146		135	0.6	0	14						
19467	35	1425	7.7				881	400	3.9	1778.1	0	267	112	146			488		720	0.5	0.6	44						
19467	8	1275	7.8				715	255	4.4	1529.3	0	273	36	152			311		715	0.3		42						
19648		824	8.3				344	300	0.8	597.3	0	34	52	52			366		60	0.3		33						
19923		1500	7.8				476	120	4.5	1145.4	0	227	121.6	41.8			146		584	0		25						
24115	33	2300	7.8				248	325	1.7	583.1	0	63	48	31			396		45	0.1								
26111	22	405	7.9				732	358	2.1	1244.1	0	128	92	122			436		435	0.1		31						
26111	22	760	8				695	364	1.8	1164.5	0	111	84	118			444		404	0.5		3						
26111	22	390	8.8				690	397	2.5	1298.4	0	152	108	102			484		416	0.4		36						
30052		1404	7.6				26	248	12.3	528.2	374.19	144	1.6	8	1.4		303		68	0.2	0	2						
30052	74	1060	7.8				26	248	12.3	528.2	374.19	144	1.6	8	1.4		303		68	0.2		2						
30127	80	1550	7.5				338	388	2.5	861.2	0	105	99	22			473		160	0.2		2						
30133	107	1040	7.8				298	415	14.7	2040	0	585	98	13			506		764	1		73						
30192		660	8				653	319	2.7	1249.5	1054.31	160	2	110	92		384	2.6	480	0.2	5.7	13						
30192	73	1900	7.4				47	287	9.8	586.3	0	154.4	0	11.4			350.4	0	70.1			0						
30192	73	1600	7.9				35	285	11.3	576.1	0	154	14				347.8		60.3									
30192	86	540	8.2				310	308	2.7	773.25	0	110	27	59			376		128	0.25	55	18						
30192	87	780	8				719	345	10.2	2262.7	0	627.6	2	136.1	92		414.9	2.8	968.4	0.2	5.7	13						
30335	10	1450	7.7				769	592	2.4	1476.3	0	155	110	120			722		360	0.3		9						
30480	39						270	355	1.9	656.1	437.53	72	1.6	64	26.8		430	1.5	60	0.2								
30480	39	485	8				285	365	1.9	679.6	453.41	72	1.6	68	28		445		65									
30588		1450	7.9				86	140	4.4	397.2	0	93	18	10			171		105	0.2		0						
30588	53	650	8				86	140	4.4	397.2	0	93	18	10			171		105	0.2		0						
30781	25	660	8.5		35		774	440	1.1	1255.8	1021.91	70	2	117	117		529	3.6	247	0.2	80	90						
31245	27	490	8		23		924	746	4.4	2262.19	1825.94	307.4	9.8	223.7	89	0	1.53	903.5	3.2	425	0.14	0.9	299.5					
31504		7200	7.5		34		150	455	4.1	813.1	567.54	115	2.4	60			550	2.6	78	0.1	0	5						
31504		2480	7.8		33		327	453	2.6	851.64	610.16	110	2.4	74	34.5	0.03	0.01	540	6.3	80	0.1	0.5	3.8					
31523	79	2750	7.2				52	210	9.4	563.3	0	156	16	3	0		256		120	0.3		12						
31797	43	890	8.7		38		864	406	1.4	1356.6	1148.07	93	1	140	125	0.08	0.02	485	4.8	455	0.2	32	20.5					
31820	42	1040	7.8				385	289	3.4	918.92	741.01	155	3	57	59	0.01	0.01	350	1	285	0.4	0.5	8					
31864		1770	7.6				143	141	1.2	314.6	0	34.3	57.2				171.6		51.4									
31864	42	1125	7.3				0	0	99999.9	85.8	0	34.3	0	0			0	0	51.5			0						
31864	20	1125	7.4				0	0	99999.9	85.8	0	34.3	0	0			0	0	51.5			0						
31864	12	585	7.6				0	0	99999.9	114.4	0	44.3	0	0			0	0	70.1			0						
31864	48	585	7.6				570	288	1.6	963.72	788.36	90	3	85	87	0.01	0.01	345	3.1	335	0.1	0.5	15					
31938	16	1150	8.8				2494	450	2.3	3373.4	3094.34	260		196	487		549		1770	0.4	3	108						
32163	29	800	7.1				868	640	2	1553.75	1156.77	135		74	166	0.5		781		308	0.25	20	69					
32270	43	2010	7.5				0	0	99999.9	214.5	0	84.4	0	0			0	0	130.1			0						
32270	43	1500	7.8				0	0	99999.9	214.5	0	84.4	0	0			0	0	130.1			0						
32271	34	1400	7.7				320	280	1.1	609.3	0	43.6	128.1				341.7		95.7									
32271	34						295	275	1.2	584.84	0	45.9	118.1				335.6		85.1									
32290		1570	8.3				685	289	2	1154.5	975.58	123	88	113			352		452	0.5		26						
32290		506	7.7				686	376	2.4	1275.4	1042.09	147	128	89			459		432	0.4		20						
32290		1810	7.9				495	560	4.7	1403	1055.63	241.4	80.1	71.7			683.4		326.4									
32290		540	8.1				555	620	5.2	1615.6	1231.02	282.8	130.1	55.9			756.6		390.2									
32290		2000					495	480	5.3	1463.7	1165.94	273.6	92.1	64.4			585.8		390.2			57.6						
32290		535	9				35	420	17.6	860.7	600.15	239.1	12	1.2			512.6		95.8									
32290		1750	7.5				70	380	11.5	828.3	592.6	220.7	16	7.3			463.7		120.6									
32290		725	8				50	365	13.3	788.4	562	216.1	12	4.9			445.4		110									
32471		1600	7.2		36		579	363	1.5	1009.54	821.89	84	0.8	90	86	0.02	0.02	440	1.5	235	0.2	58	14					

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
32471		1610	7.3				318	318	1501.3	1304.33	387.5		127.2				387.5		599.1									
32787	131	1000	8.3				20	48	14.4	441.2	0	148	8	0			59		160	0.2			66					
32944	67	920	8.5				62	498	13.2	888.85	613.35	238	14	6.5			542	32	56	0.35	0							
32944		850	8.5		55		686	537	1.5	1228.5	953.11	90	1	110	100		650	2.3	250	0.2	1	24						
33219	39	1200	7.9				229	230	2.1	557.7	0	72.9	91.5				280.2		112.9									
33219	39	0					229	230	1.9	543.4	0	67.2	91.5				280.2		104.3									
33219	39						275	273	1.5	586.3	0	55.7	110.1				333.1		87.2									
33219					34		298	413	2.6	801.6	581.45	105	2.3	68	31		500	2	87	0.1	0.6	5.6						
33232	51						341	380	2.8	797.2	561.35	121	74	38			464		96	0.2		4						
33232					35		318	420	2.3	812.9	588.67	96	2	73	33		510	1.3	87	0.1	0.5	10						
33232	51				29		263	395	2.7	751.2	538.76	100	2	54	31	0	0	475	3.5	79	0.1	0	6.6				0	
33232		838	7.7		32		325	435	2.4	820	590	98	1.9	75	34	0.04	0.01	510	7.9	78	0.1	0.5	6					
33293		2100	8				727	489	0.9	1141.1	838.15	57	128	99			596		249	0.1	12	0						
33523	10	1300	8.3				672	560	1.3	1195.4	0	76	180	54			683		190	0.4		12						
33523	10	1550	7.9				260	515	2.3	1106.2	0	86	104			85	628		190	0.2		13						
33523	39	940	7.6				632	620	2.7	1368.3	0	156	108	88			756		230	0.3	25	5						
33523	39	930	8.2				629	626	2.7	1359.3	0	153	102	91			763		225	0.3	20	5						
33663	27	770	8.5				230	352	3.6	738.2	0	126	46	28			429		106	0.2	0	3						
33663		1050	8.1		39		256	309	2.9	694.5	542.89	105	2.5	53	30		375	0.9	125	0.1	0	3						
33663		890	8.4		36		250	310	2.9	700	540	105	2.3	52	29	0.01	0.01	370	3.4	130	0.1	0.5	3.4					
33794	28	810	8.3				285	392	3.1	806.15	0	120	68	28			478		104	0.15		8						
34000	89	1200	8.4		22		28	219	17.2	684.33	572.65	210	2	10	0.8		263	2.2	190	0.33		6						
34646	38	0	7.2				233	325	3.1	684.1	0	109	47	28			394	1	105	0.1	0							
34646		1150	7.8		34		256	339	3.3	745	570.6	120	2	53	30		410	1.9	125	0.1	0	3						
34646		850	7.9		31		260	335	3	740	570	110	2	54	30	0.01	0.01	395	7.2	135	0.1	0.5	3.4					
34671	37	1250	8				330	389	3.6	926.15	0	151	66	40			474		186	0.15	0	9						
34729	29	1100	8.5				319	356	1.9	701.2	480.6	77	42	52			434		90	0.2		6						
34769	16	3020	7.8				586	620	1.5	1115.2	730.93	84	68	101			756		100	0.2	0	6						
34769	46	740	8.4				379	525	3.2	1025.1	699.79	144	56	58			640		105	0.1	10	12						
34849	30	975	8.8		65		752	426	2.2	1294.81	1098.39	138	2.2	58.8	147	0	0	514.3	2.7	372	0.21	52.8	6.8					
34866	57	950	8				268	355	2.3	1377.2	0	87	18	58	30		425	3.6	750	0	0.6	5						
34866		3120	7.4		35		262	361	2.2	672.72	494.23	81	1.4	57	29	0.01	0.01	420	9.9	71	0.1	0.5	2.8					
34970	37	650	7.4				616	395	0.7	950.25	705.25	42	108	84			482		200	0.25	25	9						
35001	40	810	8.3				368	437	2.2	858	0	98.7	81.5	40			533.4	0	104.4			0						
35001	42	940	7.6				355	430	2.2	832.2	565.49	96.5	74	41.3			524.7		95.7									
35001					34		306	439	2.6	817.5	582.1	105	1.5	69	32.5		530	2.6	70	0.1	0.6	6.2						
35001					32		322	442	2.5	824.14	586.74	105	1.8	72	34.5	0.03	0.01	530	4.3	71	0.1	0.5	4.9					
35029		755	8.4		33		315	470	2.8	866.5	609.77	115	2	70	34		570	1.4	70	0.1	0	4						
35029		875	7.7		30		305	460	2.7	830	600	110	1.9	68	33.5	0.01	0.01	520	18	73	0.1	0.5	5.5					
35030	59						195	396	6.7	946.2	0	216	32	28			458	12	165	0.2		35						
35030	79						233	420	6	980.2	738.25	210	44	30			476	18	165	0.2		37						
35030	97						226	335	6.4	960.7	765.51	221	46	27			384	12	245	0.7		25						
35030	101	735	7.1				226	428	5.6	945.3	0	192	41	30			522		136	0.3		24						
35030	103	695	7.6				176	345	6.1	845.7	636.79	187	3.5	21	30		411	4.7	160	0.3	0.2	28						
35030		626	7.5		26		221	394	5.4	909.1	709.41	186	3.7	39	30		444	18	162	0.4	0	26						
35030	104	1725	7.2		26		212	397	5.7	934.65	716.67	190	4.7	37	29	0.04	0.01	480	1.9	165	0.3	0.7	26					
35241	45	1200	7.6				690	370	2.3	1248.1	0	137	100	107			451		404	0.1	6	43						
35413	38	690	8.2				912	476	1.3	1383.5	0	87	95	164			580		422	0.5	24	11						
35601		1700	7.5				427	498	4.2	1218	909.46	200	4	90	49		607		240	0	0	28						
35601	27	2000	7.7				205	360	5	806.6	0	163	18	38.9			439.2		125	0	0	22.5						
35601	31	2480	7.7				427	498	4.2	1218	0	200	4	90	49		607		240			28						
35851	30	0					917	372	1.2	1355.54	1129.35	83	3	120	150	0.02	0.02	445	4.3	495	0.2	34	21					
35898		960	8.7				50	481	18.7	1077.95	780.09	304	14	3.6			586		145	0.35		25						
35926		1100	8.1				485	305	1.8	882.48	0	91.9	66	77.8			372.2		269.6			4.8						
35926		2070	8				465	310	1.6	836.75	0	80.4	66	72.9			378.3		234.1			4.8						
36232		2230					204	203		629	503.3	118.6	81.5				247.3		181.6									
36316	37.7	739	8				270	365	2.4	696.9	470.5	92	58.1	30.4			445.4	0	71									
36356	58	902	8.3				640	460	2.2	1208.2	923.04	129	70	113			561		305	0.2		30						
36356		480	7.4				907	502	1.7	1645.22	1334.14	120	15	70	178	160	612		444	0.22		46						
36356	79	880	7.7		42		1013	470	1.6	1549	1302.29	116	1.5	76	200		568	2.4	536	0.1	13	36						
36356	79	1600	7.9		41		893	429	1.7	1411.3	1188.49	116	1.5	76	171		519	2.2	490	0.1	1.5	34						

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
36434		1950	8.1				204	203	4.8	729.3	0	157.3	81.5				247.3		243.1									
36446	14	1220	7.8				818	570	1.6	1398.2	0	108	110	132			695		320	0.2			33					
36605		1000	8				732	514	1.8	1073.45	754.75	114	54	145			627		124	0.45		0	9					
36605		1200	8				447	518	2.4	1005.35	684.1	115	52	77			632		122	0.35			7					
37002	123	1230	7.7				103	150	3.7	400.1	0	86	15	16			183		100	0.1								
37026	49	700	8.9				633	408	2.6	1229.8	0	151.6	81.5	104.4			497.6	0	394.7				0					
37148	49	443	8.3				125	285	4.6	579.15	0	117	22	17			348		55	0.15		18	2					
37205		1100	8.1				189	140	4	604.3	517.38	127	46	18			171		200	0.3			42					
37306		675	8				153	226	6.3	738.5	0	178	40	13			275		200	0.5			32					
37306		2880	7.2				91	180	6.7	564.4	0	148	20	10			220		155	0.4			11					
37306		2010	7.7				51	164	9.7	541.35	0	159	12	5			200		160	0.35		0	5					
37306	146	2160	7.6		11		44	170	9.8	537.02	443.82	150	2.1	12.5	3.1	0.01	0.01	205	1	155	0.2	0.8	7.3					
37311		2840	7.6				581	608	1.5	1131.2	0	82	96	83			742		84	0.2		44	0					
37485	49						38	212	8.3	451.1	0	118	12	2			259		58	0.1			2					
37485	49						13	176	13.7	387.02	0	111	5	0			215		54	0.02			2					
37622	40						15	176	11.7	373.1	0	104	6	0			215		46	0.1			2					
37631	77	1660	7.6				746	492	1.5	1263.02	958.04	95	16	55	148	0.8		600	0	310	0.22		2	36				
37637		791	8.1				18	156	11.1	355.25	281.04	109		4	2			146	22	66	0.25		0	6				
37830		2630	6.4		4		144	74	4.2	507.2	465.33	115.6	4.3	44.9	7.7	0.85	0.06	90.2	0	197.2			46.4					
38215	49	1700	7.9				1191	671	1.7	1881.5	1465.86	131	184.2	177.5			817.7		571.1									
38290	33	810	8.1				272	510	19.8	2432.5	2178.35	751		28	49			500	60	885	0.5	93	66					
38358	83	1890	7.5				31	370	15.8	741.2	0	204	6	4			451		74	0.2			2					
38358		1790	7.7				827	370	2.1	1391.45	0	140	1	130	122			443	4	530	0.25	8.2	13					
38358		444	9.4				827	370	2.1	1391.45	1166.27	140	1	130	122			443	4	530	0.25	8.2	13					
38444	27	1250	7.2				13	235	15.8	448.05	0	132	2	2			238	24	40	0.05			10					
38460	61	955	7.4				132	132		629	546.91	163		52.9			161.5		251.6									
38797	86	1630	7.8				40	235	11.1	537.1	0	161.8	8	4.9			213	36	105	0		0	8.4					
38797	122						474	300	4.6	1225	0	230	2	40	91			352	6.8	480	0.2		23					
38798							41	214	9.3	510.4	377.73	136	2.4	12	2.6			261		88	0		0	8.4				
38798	122	990	8				40	235	11.1	537.1	0	161.8	8	4.9			213	36	105	0		0	8.4					
38798	122	1750	7.8				41	214	9.3	510.4	0	136	2.4	12	2.6	0	0	261	0	88	0		0	8.4				
43148		1230	8.6		17		14	472	31.9	956.1	689.98	275	1	4	1			557	9.4	95	0.7		0	13				
43642	34	970	8				17	320	23.3	690.4	535.37	218		3	2.2			305	42	120	0.2							
43642	37	900	8.2		11		6	355		749.31	541.74	215	1.5	2.3	0	0.1	0.01	430	1.7	95	0.4	2.3	1					
43843	24	845	8.1		31		248	300	3	684.7	530.18	109	1.5	48	31	0	0	365	0.6	120	0.2		0	9			0.4	
44460		940	7.9				976	330	0.9	1307.21	0	62	132.1	156.8			402.7		553.4									
48011	117	3100	7.3				440	290	9.1	1754.63	1577.23	438	10	110	40	0.29		349	2.2	750	0.14		55					
48011	117	2000	7.7		22		514	300	8.5	1910.94	1747.41	444	6	130	46	10.3	0.14	365	0.5	800	0.1	0.9	108			0		
48013	79	4450	7.9				704	240	9.5	2385.18	0	580	6	140	86			293		1280	0.18		0					
48013	70	3650	7.4		24		722	205	9.7	2437.38	2334.82	600	7	144	88	8.1	0.08	249	0.5	1300	0.1	0.6	40			0		
48060		6510					101	315	21.7	1553.07	1359.92	500	4	32	5			380	1.8	570	0.27		0	60				
48060		2250					101	320	22.5	1613.16	1417.46	520	4	33	4.5			385	2.4	605	0.26		0	59				
48060	67	2500	7.9				168	168	43.1	3532.1	0	1282.7		67.2			204.4		1977.6									
48060	141	2470	7.8				193	195	10.6	1172.6	0	337.4		77.2			237.3		520.5									
48060	146	6980	7.8				101	320	22.5	1613.2	0	520	4	33	4.5			385	2.4	605	0.3		59					
48060	146	2650	7				101	315	21.7	1553.1	0	500	4	32	5			380	1.8	570	0.3		60					
48062	40	652	8.2				174	234	2.5	474.8	0	76	1.8	25	27			277	4.4	60	0.1	3.5	0					
48066	77	3750	8.3				71	154	8.1	607.1	512.05	156	1.6	20	5			187	0.5	125	0		0	112				
48071	37	950	7.9				56	500	28.2	1544.62	1239.64	485	3	10	7.5			600	4.6	420	0.52		14					
48071	37	880	7.8				42	490	33	1542.63	0	490	2	6	6.5			586	5.6	435	0.53		11					
48071	60	950	7.8				81	589	14.2	1123.9	766.57	295	2.5	5	16.7			703	7.8	85	0.9		8					
48071	60	910	8.3				11	579	42.3	1125.48	774.24	325	2	2.5	1.2			691	7.6	85	0.18		11					
48082	32	1400	8.2				726	505	1.7	1312.02	0	104	0.8	88	123			612	1.6	345	0.22	17.4	20					
48088	109	0					104	280	4.8	541.7	0	112	2.4	20	13.2			337	2.1	55								
48136	36	980	7.8				276	365	2.1	692.8	0	80	1.4	60	30.7			436	4.6	80	0.1							
48175	50						566	484	2.5	1167.37	0	135	3	90	83			585	2.8	255	0.37	13.2						
48179	43						132	133	1.1	286	0	28.6		52.9			161.5		42.9									
48192	47						89	70	8.7	674.22	631.01	190	4.5	30	3.5			85		145	0.22		216					
48192	47	0					83	75	8.8	672.21	625.95	185	4	27.5	3.5			91		145	0.21		216					
48192	47	0					62	75	8.4	541.21	494.95	152	3.2	20	2.8			91		125	0.21		147					
48205	41	2300	8.3				605	162	6.7	1701.3	1601.67	380	6.5	145	59			196	0.8	790			124					

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
48213	62	8120	7.8		37	520	325		2.4	1026.7	864.45	127	1	93	70		392	2.2	328	0.1	3.4	10						
48253	43	1800	7.7			504	436		1	850.44	0	52	0.4	60	86		525	3.4	113	0.14	1.5	9						
48309	65	1350			36	233	300		2	577.4	428.89	71	2	47	28		363	1.3	55	0.1		10						
48309	65				36	153	227		2.6	448.3	347.57	73	2	20	25		269	3.6	50	0.7		5						
48309	65	940	7.9		38	247	313		2.2	611.6	457.97	78	2.4	56	26		377	2.1	65	0.1		5						
48309	65	920	8		37	246	314		2.2	609.1	453.45	79	2.8	54	27		379	2.1	55	0.1	0.1	10						
48309	65	801	8.1		27	239	294		2.2	590.3	436.85	78	3.6	48	29		355	1.6	70	0.1	0	5						
48323		1100	8.2			916	552		2.3	1632.19	1290.1	161	4.8	149	132		673		480	0.39	32							
48325	18	788	7.8			671	429		1.2	1090.5	0	72	1	102	101		520	1.3	277	0.2	0	16						
48325		2100	8.1		34	710	450		1.2	1146.5	902.97	73	1	108	107		546	1.3	294	0.2	0	16						
48378	106	1750	7.9			15	55		11.2	311.75	0	101	0.8	4.8	0.8		67		135	0.35		2						
48388	25	2720	7.1			215	65		0.9	325.91	0	31	1.8	30	34		79		150	0.11								
48461	164	2470	7.8			7	54		16.6	313.02	0	104	0.8	2.8	0.1		64	1.2	140	0.12								
48461	164	2950	8			11	60		14.1	315	0	106	1	3.6	0.4		61.5	5.5	136			1						
48478		720	7.4			628	475		2.4	1231.8	0	136	1	95	95		577	1.3	305	0.5	19	2						
48490	24	2100	8.1		37	1710	240		1.6	2329.4	2217.47	152	2	174	310		293		1100	0.4	170	128						
48491	60	875	8		8	483	245		3.6	1081.8	938.33	180	3	63	79		298	0.5	360	0.3	49	49						
48492	56	620	7.9		21	107	176		2.9	371.5	284.75	68	1	28	9		212	1.2	48	0.3		4						
48505	181	1000	7.9		34	733	285		2.1	1213.3	1071.94	133	6	117	107		345	1.3	485	0	4	15						
48514	75	1740	7.5		52	741	548		1.3	1261.6	975.07	80	3	122	106		666	1.3	264	0.3	19	0						
48514	75	1760	7.5		57	764	564		1.3	1289.2	998.01	80	2.5	128	108		685	1.5	264	0.2	20	0						
48544		545	7.4			654	469		2.6	1299.9	0	154		92	103		566	3.2	340	0.7	24	17						
48546	40	2500	8.2			326	414		2.5	810.6	555.94	102	2	76	33		501	1.8	90	0.8	1	3						
48590	54	930	8.2			360	375		2	790	560	88	2	86	35	0.01	0.01	450	3	120	0.1	0.5	4.9					
48594	25	1400	7.6		38	535	388		1.7	955.5	758.67	92	1	38	107		462	5.3	232	0.2	10	8						
48594		1400	8		39	604	450		1.7	1082.7	844.17	94	1	64	108		546	1.5	241	0.2	17	10						
48594		1340	8.2		40	590	450		1.7	1093.7	858.2	94	1.5	65	104		542	3.1	250	0.1	16	18						
48761	13	634	7.2			72	90		16.9	839.92	784.01	330	6	10	11.5		110		355	0.12	2.3	15						
48791		2400	7.9		15	26	510		51.5	1787	1494.99	600	4	7	2		604	8.8	560	1.2	0	0						
48791		2350	8.1			33	506		44.8	1754	0	593		10	2		519	48	582									
48791	103.7	1700	7.6	1	14	20	506		56	1720	1440	568	3.2	5.9	1.2	0.01	<0.01	582	17	540	1.7	<1.5	<6	0.02	<0.05	0.36	<0.03	
52128	28	2710	8.6		10	68	443		28.6	1712.95	1448.47	542	5	19	5		540		565	0.95	36							
52208	23	1139	8.6		18	21	565		32.4	1177.7	870.39	339	1.5	5	2		640	24	130	0.9	5.3	30						
52510		1200	8.2			985	550		0.9	1453	0	67		144	152		671	0	419			0						
52510		1450	7.9			950	565		1.1	1445	0	76		130	152		689	0	398			0						
52514	44	4100	7.9		45	775	355		0.7	1207.4	1033.83	45	1	119	116		430	1.2	220	0.2	230	45						
52514	44	1150	7.1		52	463	385		1.4	886	701.13	69	1	65	73		466	1.7	120	0.3	40	50						
52517	130	1910	8.2		22	33	220		10.9	526.43	412.21	145	1.2	12	0.8		268		88	0.43		11						
52517	149	2620	7.6			13	40		14.2	330.7	0	118	1	5.2			44	2.2	160	0.3								
52673		1060	7.9		20	112	298		6.5	693.5	529.5	158	1.5	30	9		362	0.7	120	0.2	2.1	10						
52715	50	1580	7.6		64	570	187		3.3	1161	1112.16	182	7	167	37		222	2.8	480	0.2	8	55						
52719	58	1410	8.2			520	450		2.1	1024.8	0	110.3		48	97.2		549.1		219.9									
52772	61	1900	8		60	486	415		0.7	787.5	593.35	37	1.4	66	78		500	3	80	0.1	18	4						
52782	126	2050	8.1			372	219		4	974	838.23	177.8		107.4	25.1		267.1	0	352		16.1	28.5						
52816	56	2800	7.6			310	474		1.5	867.9	574.1	62		116	4.9		578		107	0								
52846	40	1150	8.3		41	359	328		1.4	702.2	543.44	60	3	45	60		393	3.5	120	0.2	2.5	15						
52865	31	555	8.4			1243	604		2.3	1683.2	0	184.5		210.2	174.5		0	361.8	693.6			58.6						
52886	30	1150	7.8			762	350		2.9	1377	0	183	1.3	17	175		413	6.6	495	0.1	35	51						
52886	30	1350	7.8			59	585		34.4	1901.2	0	610	2	4	12		660	26	500	0.2	33	54						
52970		2700	7.8		16	5	109		19	320.9	281.5	101	0.6	1.8	0.2		109	12	87	0.1	0.2	9						
52970		600	8.9		17	7	109		16.4	320.6	282.2	101	0.7	2.2	0.4	0	0	109	12	86	0.1	0.2	9					
52975	39	480	8.9			306	470		2.9	877.5	587.77	117	1.8	63	36		570	1.6	75	0.1		13						
52975	39	733	7.2		27	205	362		3.2	680.9	489.33	105	1.6	36	28	0	0	430	5.4	68	0.1	0.2	6.6				0	
52975		741	7.2		29	270	399		2.6	747.44	535	100	1.6	58	30.5	0.03	0.01	475	5.7	71	0.1	0.5	5					
52975	18.3	700	8.4			315	490		3.5	933.4	629.44	142.5		52.1	45		598	0	95.8			0						
52996	57	0				285	375		2.7	765.84	0	105.7		86	17		457.6		99.3									
55026		1950	8.4			318	245		5.1	1020.7	0	211	6	40	53		295	1.6	360	0.1		54						
55111		775	7.8		48	619	420		1.3	1023.6	813.89	77	1	65	111		507	2.3	225	0.3	25	10						
55201	26				52	1648	357		6.2	3380.07	3210.71	580	5.9	235.2	257.6	0.03	435.5		1640	0.34		225.5						
55338		1050	8.2			289	292		5.2	971.2	793.3	203	2	45	43		350	3	305	0.1	3.1	17						
56004		1650	7.7		22	566	230		1.4	926.8	807.49	75	3.5	90	83		278	1.2	300	0.1	36	60						

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Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
56023	28	465	7.7				561	605	1	846.25	0	55	32	117				362	250	0.25		30						
56023	65	440	8.1		49	738	270		3	1366.8	1250.6	189	2.5	88	126			325	2.2	550	0.1	19	65					
56032		860			66	536	445		1	903.6	701.22	52	2.3	58	95			528	7.1	140	0.2	18	3					
56076		5000	6.8		26	231	230		0.7	431.6	316.8	25	1.5	58	21			277	1.5	40	0.1	1.5	6					
56076		4770	8.7		13	167	160		3.3	539.8	455.71	99	6	42	15			191	1.8	157	0	1	27					
56079	31	702	8.9		41	367	399		1.1	724.77	521.79	47	1.1	58	54	0.06	0.01	480	3.5	43	0.2	31	6.9					
56138	9	650	7.2		44	449	445		0.7	746.4	520.49	32	1	66	69			531	5.6	40	0.2	1.6						
56563		920	7.5			8	70		9.3	213.6	170.9	62	6	2.4	0.6			84	0.5	52	0.1	0	6					
56564	20	870	7.5		41	188	265		3.7	643.3	520.63	116	5	57	11			322	0.6	126	0	0.7	5					
56573	42	1650	7.7		29	199	230		1.8	467.4	355.09	58	1	35	27			278	1.3	58	0.1	3	6					
56576	61	1200	8.2			194	230		3.4	598.3	0	110		38	24			280		145	0.3		1					
56606		2010	7.5		54	56	365		11.4	749.3	581.68	195	4	10	7.5			436	4.3	84	0.4	0.1	8					
56640	59	1170	7.3		16	138	170		3.4	469.6	380.89	93	2	29	16			206	0.5	112	0.1	1	10					
56695	31	1265	8.4		55	463	442		1.1	868.9	652.47	55	5.3	80	64			534	2.4	63	0.2	60	5					
56708		960	7.9		17	22	45		10.2	327.6	319.19	110	0.8	5.5	2			50	2.2	152	0	0.1	5					
56718	45	0			35	329	210		3.8	827.2	751.4	157	2	28	63			218	19	325	0.2	2	13					
56758	86	850	8.6		13	2590	165		34.3	12764.2	12675.03	4010	25	460	350			201	0	7700	0.2	17	1					
56758	329	900	7.5		16	1986	156		30.3	9935.2	9854.62	3100	25	350	270			190	0	6000	0.1	0.1	0					
56778	55	620	7.1		45	518	452		1.2	957.06	722.5	65	1	82	76	0.05	0.01	550	0.8	145	0.2	27	10					
56778	56	702	8.9		48	475	385		1.3	862.52	679.24	63	0.7	60	79	0.02	0	455	7.2	155	0.2	34	8.4				0	
56783	24	840	8.2			446	440		1.8	906.1	0	88	3.5	55	75			529	3.5	132	0.1	12	8					
56795	88	405	8			619	431		1.6	1093	826.14	92		116	80			525		280								
56795		570	8.4			623	431		1.8	1144	0	106		152	59			525		302								
56798		970	8.2		35	255	381		2.7	724.8	524.97	98	2.5	56	28			462	1.2	74	0.1	0	3					
56881		4500	7.9		3	211	509		27.5	2866.2	2557.1	918	13	25	36			614	3.6	1250	1.4	0.2	5					
56902	13	2670	8.3		1	7	5		0.3	23.4	21.3	1.7	2.7	1.7	0.7			6.1	0	3	0.1	6.4	1					
61004		395	8.5			49	200		6.9	433	0	110		8	7			244		64								
61004		740	8.3			41	210		8.2	453	0	120		8	5			256		64								
61005	153	750	7.9			38	65		10.1	462.4	0	144		12	2			79		145	0.4		80					
61025	27	2000	7.8			792	460		1.2	1147.4	0	75		144	105			561		232	0.4		30					
61027		998	7.6		40	260	337		2.7	681.9	513.5	99	2.5	58	28			410	0.3	80	0.1		4					
61027		985	7.4		35	256	343		2.5	680.24	509.38	92	2.3	57	27.5	0.01	0.03	405	6.8	87	0.1	0.5	2					
61151	45	990	8.2			111	255		5	586	427.92	120		28	10			311		117								
61151	45	1000	8.3			114	276		6.1	644	473.21	150		34	7			336		117								
61232		2140	7.9		12	174	155		8.1	904.1	822.06	244	3	53	10			185	2	375	0.1	5	27					
61232		2720	7.7		12	266	150		8	1165.7	1086.71	300	4.5	80	16			179	2.1	535	0.1	7	42					
61232		2200	7.6		13	703	44		8.4	2149.3	2135.36	510	6	245	22			53	0.2	1250	0.1	2	61					
61232	170	3250	7.7		13	399	96		7.7	1393.93	1348.48	355	4.2	140	12	0.03	1.7	115	1	710	0	0	55				0	
61232	181	5500	8.6		13	487	63		8.4	1687.76	1662.13	425	4.8	170	15	0.04	0.02	76	0.3	950	0.1	0.5	46					
61258		1600	8	<1	41	256	345		3.9	804	636	144	1.5	48	33	<0.01	<0.01	411	4.9	131	0.08	<0.5	30	<0.01	<0.05	0.06	<0.03	
61258		2350	7.9		44	1949	362		2.4	2761.1	2580.94	246	4	174	368			441	0	1420	0.1	8	100					
61301	76	670	7.4		46	527	412		1.9	1018.6	810.45	100	2	94	71			500	1.1	210	0.5	32	8					
61302	95	1750			29	219	206		3.8	673.8	575.73	130	2	45	26			250	0.6	210	0.2	5	5					
61302	95	1800			28	257	199		3.3	675.9	581.91	120	2.5	50	32			240	1.2	220	0.2	2	8					
61324	17	1600	7.9		11	55	116		6.9	427	366.33	118	1.8	17	3			141	0.2	137	0	2	7					
61426		1890	7.5		70	425	450		1	795.7	588.17	47	2.3	78	56			546	1.3	55	0.1	8	2					
61456	73	2400	7.9		40	745	219		21.4	4431.3	4338.13	1340	15	150	90			262	2.3	2520	0	1	51					
61456	27	2200	7.6		31	553	507		1.4	1018.43	739.37	78	1	70	92	0.02	0.01	610	4.3	140	0.2	1.9	21					
61456	27				31	553	507		1.5	1017.57	738.51	79	1	70	92	0.01	0.26	610	4.3	140	0.2	1.8	19					
61503		685			90	909	494		1.1	1422.2	1208.24	78	3	125	145			598	2	413	0.2	30	28					
61504	77	2450	8.2		17	404	444		1.5	841.5	586.05	68	7.5	76	52			536	2.7	90	0.3	0	9					
61549	35	1450	8.6		31	433	333		3.5	1064.9	892.58	169	2	58	70			400	2.7	340	0.2	9	14					
61549	35	1200	8.5		31	383	319		3.4	955.8	791.1	153	2.5	51	62			385	2	280	0.3	8	12					
61575		1000	8.1		44	752	450		1.8	1315.1	1081.57	115	0.5	87	130			546	1.4	398	0.2	18	19					
61575		768	8.3		42	392	330		3.3	981.5	820.69	152	1.5	76	49			399	1.8	280	0.2	10	12					
61575	61	768	8.3		42	901	554		1.6	1513.3	1214.74	110	0.5	130	140			670	2.5	420	0.3	20	20					
61575	61	1700	7.6		40	674	454		2.5	1350.1	1110.53	150	1	120	91			550	1.9	410	0.2	2	24					
61618	73	1860	7.4		29	1400	310		1.7	2060	1900	150	4	105	275	0.1	0	370	3.9	540	0	1.1	610				0	
61630	93	1250	7.8			366	326		1.4	689.1	487.3	60		56	55			397		121	0.1							
61677	35	2010	7.7		32	352	478		5.1	1175.3	921.64	218	1	29	68			562	10	250	0.3	0	37					
61683	26	1000	7.2		13	161	215		2.9	523	404.36	84	6.3	33	19			259	1.3	88	0.4	6	26					

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
61683	84	1250	8.3		10	48	235		8.2	516	383.17	130	2.8	11	5			281	2.8	70	0.4	1	12					
61683	87	920	7.4		10	53	237		7.7	518.5	384.66	128	2.8	12	5.5			283	2.8	70	0.4	1	13					
64075	39	2950	6.9		22	584	472		1.6	1032.52	764.79	88	2	69	100	0.11	0.01	570	2.9	190	0.2	0.5	9.8					
64090		1000	8.3		45	355	352		2	779.5	608.48	85	3	68	45			425	1.8	145	0.1	0	6.6					
64090		1000	8.4		40	284	306		2.2	680	531.93	84	3	56	35			370	1.7	125	0.1	0	5.2					
64091	69	2700	7.5		38	235	223		3.7	691.3	592.06	130	1.8	48	28			270	1.1	200	0.1	1.3	11					
64091		880	8		39	612	328		2.2	1120.6	956.29	125	2	105	85			400	0.1	370	13.5	6	14					
64091		2250	7.6		29	139	207		3.7	518.3	420.23	100	1	26	18			250	1.1	115	0.2	2	5					
64091	69	1400	7.5		40	910	461		1.9	1494.5	1249.86	130	2	150	130			560	1.3	480	0.2	14	27					
64129	61	1650	8.1		49	814	461		1.1	1248.55	1012.91	71	1.5	120	125	0.04	0.01	560	1.1	335	0.1	6.8	28					
64129	61	1920	7.8		50	647	245		1.2	922.33	822.39	69	1.4	45	130	0.02	0.01	295	1.7	345	0.1	8.1	27					
64157	49	720	8		9	27	69		18.4	648.7	615.52	220	1.5	10	0.5			83	0.6	250	0.1	38	45					
64232	39	830	7.3		17	164	658		17.3	1833.9	1449.35	510	6	26	24			790	6.1	440	0.8	1	30					
64235	54	1500	7.5		23	695	334		2.1	1230.3	1047.44	125	2	120	96			405	1.2	430	0.1	25	26					
64235	71	1100	7.8		36	641	319		2	1131.5	971.8	115	1.5	67	115			385	1.8	420	0.2	13	13					
64235	55	1800	6.6			680	471		2.5	1303	1011.24	147		104	102			574		376			0					
64272		1150	8			42	240		8.4	499.2	0	125	2.5	12	3			290	1.5	50	0.2	4	11					
64276		1700	7.9			945	521		0.7	1301.3	0	48	2	57	195			630	2.9	305	0.1	7.3	54					
64283	56	810	7.8		24	94	223		6.3	565.8	452.56	140	1.8	13	15			270	1.1	115	0.1	6.1	3.7					
64287	93	580	9.3		23	559	356		3.3	1245.6	1052.58	180	3.3	105	72			425	4.5	440	0.2	3.6	12					
64303	91	779	7.3		23	925	400		2.9	1681.55	1458.03	205	2.8	115	155	0.04	0.01	485	1.4	700	0.1	6.2	11					
64345		2200	7.6			389	715		7.4	1616.5	0	335		60	58			872		270	0.5		21					
64397	55	395	9		43	308	281		1.3	607.92	478.1	54	2.5	31	56	0.01	0.01	340	1.3	96	0.1	19	8					
64444		2700	6.5		51	837	357		1.2	1205.8	1038.24	77	3	96	145			430	2.6	450	0.2	2						
64479		1650	8			531	226		1.6	838.1	0	83		28	112			216	29	270	0.1		100					
64485	54	560	8.5		32	408	321		1.6	757.23	593.54	72	2.1	61	62	0.02	0.01	385	3.4	160	0.1	3.2	8.4					
64493	55	1200	8.3		52	621	564		1.5	1189.4	895.76	87	2.5	110	84			680	3.7	155	0.2	54	13					
64536		2900			38	674	503		2.2	1282	1009.94	130	6.5	72	120			610	1.8	270	0.7	11	60					
64555	40	2450			20	237	582		24.3	2770.7	2434.89	860	5	42	32			700	4.7	1100	2	10	15					
64555	59	2800	8.5		15	48	308		32	1545.3	1374.77	510	3	11	5			365	5.3	640	1	0	5					
64555	39	2880	8.6		10	101	376		22.5	1649.9	1431.17	520	5.5	19	13			450	4.2	630	2.2	2	4					
64555		4250	7.9		12	65	337		28.7	1633	1441.69	530	4	16	6			400	5.2	640	0.8	12	19					
64555		2600	8.3		13	47	392		38	1830.7	1604.8	600	4.4	9	6	0.18	0.02	470	3.8	730	1.2	2.1	4					
64804	63	1650	7.9		0	782	545		1.7	1342	1003.99	110	0	102	128	0	0	665	0	337	0	0	0					0
64804	57	480	8			782	545		1.7	1342	0	110		102	128			665		337								
64832	34	690	7.6		8	56	220		10.5	641.6	514.9	180	3.5	12.5	6			265	1.9	165	0.3	1.3	6.1					
64832	58	810	8		10	67	263		10.6	716	565.89	200	3	8	11.5			315	2.9	145	0.4	1.7	28.5					
64832		845	7.4		10	66	324		11	762.1	573.87	205	2.5	5	13			390	2.6	135	0.4	1.6	7					
64884		555	9.2		40	297	270		2.3	675.8	550.61	91	2.3	53	40			325	1.8	145	0.1	1.1	16.5					
64900	71	885	7.6		13	31	242		27.8	1071.25	936.84	355	2.4	7.6	2.9	0.04	0.01	290	2.4	390	0.2	1.7	19					
64910		1630	7.1		28	574	448		2.6	1172.7	926.22	145	3	98	80			540	3.2	285	0.5	10	8					
64911		1800	0		17	50	201		5.2	378	270.47	84	2.1	13	4.2			245	0.1	26	0.4	0	3.2					
64930	19	1050	7.8		38	552	300		1.6	934.1	789.12	86	3	89	80			360	2.9	300	0	4.6	8.6					
64941	76	0			44	177	291		4.1	676.2	542.3	125	5.3	43	17			350	2.2	120	0.2	0	13.5					
64941	63	1500	8.1			182	294		4.2	695.7	0	128.7	12.6	46.5	16			358.9		121		0.3	11.7					
64941	63	1660	7.6			180	292		4.6	722.6	0	140.8	12.3	45.9	15.9			356.1		140		0.3	11.3					
64941	63	1300	7.5			180	292		3.8	661.8	0	117.2	11.8	45.4	16.1			355.7		101		0.3	14.3					
64942	15	1450	7.5		33	810	299		2.5	1386.5	1236.52	165	0.5	69	155			360	2.4	580	0.2	4.4	50					
64942	25	2360	7.2		37	892	322		1.5	1320.3	1159.07	105	0.9	110	150			390	1.3	510	0.1	13	40					
64942	67	2360	7.2			279	414		3.2	975.1	0	124	81.8	56.1	33.7			504.5		155.4		2	17.6					
64942	67	2360	7			470	330		2.3	955.8	0	113.4	6.7	76.2	68			402.7		258		4.8	26					
66257		1550	7.5		32	604	404		2	1104.3	887.23	115	4	110	80			490	1.3	295	0	0	9					
66261		2000	7.6		47	888	372		1.6	1350.7	1168.97	110	1	92	160			450	1.5	500	0.2	24	12					
66425	15	495	8.5		42	1099	437		1.5	1650.2	1422.81	115	1.3	135	185			530	1.5	590	0.2	6.2	86					
66497		1800	7.9		39	612	412		1.4	1050.24	837.63	81	2.4	110	82	0.03	0.01	495	3.7	235	0.1	21	20					
66532		1640	7.6		50	583	322		2.3	1132.62	984.38	130	9.2	105	78	0.02		390	1.6	370	0.3	1	47.5					
66533	50				41	171	280		2.7	543.64	411.82	81	2	32	22	0.03	0.01	340	0.5	54	0.1	3.7	8.3					
66613	49	1500	8.4		32	463	374		1.7	858.94	677.46	82	2.7	4.1	110	0.03	0.01	420	18	185	0.1	12	25					
66652		685	7.8			490	281		3.5	1110.53	942.79	180	1	33	99	0.03												

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
66652		620	7.9				234	283	4.8	824.63	656.89	170	1.3	23	43	0.03	0	330	7.4	235	0.3	4.7	9.9					
66652		1450	8.1				132	297	6.1	707.5	534.68	160	0.9	15	23	0	0	340	11	150	0.2	2.5	4.9					
66652		1730	8.1				96	284	7.1	661	495.8	160	1.1	12	16	0	0	325	10.5	130	0.2	2.2	4					
66727	61	1660	7.2		42		860	472	1.1	1396.58	1148.85	77	4.5	130	130	0.07	0.01	570	2.9	280	0.1	160	42					
66763		880	7.8				762	760	2	1486	1014.81	127		104	122			927		168			38					
66763	26	730	8.1		51		634	753	1.9	1340.46	928.91	110	1.4	81	105	0.03	0.03	910	4.2	110	0.3	8	10.5					
71013		1640	8		38		187	218	2.1	467.51	380.67	66.6	3.2	18.7	34.2	0	0	245.6	9.8	69.9	0.11	0	19.4					
71032	36	1100	8.2		49		674	369	1.4	1050.05	872.86	85	1.4	31	145	0.04	0.01	445	2.4	290	0.2	37	13					
71039	57	820	8.4				131	31	8.9	789.22	0	235	2.5	45	4.5	0.01	0.01	37.5	0.2	435	0.5	0.5	28.5					
71039	59	1020	7.7		5		130	31	8.9	790	770	235	2.5	45	4.5	0	0	37.5	0.2	435	0.5	0	28.5				0	
71044		415	8.2				320	460	2.6	840	560	105	1	39	54	0.01	0.01	550	5.7	55	0.4	27.5	6.6					
71104		2100	7.7		39		451	314	1.3	820.13	668.52	65	2.9	90	55	0.02	0.01	375	3.9	215	0.1	3.8	9.4					
71129	158	1950	8.2		12		105	220	7	670	550	165	6	32	6	0	0	260	3.6	185	0.1	0	8.5				0	
71159	113	1450	7.5		13		73	279	9.9	721.32	564.04	195	1.4	11	11	0.01	0.01	335	2.6	160	0.1	0.5	4.7					
71262	1090				47		125	175	4.1	500	440	105	6.6	25	15	0.03	0	210	1.8	115	0.5	0	18				0	
71372	220	4650	7.9		10		137	149	9.1	874.82	795.87	245	4.2	39	9.6	0.02	0	175	3	385	0.1	1.9	12				0	
71449	1480	1550	7.9		14		160	340	6.8	890	700	200	3.5	42	14	0	0	405	5.4	190	0.1	0	30				0	
71449	0	1200	8		13		75	270	10.6	780	630	210	3.3	18	7.2	0	0	315	6.5	190	0.1	0	24				0	
71499	45	890	7.1		34		258	366	2.1	676.63	489.52	79	1.3	57	28	0.02	0.01	435	5.7	68	0.1	0.5	2					
71538	59	1320	8.4		52		412	378	1.1	775.84	604.19	52	6.7	71	57	0.03	0.01	440	10.5	66	0.1	66	6.5					
71593		2280	7.7				705	544	1	1131.39	801	60	1.4	68	130	0.04	0.05	650	6.7	100	0.2	17	98					
71615	68	0			16		14	291	37.6	982.39	822.44	320.4	1.7	5	0.3	0	0	346	4.4	303.3	0.19	1.1	0					
71637	0	0			0		220	255	7.9	1070	940	305	1.3	3.4	1.8	0.6	0	620	23.5	80	0.5	0.9	9.9				0	
71785	12	2850	8		35		670	480	1.1	1110	850	66	1.8	115	93	0.1	1	580	4.6	255	0.1	0	0				0	
71984	61	500000	0		18		22	232	19.5	696.71	574.93	210	2.5	7.3	0.9	4.5	0.01	275	3.8	180	0.2	0.5	12					
77390	28	485	7.2	11	72		18	135	8.9	318	307	88	1.5	3	2.7	<0.01	<0.01	164	0.3	52	0.4	<0.5	6.6	0.02	0.08	0.05	<0.03	
77390	28	463	7.6	7	71		18	132	8.9	315	304	88	1.6	2.9	2.7	<0.01	<0.01	161	0.1	52	0.41	<0.5	6.4	0.01	<0.05	0.05	<0.03	
80167		4300	8.3				56	340	29.4	1564	1377.96	508	3.9	16	4	0.9		366	24	606	0.8	0.4	34					
80898		2470	7.8	1	30		364	287	7.4	1358.03	1211.62	322.8	4.3	90.7	33.5	0	0.12	347.3	1.2	539.4	0.3	0	18.6	0.45	0	0.1	0	
83108	110	930	7.7		14		308	374	1.7	704.06	489.32	67	8.6	41	50	0.05	0.01	450	3.2	79	0.2	0.5	4.5					
83112	37	1100	8.2				260	280	2.7	670	500	100	3	51	32.5	0.01	1.4	335	3.4	135	0.1	0.5	6.2					
83132	106				48		40	255	9	510	400	130	5.1	12	2.4	0	0	305	2.4	44	1	1.7	6.1				0	
83152		1030	7.9		19		797	625	1.3	1459.05	1090.62	82.4	1	116.2	123.2	0.07		762.2	0	209.2	103.13	23.4	37.3				1	
83153		2560	6.8				1181	490	0	1435.2	1131.24	2		140	202			598		493	0.2							
83161	45	1050	8				83	207	5	454.52	329.99	105	3	19.5	8.4	0.01	0.01	245	3.5	66	0.1	0.5	3.5					
83266	160	900	8		14		156	100	9.2	900.6	853.6	265	3.3	51	7	0	0	120	0.7	450	0.1	0.2	3.3					
83279	43	890	8.2		32		151	251	2.2	454.42	333.93	63	2.3	21	24	0.01	0.01	300	3.1	35	0.1	0.5	5.4					
83298	38	3600	7.8		21		1655	304	2.4	2367.62	2203.82	224	3.6	116	332	0	0	363.8	3.5	1226	0.17	0	98.6					
83445	51	2969	7.6		12		158	229	3.1	521.12	395.88	89	12	7.2	34	0.01	0.01	270	4.8	99	0.1	0.5	4.5					
83462	71	0			50		404	315	1.3	747.22	606.61	62	3.1	40	74	0.01	0.01	375	4.5	170	0.1	15	3.5					
83462	59	820			50		567	482	1.1	995.25	760.6	60	2.2	100	77	0.04	0.01	560	13.5	165	0.1	15	2.4					
83473	61	1200	8.3		21		105	160	3.9	432.92	354.8	91	1	19	14	0.01	0.01	195	0.3	100	0.1	7.6	4.9					
83494		3900	7.6		30		49	81	4.4	274.97	254.65	71	0.7	7.2	7.6	0.07	0.1	99	0.1	86	0.2	0.5	2.5					
83519	36	1740	7.4				435			1345.3	1075.9	440						530		375	0.3							
83519	36	1550	7.8		12		6	419	73.5	1340.14	1105.61	430	1.4	2.1	0.3	0.03	0.01	485	12.5	405	0.6	1.2	2					
83649	38	1200	8.8		49		699	461	1.5	1207.34	976.77	90	1	125	94	0.03	0.01	550	6.1	220	0.2	90	31					
83651		716	8		33		290	290	2.9	770	620	115	1.3	38.5	47.5	0.01	0.01	345	4.8	165	0.1	18.5	30.5					
83696	33	710	8.1		58		660	500	0.9	1070	820	56	1.6	83	110	0.05	0.17	600	4.9	185	0.2	19.5	9.6					
83737	94	1250	8.5				159	223	4.3	603.32	466.08	125	2	29	21	0.01	0.01	270	1	145	0.1	1.7	8.5					
83740		5500	7				1050	350	2	1740	1530	150	5.1	105	195	0.02	0.08	420	2.7	640	0.1	145	79					
83741		2000	7.8		18		32	125	7.6	361.69	303.45	98	1.4	9.1	2.2	0.38	0.01	150	1.2	94	0.1	0.7	4.6					
86034		2650	8.1		13		55	324	29.4	1537.04	1354.34	500	3	12	6	0.02	0.02	385	4.9	620	1.1	1	4					
86089		5300	8.3				230	465	23.5	2600	2320	820	10	26.5	40	1.2	0.25	550	9.2	1100	0.9	2.5	47.5					
86553	35	0	8.8		52		639	450	2.3	1306.56	1084.08	135	3.6	96	97	0.05	0.01	540	4.1	310	0.3	110	10.5					
86569		1500	7.8		25		649	496	1.1	1101.12	826.22	62	1.1	87	105	0.01	0.01	590	7.3	175	0.2	39.5	34					
86589	27	1870	8.1		50		650	507	1.9	1212.72	952.66	110	1.1	97	99	0.01	0.01	610	4.1	270	0.3	18	3.2					
86616	36	1160	8				317	355</																				

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
86821	54	1391	7.1		14	19	104		7.9	285.62	236.08	79	1.2	5.6	1.2	0.01	0.01	125	0.7	65	0.1	0.5	7.3					
86895	58	1250	7.3	4.5	47	917	363		1.7	1423.39	1251.87	118.3	3.2	73.1	178.7	0.01	0.01	429.5	6.7	571.7	0.09	32.6	9.4	0.06	0	0.1	0	
86912		1070	8.3		11	41	157		10.8	533.03	448.22	159	2.6	9.7	4	0.01	0	188.5	1.5	159	0.12	0	8.6					
87063	32	1120	7.7		17	105	108		4.2	440.27	391.19	100	3.9	33	5.5	0.02	0.05	130	0.7	150	0.1	0.5	16.5					
87063	32	1120	7.7		17	105	107		4.2	437.23	387.93	99.9	3.9	33.1	5.5	0	0.05	129.5	0.7	147.9	0.01	0	16.7					
87273	78	722	8		55	518	278		3	1102.14	986.86	155	5.8	92	70	0.02	0.02	335	2	385	0.3	1	56					
87274	133	1220			33	753	320		2.9	1442.04	1279.34	185	8.2	120	110	0.02	0.02	385	2.4	570	0.4	3	58					
87420		540	9.3		28	206	161		3.6	550.08	478.25	119	1.8	48.7	20.6	0.52	0.03	196.4	0	157.2		0	5.8					0
87536		1800		0.1	59	763	446		1.7	1315.9	1101.18	106.8	1.2	115.5	115.4	0	0	538.9	2.6	393.9	0.34	29.5	11.8	0.01	0	0	0	
87550	53	5500	7.9		55	1405	466		2.5	2207.42	1982.86	215	1.6	200	220	0.1	0.02	550	9	990	0.2	1	20.5					
87642		835	7.4		41	33	150		13.7	585.44	534.95	180	1	11.5	1	0.02	0.02	180	1.3	145	0.1	0.5	65					
87746	100	1930	7.8		24	418	295		2.1	846.44	692.54	100	2.8	67	61	0.02	0.02	350	4.7	255	0.1	0.5	5.3					
87767	163	2440			11	20	182		16.1	548.07	449.79	165	1.8	6.5	0.9	0.02	0.05	215	3.6	150	0.2	0.5	4.5					
87818	74	800	8.2		17	286	321		1.7	653.08	474.88	64.4	9.1	69	27.7	0	0.01	384.8	3.2	85.7	0.12	0.8	8.3					
94087	57.95	1980	7.6	0.8	34	824	429		4.2	1792.45	1562.68	275.3	1.2	99.7	139.8	0	0.01	519.7	1.9	727.7	0.32	6.3	20.5	0	0	0.1	0.01	
94102	134	2000	6.8	12.5	17	99	217		7.8	694.57	582.28	178.7	5.2	31.3	5.2	0.02	0	254.8	4.6	189.6	0.18	1.1	23.9	0	0	0	0.01	
94156	75	620	8.9	7.5	32	322	432		6	1164.75	936.39	245.5	1.5	51.4	47	0	0	512.6	7.2	278	0.21	12.9	8.4	0.02	0	0	0	
94176		1750	7.4	0.3	20	12	72		10.8	264.1	250.21	87.2	0.4	4	0.6	0.02	0	67.3	9.4	80.4	0.07	1.9	12.5	0	0.02	0	0.01	
94302		793	7.3			21			17.3	451.55	451.55	183	4.7	7.8	0.4	0.6	0.05			233		0.9	21					0.1
94424	110	1000	7.7	<1	38	144	221		4.7	592.97	501.35	130	2.4	26	19	<0.02	<0.02	255	6.6	140	0.2	<0.5	13	0.03	<0.05	<0.1	<0.05	
94434		825	7.3			74			8.3	370.82	370.82	164	3.6	14.3	9.2	0.2	0.02			155		0.1	24.3					0.1
94559	115	2800	8.7			1332	274		3	2181.73	2013.99	250	11.5	245	175	0.02	0.01	330	2.1	1000	0.1	3	165					
107140	100	1400	7.2	238	13	18	84		8.8	277.56	241.61	85.1	0.2	3.7	2.1	0.04	0	96.9	2.6	77.1	0.22	0.1	9.4	0	0	0	0	
41640003	101.5	1150	8.2	0.2	15	6	493		56.2	1013.53	738.93	307	1.2	2.1	0.1	0	0	569.1	15.6	103.4	0.65	2.3	11.9	0	0	0.1	0.09	
41640003	47.5	1141	8.8	118	13	6	526		55.9	1059.16	763.54	318.5	1.3	2.3	0.1	0	0	608	16.4	94.4	0.62	1.8	15.7	0	0	0.1	0.13	
41640003		1240	8.5		14	7	492		45.6	986.28	705.47	285	1.5	2.8	0.1	0.07	0.01	580	9.7	92	0.6	0.5	14					
41640003	0	1120	7.6		16	5	495		54.1	990	720	285	1.3	2.1	0	0.02	0	570	17	100	0.6	0	13.5					0
41640003		0	9		18	13	543		36.7	1070.71	768.49	300	2	4.9	0.1	0.4	0.01	630	16	97	0.8	0.5	19					
41640003	0	1650	8.5		16	6	530		55.7	1070	780	320	1.4	2.5	0	0.16	0	610	19.5	95	0.6	2.6	19					0
41640003	30	1500	9.2	556	14	6	527		56	1060	760	309	1.4	2.1	0.1	<0.01	<0.01	613	15	97	0.54	1.9	18.4	0.01	<0.05	0.14	<0.03	
41640003	30	1490	8.9	<1	16	6	487		54	997	728	295	1.5	2	0.2	<0.01	<0.01	562	16	110	0.58	<0.5	15.3	0.02	<0.05	0.12	<0.03	
41640003	45	5460	7.7				520				848	314	1.2	2.1	0.1	0.03	0.01	487.5		69.7			13.7	<0.01	0.1	0.15	<0.01	
41640003	45	1470	9.1																	0.59	<0							
41640004	30	1300	8.4		12	26	640		28.3	1230	860	335	5.4	9.6	0.6	3	0.12	760	12	99	0.1	7.6	3					0
41640004	92	1360	8.4		31	6	520		50	1040	760	295	2	2.3	0.2	1.4	0	600	14.5	100	0.6	2.5	15					0
41640005	20	1050	8.6	2.4	24	31	423		20.3	915.3	681.41	259	3.2	6.3	3.7	0	0.01	506.6	4.8	129.9	0.9	0.6	0.4	0	0.01	0.15	0	
41640005	25	1150	8.5	5	23	29	426		21	921	686	262	3.2	5.6	3.6	<0.01	<0.03	507	6.4	131	0.8	1.1	<1	<0.01	<0.05	0.15	<0.03	
41640005	22	1190	8.4	23.1	51	6	322		30.1	614.51	471.96	174.7	1.9	0.9	1	0	0	380	6.5	32.7	3.7	0	13.1	0	0	0.12	0	
41640005		1250	7.8	1710	54	24	200		9.6	403	333	108	1.4	3.9	3.5	<0.01	<0.01	243	0.6	27	0.66	<0.5	14.3	0.12	<0.05	0.1	<0.03	
41640005	17	1229	7.9	708	56	22	205		9.9	404	333	106	1.4	3.5	3.2	0.02	<0.03	250	0.3	27	0.7	<0.5	11.7	0.01	<0.05	0.06	<0.03	
41640005	15	0		612	58	21	186		9.1	371	314	95	1.2	3.1	3.1	0.01	<0.01	225	0.6	29	0.8	<0.5	13	<0.01	<0.05	0.06	<0.03	
41640005	0	0			18	26	306		14.1	615.66	448.13	165	3	5.6	2.9	0.04	0.02	365	4	69	1.1	0	0					0
41640005	0	1200	8.4		31	62	385		9.1	690	490	165	4	12	7.8	0.31	0.5	460	3.7	35	1	0	0					0
41640005	14.5	1266	8.6	1870	59	17	151		10	352	317	98	1.6	3	2.2	0.33	<0.01	184	0.2	38	0.82	4.1	19.3	0.07	1	0.15	<0.03	
41640038	9.8	563	7.2	500	43	209	258		3.7	661	544	124	1.3	36	29	<0.01	0.84	313	0.6	150	0.41	<0.5	11.5	<0.01	<0.05	0.06	<0.03	
41640038		1005	8.1	53	50	119	209		3.4	450	371	85	0.9	20	17	0.17	0.85	254	0.3	72	0.39	<0.5	1.1	<0.01	<0.05	0.05	<0.03	
41640038	9.5	960	8.3	120	51	125	202		2.9	425	351	74	0.9	21	17	0.62	0.91	245	0.3	64	0.46	<0.5	<1	<0.01	<0.05	0.05	<0.03	
41640039	17	1200	8.3	1	15	18	406		34	1040	862	335	2.5	6.8	0.4	<0.01	<0.01	375	58	250	0.99	<0.5	4.5	<0.01	0.32	0.12	<0.03	
41640039	15	1250	8.2	1	17	16	396		36	1050	844	329	2.3	5.5	0.6	<0.01	<0.01	441	20	250	1.1	<5	<20	<0.01	0.13	0.12	<0.03	
41640039	15	1487	8.3	<1	14	8	341		51	976	811	322	1.8	2.8	0.1	<0.01	<0.01	352	31	260	1.4	<1	5.8	0.01	0.11	0.11	<0.03	
41640040	10	1250	8.2	23	38	291	807		29	3600	3140	1140	1.8	46	43	<0.01	0.82	977	3.4	1300	0.9	<5	83	0.01	<0.05	0.06	<0.03	
42230024		750	7.7			324	440		2.8	849.12	576.16	114		62	41			537		90	0.12		5					
42230024		710	8.2		32	304	430		3	854</																		

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR	
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
42230025	39	820	7.8				179	392	10.3	1206.55	963.58	316	37	21	1.4		478		300	0.15			53						
42230025	47	695	7.9				359	472	10.6	1801.15	1508.37	461	58	52	0		576		564	0.15	0		90						
42230025	55	530	8.7				272	380	11.3	1565.7	1329.85	428	38	43	0.8		464		556	0.9			35						
42230025	24	720	8.5				371	380	10.8	1796.9	1561.05	478	66	50			464		708	0.9			30						
42230025	47	2400	8				303	510	12.2	1855.45	1539.29	487	118	2			622		545	0.45			81						
42230025	39	1150	8.3				324	485	10.2	1690.45	1389.54	424	100	18			592		490	0.45			66						
42230025	23	1700	8.1				2202	120	10.6	5307.8	5307.8	1145	825	34				72	2720	1.8			510						
42230025	47	855	7.9				397	520	9.7	1811.35	1489.09	443	50	66			634		545	0.35			73						
42230025	39	740	8.2				329	455	9.6	1602.3	1320.19	401	46	52			555		475	0.3			73						
42230025	23	815	7.7				1569	70	13.7	5098.75	5055.54	1244	580	29			85		2480	0.75			680						
42230025	47	830	7.6		30		345	375	10.6	1663	1462.74	452	4	46	56		453	2.3	600	0.4	1.3		48						
42230025	39	1670	7.6		15		279	490	11.8	1693.1	1408.2	452	4	36	46		590	3.5	480	0.3	1.3		80						
42230025	23	1600	8.1		12		1778	155	15	5754.4	5670.33	1450	8	448	160		189	0	2800	0.7	8.7		690						
42230025	47	950	8		20		123	445	16.9	1627.5	1374.54	431	3.5	41	5		537	2.8	520	0.1	0.1		87						
42230025	39	640	8.4		20		223	403	11.9	1483.5	1260.02	408	3	20	42		479	6.2	450	0.2	0.1		75						
42230025	23	1400	7.9		15		1511	121	19.8	6337.4	6277.17	1770	7.5	45	340		148	0	3100	0.1	1.8		925						
42230025	48	1950	7.4		20		341	452	10.3	1728.46	1472.45	435	4	49	53	0	0.06	543	4	550	0.2	0.2		90				0	
42230025	47	1950	8.5		26		229	371	12.6	1555.14	1370.2	440	3.3	9.4	50	0.04	0	415	18.5	530	0.1	1.8		87					
42230025	39	810			25		239	438	11.4	1527.1	1287.78	405	2.6	23	44	0.3	0	520	7.1	450	0.1	0		75					
42230025	23	590	7.3		17		2325	116	15.3	6778.55	6724.39	1700	7.6	395	325	0.1	0.05	140	0.6	4100	0.2	5		105					
42230025	47	580	7.6		27		337	465	10.3	1714.84	1462.28	435	3.4	46	54	0.02	0.02	550	8.2	530	0.2	1		87					
42230025	39	1000			27		297	466	10.2	1575.85	1323.29	405	3.2	39	48.5	0.03	0.02	550	8.9	445	0.2	1		75					
42230025	23	1135	7.5		27		2619	180	14.5	7395.73	7313.45	1700	8	455	360	0.23	0.1	215	2.2	3750	0.2	5		900					
42230030	20	1050	8				318	377	3.7	677.8		0	153	61.5	40		0	225.9	180.2					17.2					
42230031	16	810	8.1				302	344	4.1	696.5	696.5	161.6		61.5	35.8		0	205.9	188.8					42.9					
42230031	21	650	7.7				310	347	3.8	675	675	151.6		67.2	34.3		0	207.4	191.6					22.9					
42230031	23	650	7.8		76		159	171					24	24			208		110	0.05									
42230032	21	1200	8.2				315	437	3.5	643.5	0	144.4		60.1	40		0	261.7	137.3					0					
42230033		1000	7.7	20	99		126	210	3.6	496	468	92	17	20	18	<0.01	<0.01	249	3.9	78	0.14	<0.5	18.4	<0.01	<0.05	0.13	<0.03		
42230033	20	1070	7.6				196	301	4.1	497.6	497.6	130.1		35.8	25.7		0	180.2	114.4					11.4					
42230033	22	986	7.5		0		38	20	5.3	239.2	227	75		2	8		24		130	0.2									
42230034	22	771	8.1				315	437	3.1	596.3	0	125.8		60.1	40		0	261.7	108.7					0					
42230035	24	782	8.2				332	461	2.8	583.5	583.5	115.8		64.4	41.5		0	276	85.8					0					
42230035	22	948	7.5				313	651	7.3	1393.2	989.61	297		15	67		794		220	0.2									
42230036	21	0					382	466	2.1	583.6	583.6	93		84.4	41.5		0	278.9	85.8					0					
42230036	27						311	497	3.3	607.8	607.8	133		70.1	32.9		0	297.4	74.4					0					
42230036	46	1650	8				242	347	2.9	474.8	474.8	103		54.3	25.7		0	207.4	84.4					0					
42230037	37	745	7.1				362	465	2.5	889.15	600.94	110		74	43		567		95	0.15									
42230037	37	1030	7.3				362	465	2.5	889.15	600.94	110		74	43		567		95	0.15									
42230037	37	1000	7.6		25		241	395	3.3	764.9	546.93	117	3	39	35		478	1.8	80	0.1	1		10						
42230037	38	920	8		32		337	445	2.5	852.3	610.83	105	2.2	74	37		538	2.4	86	0	3.5		4				0.2		
42230037	37	930	8.3		30		222	363	2.9	682.82	491.71	100	2.1	34.5	33	0.01	0.01	435	4	69	0.1	0.5		4.6					
42230041	10	2741	7.7				324	515	3.8	1004.95	685.74	159		72	35	0.6		628		110	0.35								
42230041	10	2486	7.7				330	506	4	1021.35	707.73	166		66	40		617		132	0.35									
42230042	25	2250	8.3				280	364	1.9	442	442	72.9		67.2	27.2		0	217.4	50.1					7.2					
42230042	35	11500	7.9				249	332	2.3	444.8	444.8	84.4		57.2	25.7		0	198.8	65.8					12.9					
42230042	44	895	7.8				293	373	1.9	457.7	457.7	74.4		70.1	28.6		0	223.1	55.8					5.7					
42230042	44	1000	7.8				162	50	2.9	412.4	381.39	86		40	15		61		210	0.4									
42230042		940	8.4		10		185	180	2.1	477.7	376.89	65	4	46	17		218	0.6	95	0.3	1.8		30						
42230043	34						340	387	1.9	509.1	509.1	81.5		55.8	48.6		0	231.7	91.5					0					
42230043	30	1000	6.6				315	255	2.4	699.15	541.07	98		42	51		311		180	0.15				17					
42230044	105	2400	7.8				186	327	8.9	868.1	0	277.4		27.2	28.6		0	195.9	303.2					35.8					
42230047	46	820	7.6		27			397			680	107	1.3	50.7	27.2	<0.1	<0.05	397	0	88	0.1	4.3	4.4	<0.05	<0.05	<0.1	<0.05		0.4
42230047	42	1090	7.9				214	345	4.3	761.2	547.21	143		38	29		421		115	0.2	0		15						
42230047	49	1150	7.6				216	321	3.7	702.2	0	126		32	33		391		120	0.2	0		0						
42230047	55	1050	7.6				242	350	3.1	679.2	493.16	112		44	32		366	30	95	0.2	0		0						
42230047	73	1050	7.6				190	290	3.8	592.2	0	121		30	28		244	54	115	0.2	0		0						
42230047	73	1130	7.7				33	135	9.2	427.5	343.63	122		10	2		165		90	0.5			38						
42230047	73	1060	7.9				154	240	2.2	442.2	298.86	62	3	37	15		282	5.3	36	0.1	1.8			</					

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
42230047	50	3700	7.6		27	224	328		3.4	697.98	523.18	116	2	42	29	0.05	0.43	397	1.3	100	0.1	0	10					0.1
42230047	49				38	203	298		3.7	685	540.01	120	1.9	45	22			360	1.8	110	0.2	7.1	17					
42230047	71	980	7.6		31	230	329		3.3	720.32	553.08	115	3.5	43.5	29.5	0.01	0.01	390	5.5	125	0.3	0.5	7.5					
42230047	48	1000	7.3		35	233	351		3.3	722.32	543.83	115	2	39	33	0.01	0.01	420	3.7	105	0.1	0.7	3.8					
42230295	38	1050	7.5		32	269	310		2.1	666.8	508.7	80	2	60	29			374	1.8	85	0.2	0.8	34					
42230295	36	950	8.6		34	240	295		2	590	440	72	1.5	46	30	0.02	0.01	350	3.8	80	0.1	1.9	2					
42230374		650	8.3		39	452	419		1.6	863.32	650.72	76	0.7	26	94	0.02	0	495	7.9	150	0	3.9	9.8					
42230954	38	1900	6.9			178	258		3.7	621.5	463.42	115	5.5	40	19			311	1.8	111	0.2	0	18					
42230954	66	700	8.2			187	234		4.3	678.6	0	135	5	50	15			284	0.5	169	0.1	0	20					
42230954	31	1950	7.9		35	661	330		3	1317.25	1151.48	175	2.6	67	120	0.04	0.01	395	3.9	445	0.2	34.5	74					
42230954	31	1500	7.5		35	740	250		3.2	1440	1320	200	1.5	51	150	0.03	0	295	4.2	600	0.2	62	74					0
42230955	18	1440	9.1	56.7	42	877	455		3.2	1744.87	1505.83	216.2	13.2	87.6	160.1	0.01	0.53	553.1	0.8	708.6	0.13	0	5	0.01	0.01	0.01	0	
42230955		1550	8.2	4	35	879	549		1.7	1450	1140	114	1.7	113	145	<0.01	0.05	666	1.8	355	0.12	13	36	<0.01	<0.05	0.03	<0.03	
42230955	13	2000	8.2	1	38	929	534		1.6	1490	1200	111	1.7	122	152	<0.01	0.08	646	2.4	396	0.1	14	43	<0.01	<0.05	0.04	<0.03	
42230955		3800	7.5	<1	18	7	59		14	258	241	85	0.4	2.3	0.3	<0.01	<0.03	69	1.2	89	<0.1	<0.5	11.7	<0.01	<0.05	0	<0.03	
42230955	15	2500	8	<1	37	898	539		1.6	1470	1170	110	1.8	116	148	<0.01	0.07	653	2.5	380	0.2	13	42	0.04	<0.05	0.02	<0.03	
42230955	15	3100	7.6	2	40	1151	600		1.9	1832.57	1503.54	147	2.2	136	197	<0.01	0.06	726	2.4	572	0.1	2.7	47	<0.01	<0.05	0.01	<0.03	
42230955	56	997	8.4			720	234		2.3	1235	1091.15	140	5	130	96			283	0.9	540	0.1	0	40					
42230955	16	5800	7.8		37	1314	285		2	1877.75	1739.39	165	2.4	73	275	0.04	0.01	345	1.5	950	0.1	2.7	63					
42230955	16	790	8.1		39	2200	235		1.9	2820	2730	200	0.7	155	440	0.2	0	260	12	1600	0	2.1	150					0
42230955	17	1150	7.7			1850	425		1.5	2470	2210	150	10	180	340	0.02	0.02	510	1.9	1150	0.1	10	115					
42230957	17	2250	7.5	22	43	685	324		1.1	1050	899	66	1.6	105	103	<0.01	<0.01	389	3.2	350	0.16	25	11.4	<0.01	<0.05	0.05	<0.03	
42230957	19	430	7		34		341				901	58.2	1.4	99.9	92.1	<0.1	<0.05	340.6	0	285	<0.2	14.5	8.4	<0.05	<0.05	<0.1	<0.05	0.5
42230957	20	1870	7.8			397	310		1.2	719.9	529.8	55	2	60	60			374	1.7	150	0.2	0	17					
42230957	23	1200	7.6			401	308		1.1	702.3	0	50	1.5	65	58			372	1.6	142	0.2	0	12					
42230957	20	1900	7.9		36	461	241		1.1	737.75	626.35	56	1.3	56	78	0.04	0.01	290	1.9	245	0.1	3.6	5.8					
42230957	26	1510	8.1		36	486	206		1.2	759.63	671.1	61	1.4	56	84	0.02	0.01	245	3.1	285	0.1	12	12					0
42230957	26	617	7.9			550	250		1.2	840	690	63	1.3	82	84	0.01	0.01	300	1.6	285	0.2	15	11					
42230959	29	900	7.8			620	402		1	1060.8	813.26	60	3	80	102			487	1.6	135	0.2	0	192					
42230959	43					520	318		1.3	896.9	0	70	4	60	90			384	1.8	132	0.1	0	155					
42230959	107					316	264		2.1	705.7	0	85	3	50	46.5			317.6	2.1	107	0.1	0	94.4					
42230962	7	1980	8			467	525		1.7	951.2	628.43	85	1.5	47	85			635	2.5	85	0.4	0	9.8					
42230962	107					170	292		3.3	594.3	0	100	2.5	37.5	18.5			353	1.4	74	0.2	0	7.2					
42230962	47					462	535		1.8	975.6	646.73	90	4	50	82			647	2.5	80	0.2	5.9	14					
42230962	34				53	407	463		1.7	837.92	611.36	81	0.5	13	91	0.01	0.01	550	7.2	61	0.2	29	5					
42230962	13				51	409	466		1.8	844.42	615.85	82	0.5	17	89	0.01	0.01	550	9.2	57	0.2	32	7.5					
42230962	34				51	348	420		1.7	766.53	563.38	74	0.6	6	81	0.02	0.01	500	6	54	0.2	39	5.7					0
42230962	13				46	345	418		1.8	769.32	563.71	75	0.7	8	79	0.01	0.01	495	7.5	60	0.2	37	6.9					0
42230962	35	1850	8.4			170	235		2.6	490	350	77	2	28	24	0.01	0.01	285	1.3	68	0.2	1.4	6.6					
42230962	13	2750	8.3			520	570		1.5	1030	680	77	1	64	87	0.01	0.01	690	4.8	69	0.3	35	6.5					
42230963	16	1200		53.9	38	347	331		1.3	729.1	563.49	55.2	1.3	62.4	46.5	0	0.01	400.8	1.7	12	0.23	141.6	7.3	0.01	0	0.01	0	
42230963		0		1	12	4	133		19	277	232	89	0.4	1.7	0	<0.01	<0.01	113	23	41	<0.1	<0.5	7.9	<0.01	0.06	<0.02	<0.03	
42230963	12	1950	7.9	91	41	337	324		1.3	717	559	54	1.1	56	48	<0.01	<0.03	391	2	12	0.2	146	7.6	<0.01	<0.05	0.02	<0.03	
42230963	30	2750	7.9	1	19	5	149		19	301	263	98	0.4	1.6	0.2	<0.01	<0.03	113	33	43	<0.1	0.7	11.2	<0.01	0.12	0.02	<0.03	
42230963	50	440	7	1	16	4	98		20	273	239	88	0.4	1.3	0.1	<0.01	<0.03	99	9.6	63	<0.1	0.6	10.4	<0.01	<0.05	0	<0.03	
42230963		1700	7.6	13	15	5	104		18	287	243	88	0.6	1.6	0.2	0.02	<0.01	117	4.6	63	0.05	1.2	10	<0.01	0.05	<0.02	<0.03	
42230963	50	1150	7.8		12					271	83.3	0.3	1.5	0.1	0.1	<0.1	<0.05	101.2	10.5	65.8	<0.05	0.1	8.3	<0.05	<0.05	<0.1	<0.05	0.2
42230963	40	1350	8.2		12					292	100.9	0.1	1.8	0.1	0.1	<0.1	<0.05	131.8	12.1	38.5	<0.05	0.1	7	<0.05	0.07	<0.1	<0.05	0.2
42230963	107	1150	8			109	110		4	332	280.15	96	1	14	18			102	16	64			21					
42230963	47	1250	7.9			246	160		3	541	460.18	108	2	31	41		90	159	18	54			38					
42230963	54	2400	7.9		12	7	100		14.8	290.82	241.83	92	0.3	2.1	0.5	0.01	0.01	120	0.8	64	0.1	0.5	10.5					
42230963	56	7520	7.6		13	5	134		17.9	310.53	242.21	95	0.3	1.8	0.2	0.02	0.01	160	1.6	39	0.1	0.5	12					
42230963	17	1300	8		29	253	267		1.1	533.03	396.83	38.5	1.5	47	33	0.02	0.01	325	0.3	33	0.2	41.5	13					
42230963	70	1300	8		13	5	100		16.1	283.72	235.72	86	0.5	2	0.1	0.01	0.01	120	1.2	64	0.1	0.5	9.3					0
42230963	64	2100	9.7		12	5	130																					

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
42230967		438	8.7	<1	36	667	428		2.5	1290	1060	150	1.9	108	97	<0.01	<0.01	519	1.8	380	0.14	23	11.2	<0.01	<0.05	0.04	<0.03	
42230967		1240	8.2		20		138					147	0.8	3.2	0.2	0.19	0.03	150	8.9	137	0.1	0.5	4.2	<0.01	<0.05	0.02	<0.03	0.61
42230967	29	1200	8.2			574	345		1.9	1021.4	808.93	105	3	70	97			418	1.4	315	0.3	0.7	11					
42230967	107	2000				96	180		4.4	454.7	0	100	0.8	17	13			220		95	0.1	0	8.8					
42230967	107	2000			19	7	161		18.4	380.42	302.84	115	0.6	2.3	0.4	0.01	0.01	190	3	62	0.1	0.5	6.5					
42230967	67	830	7.8		20	19	164		11	385.33	306.21	110	0.6	6.6	0.6	0.02	0.01	195	2.5	63	0.1	0.5	6.4					
42230967	37	412	9.4		16	23	141		8.7	338.08	267.67	97	0.6	6.1	2	0.17	0.01	170	0.8	54	0.1	0.8	6.5					
42230967	107	862	8		19	8	167			367.62	287.5	105	0.7	3.2	0	0.01	0.01	195	4	55	0.1	0.5	4.1					0
42230967	67	455	9.5		28	238	271		7	1042.4	905.2	250	2.7	41	33	0.01	0.01	325	2.6	370	0.1	5.1	13					0
42230967	37	429	9.2		31	609	291		1.9	1040.33	893.42	105	1	71	105	0.02	0.01	350	2.4	390	0.2	9	6.7					0
42230967	107	427	8.8		20	5	162		19.6	357.62	278.5	100	0.7	1.8	0.1	0.01	0.01	195	1.1	55	0.1	0.5	3.3					
42230967	68	477	9.7		28	205	285		4.6	762.63	617.81	150	1.5	36	28	0.02	0.01	340	3.6	195	0.1	3	5.4					
42230967	37	439	9.5		33	611	389		1.8	1115.25	911.89	105	0.9	80	100	0.04	0.01	465	4.4	345	0.2	8	6.7					
42230967	66	460	9.4	5	36	625	464		2.8	1290	1050	160	2.2	110	87	<0.01	<0.01	560	2.8	350	0.1	13	11	0.01	<0.05	0.03	<0.03	
42230967	25	510	9.2	1	38	747	470		1.6	1250	1000	100	0.6	110	120	<0.01	<0.01	565	4.4	330	0.24	9	10	<0.01	<0.05	0.03	<0.03	
42231049		794	7.5		31	298	375		3.3	838.3	640.06	132	2.8	42	47			451	3	140	0.3	0.2	20					
42231049	20	764	7.4		13	246	296		3.1	699.5	534.6	110	3.6	39	36			350	5.4	135	0.3	2.2	18					
42231050	6	1050	7.9		30	326	355		3	843.9	655.84	124	2.5	43	53			429	2.1	170	0.2	0.1	20					
42231050	17	925	7.4		28	384	417		2.8	945	718.85	125	3.2	73	49			500	4.2	170	0.1	0.5	20					
42231051	45	815	8.8		48	298	332		3.5	820.9	663.55	138	2.5	60	36			404	0.3	180	0.1							
42231051		20500	7.2		33	286	314		3.9	830.5	671.87	152	2	57	35			377	3.2	190	0.2	0.1	14					
42231051	26	17800	11		34	272	312		3.5	804.4	646.78	133	2	56	32	0	0	377	1.6	190	0.1	0.1	12					0.6
42231051	26	750	8.1		40	298	368		3.5	873	689.35	140	1.9	60	36			440	4.5	175	0.1	0.5	15					
42231051	27	800			40	315	375		3.4	900	710	140	2.1	62	39.5	0.03	0.01	445	6.6	190	0.1	1.8	12.5					
42231080	18	760	7.8		28	170	240		2.9	530.64	411.24	86	0.6	35	20	0.03	0.01	290	1.4	84	0.1	0.5	13					
42231081	17	540	8.4		18	156	179		1.7	389.1	300.36	49	1.9	31	19			210	3.8	63	0.2	1.5	9.7					
42231084	21	880	8.3		33	209	284		2.6	594.9	455.08	86	1.8	41	26			340	3.2	89	0.1	0.5	7.3					
42231087	17	840	8.3		30	315	402		3.2	878.2	661.68	130	2	60	40			485	2.5	140	0.2	0.5	18					
42231089		1570	8.2		34	259	304		3.8	773.5	622.48	140	2	41	38			364	3.4	165	0.1	2	18					
42231089	23	797	7.5		40	300	358		3.6	872.8	694.24	145	1.7	54	40			430	3.5	180	0.1	0.5	18					
42231089	24	1000	8.3		39	310	370		3.6	890	710	145	1.9	53	43.5	0.01	0.01	440	5.2	185	0.1	0.8	16.5					
42231090		1050	7.6		45	127	430		11.1	1067.7	849.4	288	1.5	18	20			518	3.1	205	0.7	0.4	13					
42231110	18	850	8.2		10	256	260		2.1	617.1	472.07	79	3.5	45	35			305	5.9	125	0.2	4.5	14					
42231115	18	1050			10	223	165		1.4	431.7	340.04	49	2	40	30			200	0.7	104		2	4					
42231115	18	1020	8		10	228	167		1.3	428.6	335.92	46	2.4	40	31			202	0.8	104	0.4		2					
42231123		955	7.7		34	206	258		2.4	551.9	433.42	79	1	38	27			300	7.2	91	0.1	0.5	8.1					
42231135	81	1200	8			66	410		12	860	610	220	2.9	12	8.7	0.01	0.01	495	3.7	120	0.4	1.5	2					
42231136		940	7.8		31	209	273		2.1	554	417.77	70	1	41	26			329	1.7	53	0.2	0.1	32					
42231136	38	950	7.5		34	126	211		2.5	400.32	312.33	64	4	11	24	0.01	0.01	240	8.5	45	0.1	0.5	3.2					
42231136	37	900	8.1		33	265	350		1.7	620	440	62	1.3	62	26.5	0.02	0.01	410	8.9	45	0.1	0.9	2					
42231164	18	820	8.4		29	217	287		3.3	647.61	500.23	111	1.8	44	26	0.55	0.06	347	1.4	100	0.2	2.2	13					0.4
42231169	21	990	8.3	11.2	41	198	287		3.3	625.81	488.84	107.9	1.1	36.7	25.8	0.45	1.05	349.5	0.4	100.6	0.2	0	3.5	0.01	0.01	0.06	0.01	
42231169	20	1220	7.8	1.6	41	196	285		3.3	616.36	481.47	105.9	1	37.1	25.3	0	0.25	346.2	0.5	97.1	0.18	0	3.1	0	0	0	0	
42231169	17	1300	8	7	42	190	272		3.2	589	463	100	1.1	36	24	<0.01	<0.01	330	0.7	94	0.15	<0.5	1.9	<0.01	<0.05	0.03	<0.03	
42231169	22	1180	7.1	14	43	190	273		2.9	580	454	93	1.1	37	24	<0.01	<0.01	332	0.6	89	0.2	<0.5	3.5	0.01	<0.05	0.03	<0.03	
42231169	16.5	1180	8.1	1	14	13	546		45	1240	925	377	2.8	2.7	1.6	<0.01	<0.03	651	7.2	197	1	1.1	<4	<0.01	<0.05	0.25	<0.03	
42231169		1050	7.9	<1	42	188	277		3.1	593	464	98	1.1	36	24	<0.01	<0.01	337	0.7	92	0.12	<0.5	3.6	0.02	<0.05	0.03	<0.03	
42231169	24	1250	8.1		34	248	333		3.6	757.97	591.19	130	1.2	41.5	35	0.03	0.04	395	5.6	140	0.2	0.5	8.9					
42231378	50	1276	7.3		17		293				794	176.6	8.4	45.6	28	<0.1	<0.05	292.8	0	226	0.3	0.2	15.7	<0.05	<0.05	<0.1	<0.05	0.5
42231378	119	1200	8.3		19	234	291		4.8	859	702.64	170	8.2	45	29.5	0.02	0.08	345	4.7	235	0.5	0.5	20.5					
42231378	67	860	8.3		32	229	349		3	694.82	515.88	105	2.3	44	29	0.02	1.3	415	5.3	87	0.1	0.5	5.3					
42231378	50	1300	7.6	12	20	239	288		5	869	711	180	8.9	47	30	<0.01	0.08	350	0.8	240	0.26	<1	18	<0.01	<0.05	0.07	<0.03	
42231378	50	945	7.6	9	36	246	354		3.1	718	535	110	2.4	48	31	<0.01	<0.01	429	1.2	89	<0.05	<0.5	6	<0.01	<0.05	0.05	<0.03	
42231379	8	2500	7.9	<1	15	18	95		9.3	296	258	90	0.9	3.9	1.9	<0.01	<0.01	105	5.5	83	0.07	<0.5	6.4	<0.01	<0.05	<0.02		

Unique Identifier ¹	Bore Depth	EC	PH	Turbidity	SiO ₂	Hardness	Alkalinity (as CaCO ₃)	Sodium Adsorption Ratio	Total Ions	TDS	NA	K	CA	MG	FE	MN	HCO ₃	CO ₃	CL	F	NO ₃	SO ₄	ZN	AL	B	CU	PO ₄	BR
Units	m	µ S/cm	pH units	NTU	mg/L	mg/L	mg/L	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
42231379	70	11500	7.5		18	188	268		2.4	538.42	393.76	77	2.9	36.5	23.5	0.01	0.01	320	3.4	65	0.2	0.5	9.4					
42231412	41	860	8.1		31	224	350		2.9	660.68	477.49	99.9	1.6	35.2	33.2	0	0	420.4	3.5	62.5	0.11	0	4.3					
42231413	33	919	7.3		32	176	310		3.5	616.43	459.55	107.4	1.5	36.8	20.5	0	0	371.6	3.2	66	0.13	0	9.3					
42231414	25	11110	7.4	3.5	35	314	429		2.8	830.24	601.17	111.9	2.4	72.1	32.6	0	0	520.3	1.4	84.8	0.1	0.5	4.2	0.01	0.01	0.07	0.02	
42231414	25	10650	7.5	1.7	35	313	437		2.8	842.05	606.49	114.8	2.1	72	32.6	0	0.01	531.3	1	84.4	0.1	0	3.8	0	0.01	0	0.01	
42231414	25	2940	7.5	9	37	314	433		2.8	835	605	113	2.4	72	33	<0.01	<0.03	526	1.3	84	<0.1	<0.5	3.5	<0.01	<0.05	0.04	<0.03	
42231414	23.2	1680	7.9	1	35	322	438		2.7	846	611	113	2.3	74	34	<0.01	<0.01	531	2	88	0.06	<0.5	1.7	<0.01	<0.05	0.06	<0.03	
42231414	22	2580	7.6	5	41	316	428		2.6	827	603	108	2.2	75	31	<0.01	<0.03	521	0.9	86	0.1	<0.5	3.4	<0.01	<0.05	0.04	<0.03	
42231414	27	2450	8	10	36	329	434		2.6	842	610	107	2.4	77	33	<0.01	<0.01	527	1.4	90	0.1	<0.5	4.3	0.01	<0.05	0.04	<0.03	
42231414		2940	7.8	81	34	290	429		2.8	814	583	109	2.3	66	30	<0.01	<0.01	520	1.7	79	0.06	0.5	4.4	0.02	<0.05	0.04	<0.03	
42231414	25	2650	7.2	<1	36	307	443		2.9	843	606	115	2.2	70	32	<0.01	<0.01	537	1.5	81	0.06	<0.5	4.1	0.04	<0.05	0.04	<0.03	
42231414	25	2400	7.2		35		445				740	113.7	2.3	69.5	31.7	<0.1	<0.2	444.8	0	76.4	<0.05	0.1	0.7	<0.05	<0.05	<0.1	<0.05	0.4
42231414	26	9700	11.6		27		442				730	103	1.8	66.1	28.2	<0.1	<0.05	442.1	0	81	0.1	4.2	3	<0.05	<0.05	<0.1	<0.05	0.4
42231414	29	2500	7.8		31	214	347		3.5	693.75	513.15	117.3	2.5	31.7	32.7	0	0	415.5	3.5	86.3	0.11	0	4.1					
42231415	49	918	7.6		31	205	328		3.4	659.92	490.91	111	2.7	33.1	29.8	0	0	392.9	3.3	83.2	0.11	0	3.8					
42231416		973	7.6	2	40	253	277		2.4	635	503	86	5	53	30	<0.01	0.92	337	0.5	120	0.11	<0.5	6.4	0.04	<0.05	0.04	<0.03	
42231416		1020	7.8	367	38	248	296		2.6	665	521	94	3.4	52	28	<0.01	<0.01	359	0.9	120	<0.05	<0.5	7.4	0.02	<0.05	0.03	<0.03	
42231416	36	1020	7.5		35	215	262		2.7	588.21	464.21	91.1	2.7	44.7	25			312.8	3.5	105.2	0.11		3.1					
42231416	31	974	7.6	9	41	266	303		2.7	689	543	100	3	56	30	<0.01	0.01	368	0.9	120	<0.05	<0.5	7	<0.01	<0.05	0.03	<0.03	
42231432	30	790	8.5	12	35	289	386		2.2	718	515	87	1.3	62	33	<0.01	<0.03	468	1.6	61	0.1	<0.5	3.3	<0.01	<0.05	0.04	<0.03	
42231432		895	7.2	392	33	216	305		2.6	590	440	87	1.4	35	31	<0.01	<0.01	361	5.7	64	0.09	<0.5	4	<0.01	<0.05	0.04	<0.03	
42231432		2110	7.4	177	34	280	388		2.2	716	511	85	1.4	61	31	<0.01	<0.01	469	1.9	61	0.05	<0.5	4.1	0.03	<0.05	0.04	<0.03	
42231432	38	0			30	217	324		2.6	613.57	445.15	87.6	1.5	37	30.3	0	0	390	2.8	61.1	0.12	0	3.2					
42231600	20	320	8	7	38	340	413		1.2	694	482	51	1.7	53	50	<0.01	0.07	492	5.4	33	0.2	<0.5	7.2	<0.01	<0.05	0.04	<0.03	
42231600	20	1700	7.8		38		413					51	1.7	53	50	0.01	0.07	492	5.4	33	0.2	0.5	7.2	<0.01	<0.05	0.04	<0.03	0.17
42231668	42			<1	47	354	260		2.8	824	712	119	3.2	72	42	<0.01	<0.01	313	2.4	200	0.05	<0.5	75	<0.01	<0.05	0.05	<0.03	
42231668		1550	8	19	66	927	698		1	1440	1080	67	2.3	75	180	<0.01	0.09	847	2.1	220	0.22	<1	46	<0.01	<0.05	0.04	<0.03	
42231668	28	575	8.1	11	62	853	732		1.1	1420	1030	71	2.1	72	160	<0.01	0.08	888	2.7	180	0.09	<0.5	41	<0.01	<0.05	0.03	<0.03	
42231670		645	7.8	<1	23	44	211		7.4	448	342	113	2.8	15	1.6	<0.01	<0.01	253	2.1	51	0.14	<0.5	8.8	<0.01	<0.05	<0.02	<0.03	
42231671	50	1050	7.4		27		352				630	103	2.8	42.3	29.1	2.8	4.83	352.1	0	93	0.2	3.2	3.8	<0.05	<0.05	<0.1	<0.05	0.4
310-01-BH 2206	25.7	487	6.4			29	54		6.3		326	78	4	5	4	3.14	0.1	54	<1	115	<0.1	0.06	13	0.022		<0.05	0.002	
310-01-BH 2210	30.00	7820	7.76			237	692		43.2		4760	1530	14	24	43	77	6	692	<1	1870	1.6	0.07	108	0.382		0.25	0.155	
310-01-BH2201	29.22	1160	7.64			76	388		12		711	241	4	24	4	0.15	0.009	388	<1	149	0.2	0.33	10	<0.005		0.05	<0.001	
310-01-BH2203	25.00	506	7.14			49	166		6.28		966	101	3	13	4	8.56	0.649	166	<1	61	-	-	4	0.012		<0.05	0.003	
310-01-BH2216	18.50	6260	8.33			702	431		15		3880	912	8	141	85	5.19	0.792	419	12	1790	-	-	76	0.012		<0.05	0.002	
310-01-BH2231	17.40	1020	7.65			208	448		4.95		792	164	2	37	28	3.4	0.523	448	<1	68	0.3	0.16	8	<0.005		<0.05	0.006	
310-01-BH2233	24.50	635	7.79			164	225		2.51		442	74	1	36	18	1.07	0.424	225	<1	66	0.2	0.13	7	<0.005		<0.05	<0.001	
310-01-BH2234		582	7.91			122	208		3.15		374	80	1	24	15	1.08	0.583	208	<1	56	0.2	0.08	6	<0.005		<0.05	0.001	
310-01-BH2235	40.00	1020	7.81			285	381		3.04		724	118	2	63	31	5.12	2.16	381	<1	113	0.2	0.08	4	0.011		<0.05	0.006	
310-01-BH2309	15.00	3560	6.99			161	133		21.9		1770	640	4	25	24	3.9	0.736	133	<1	1060	0.1	<0.01	22	0.01		<0.05	0.006	
310-01-BH2344	15.00	1220	7.63			478	516		1.25		708	63	2	71	73	4.58	0.446	516	<1	108	0.2	5.24	13	0.008		<0.05	0.004	
310-01-BH2347	20.00	1220	7.64			414	312		1.43		772	67	<1	57	66	0.73	0.159	312	<1	240	0.3	0.8	9	0.008		<0.05	0.002	

¹Note: Unique identifier refers to the registered borehole ID as determined by the QLD Registered Bores Groundwater Database (DNRME, 2019), boreholes preceded with "310-01" refer to a Phase 2 Feasibility Design Geotechnical Investigation Groundwater Monitoring Bore

Appendix E

Cut and Embankment Groundwater Levels and Groundwater Aggressivity for Bridge Sub-structures

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

APPENDIX E

Cut and Embankment Groundwater Levels and Groundwater Aggressivity for Bridge Sub-structures

Name	Start (km)	End (km)	Length (km)	Median CL Elevation Along Cut (m AHD)	Median GW Level at Cut (m AHD)	Maximum GW Level at Cut (m AHD)	Groundwater Seepage Expected? *	Assumed Geology from Desktop Review and Nearby FFJV Groundwater Bores
C5	46.66	48.08	1.42	279.7	274.6	281.3	No	Sandstone
C6	48.80	49.71	0.91	295.5	288.4	291.9	No	Sandstone
C8	56.55	60.00	3.45	314.3	309.7	320.4	Yes	Sandstone
C9	60.65	61.24	0.59	310.0	304.8	310.7	Yes	Sandstone
C10	62.08	62.66	0.58	301.5	297.5	301.8	Yes	Sandstone
C25	114.31	114.69	0.38	451.3	436.6	441.7	No	Hard lateratised clay (CH)
C27	115.65	116.94	1.29	464.2	444.4	450.5	No	Hard lateratised clay (CH)
C28	121.26	123.00	1.74	467.8	448.7	455.8	No	Sandstone
C31	163.54	165.22	1.68	474.0	454.3	479.0	Yes	Sandstone and Shale
C32	165.52	166.84	1.32	495.5	488.9	490.8	No	Basalt
C37	172.65	174.94	2.29	548.1	541.9	562.0	Yes	Basalt
C39	177.49	178.66	1.17	576.6	565.3	571.8	No	Basalt
C44	188.32	189.82	1.50	509.3	505.5	518.1	Yes	Basalt
C45	191.70	192.69	0.99	478	472.8	485.5	Yes	Basalt
C48	201.25	202.22	0.97	475.5	471.5	475.2	No	Basalt

Note: Groundwater levels have been calculated based on correlation values except for C3 and C4 where water levels have been extracted from the groundwater model. * Based on maximum GWL Level at Cut

Embankment	Median Estimated Surface Elevation (m AHD) ¹	Median Estimated GW Level (m AHD) ²	Median Estimated GW Level (m bgl)	Potential Mounded GW Level (m bgl)	Formation ³
E01	238.8	228.5	10.3	7.3	WCM
E02	238.3	228.1	10.2	7.2	WCM
E03	239.3	229.1	10.3	7.3	WCM
E04	241.3	230.8	10.4	7.4	WCM
E05	243.2	232.7	10.5	7.5	WCM
E06	243.7	233.1	10.6	7.6	WCM
E07	243.7	233.1	10.6	7.6	WCM
E08	243.5	240.6	2.9	0.0	Alluvium
E09	249.5	245.9	3.7	0.0	Alluvium
E10	259.2	254.3	4.9	0.0	Alluvium
E11	257.3	252.6	4.7	0.0	Alluvium
E12	267.3	261.4	6.0	0.0	Alluvium
E13	265.3	253.4	11.9	8.9	WCM
E14	262.4	250.7	11.8	8.8	WCM
E15	270.3	258.0	12.3	9.3	WCM
E16	280.4	267.6	12.9	9.9	WCM
E17	293.9	280.2	13.7	10.7	WCM
E18	277.7	265.0	12.7	9.7	WCM
E19	278.5	265.7	12.8	9.8	WCM
E20	298.4	284.4	14.0	11.0	WCM
E21	293.3	279.6	13.7	10.7	WCM
E22	291.2	277.6	13.6	10.6	WCM
E23	294.8	281.0	13.8	10.8	WCM
E24	286.0	272.7	13.2	10.2	WCM
E25	285.7	272.5	13.2	10.2	WCM
E26	297.8	283.8	14.0	11.0	WCM
E27	308.8	294.2	14.7	11.7	WCM
E28	307.3	292.7	14.6	11.6	WCM
E29	311.2	296.4	14.8	11.8	WCM
E30	310.8	295.9	14.8	11.8	WCM
E31	314.0	299.0	15.0	12.0	WCM
E32	318.4	303.1	15.3	12.3	WCM
E33	319.3	303.9	15.3	12.3	WCM
E34	324.8	309.1	15.7	12.7	WCM
E35	332.1	316.0	16.2	13.2	WCM
E36	326.3	312.6	13.8	7.8	Alluvium
E37	323.3	310.0	13.4	7.4	Alluvium
E38	327.6	313.7	13.9	7.9	Alluvium
E39	331.8	317.3	14.5	8.5	Alluvium
E40	332.4	317.9	14.6	8.6	Alluvium
E41	337.0	321.9	15.2	9.2	Alluvium
E42	351.7	334.6	17.1	11.1	Alluvium
E43	356.1	338.4	17.7	11.7	Alluvium
E44	372.0	352.2	19.8	13.8	Alluvium
E45	381.8	360.7	21.1	15.1	Alluvium
E46	399.9	376.5	23.5	17.5	Alluvium
E47	435.2	407.1	28.1	22.1	Alluvium
E48	452.7	422.3	30.4	24.4	Alluvium
E49	452.6	422.2	30.4	24.4	Alluvium
E50	457.9	426.8	31.1	25.1	Alluvium
E51	458.4	434.3	24.1	21.1	WCM
E52	439.9	416.9	23.0	20.0	WCM
E53	407.5	383.1	24.4	18.4	Alluvium
E54	401.4	377.8	23.7	17.7	Alluvium
E55	379.3	358.5	20.7	14.7	Alluvium
E56	381.7	360.6	21.1	15.1	Alluvium
E57	426.9	399.9	27.0	21.0	Alluvium
E58	499.6	484.2	15.4	0.0	MRV
E59	499.6	484.2	15.4	0.0	MRV
E60	499.1	483.7	15.4	0.0	MRV
E61	502.4	486.7	15.7	0.0	MRV
E62	521.4	503.8	17.7	2.6	MRV
E63	559.9	538.2	21.6	6.5	MRV
E64	568.2	545.7	22.5	7.4	MRV
E65	550.0	529.4	20.6	5.5	MRV
E66	534.2	515.2	19.0	3.9	MRV
E67	528.1	509.7	18.3	3.2	MRV
E68	521.6	503.9	17.7	2.6	MRV
E69	520.9	503.3	17.6	2.5	MRV
E70	531.0	512.3	18.7	3.6	MRV
E71	514.6	497.6	17.0	0.0	MRV
E72	484.4	470.5	13.8	0.0	MRV
E73	432.9	423.1	9.6	0.0	Alluvium&MRV
E74	450.5	440.1	10.4	0.0	MRV
E75	459.1	447.9	11.2	0.0	MRV
E76	451.9	441.4	10.5	0.0	MRV
E77	454.5	443.7	10.8	0.0	MRV

¹Estimated surface elevation calculated based on the typical value for elevation along the proposed rail alignment (RL)²Estimated groundwater level based on correlation of groundwater, elevation and formation type³Formation determined from surficial mapping sources © Queensland Government Department of Natural Resources, Mines and Energy

Table E1: Estimated characteristics of groundwater at proposed bridge locations along the project alignment to inform durability assessment

Bridge Location	Kilometrage		SO ₄ ^A	Cl ^A	CO ₃ ^A	HCO ₃ ^A	Ca	Mg	Mg/Ca	pH	EC	T ^B	LSI	
	From	To	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[-]	[-]	[µS/cm]	(C°)	[-]	
Cunningham Highway Bridge ¹	25.640	NR	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Yarranbrook Farm Track Rail Bridge ²	48.561	48.630	14.0	233.0	2.0	380.0	48.0	35.0	0.7	8.0	1100.0		0.1	7.7
UT1 Macintyre Brook Rail Bridge ⁴	52.626	52.718	4.0	61.0	0.5	166.0	13.0	4.0	0.3	7.14	506		10.4	-1.6
UT2 Macintyre Brook Rail Bridge ⁴	55.200	55.522	13.0	115.0	0.5	54.0	5.0	4.0	0.8	6.40	487		12.8	-3.2
Pariagara Creek Rail Bridge ¹	66.100	66.292	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Cattle Tree Creek Rail Bridge ²	89.116	89.183	14.0	233.0	2.0	380.0	48.0	35.0	0.7	8.0	1100.0		0.1	7.7
Native Dog Creek Rail Bridge ⁴	94.957	95.055	76.0	1790.0	12.0	419.0	141.0	85.0	0.6	8.33	6260		6.4	1.0
Bringalily Creek 1 Rail Bridge ¹	98.459	98.529	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Bringalily Creek 2 Rail Bridge ¹	98.580	98.636	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Bringalily Creek 3 Rail Bridge ¹	101.430	101.584	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Nicol Creek Rail Bridge ¹	106.396	106.488	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Millmerran Inglewood Road Bridge ²	122.064	NR	14.0	233.0	2.0	380.0	48.0	35.0	0.7	8.0	1100.0		0.1	7.7
Back Creek Rail Bridge ¹	128.295	128.456	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Millmerran Inglewood Road Rail Bridge ¹	115.445	115.515	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Yarranlea Road Rail Bridge ²	160.685	160.754	14.0	233.0	2.0	380.0	48.0	35.0	0.7	8.0	1100.0		0.1	7.7
Oakey Pittsworth Road Rail Bridge ³	170.375	170.444	13.0	145.0	2.4	385.0	48.0	35.0	0.7	7.9	1080.0		0.1	7.7
Gore Highway Bridge ¹	154.228	NR	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Toowoomba Cecil Plains Road Rail Bridge ³	197.803	197.894	13.0	145.0	2.4	385.0	48.0	35.0	0.7	7.9	1080.0		0.1	7.7
Grasstree Creek #1 Rail Bridge ¹	137.478	137.814	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Westbrook Creek Rail Bridge ³	198.811	199.064	13.0	145.0	2.4	385.0	48.0	35.0	0.7	7.9	1080.0		0.1	7.7
Grasstree Creek #2 Rail Bridge ¹	137.842	138.794	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Dry Creek Rail Bridge ³	199.647	199.808	13.0	145.0	2.4	385.0	48.0	35.0	0.7	7.9	1080.0		0.1	7.7
Brimblecombe Road Rail Bridge ¹	200.408	200.477	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Condamine River South Branch Rail Bridge ¹	140.801	141.459	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Warrego Highway Rail Bridge ³	204.710	204.814	13.0	145.0	2.4	385.0	48.0	35.0	0.7	7.9	1080.0		0.1	7.7

Bridge Location	Kilometrage		SO ₄ ^A	Cl ^A	CO ₃ ^A	HCO ₃ ^A	Ca	Mg	Mg/Ca	pH	EC	T ^B	LSI	RSI
	From	To	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[-]	[-]	[µS/cm]	(C°)	[-]	[-]
Condamine River Main Branch #1 Rail Bridge ¹	142.059	143.977	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Condamine River Main Branch #2 Rail Bridge ¹	144.005	144.607	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Condamine River North Branch Rail Bridge ¹	147.222	148.790	5.3	91.5	4.4	415.0	54.3	35.0	0.6	7.6	1060.0		-0.1	7.8
Chamberlain Road Rail Bridge ³	203.755	203.842	13.0	145.0	2.4	385.0	48.0	35.0	0.7	7.9	1080.0		0.1	7.7

Notes: ^A Records retrieved from the Queensland registered bore database for an approximately 5 km wide corridor of the proposed project alignment.

^B T = Temperature – estimated at 20.0°C.

NR – Not reported.

1 – Median value of 11 alluvium groundwater samples.

2 – Median value of 7 bedrock (Walloon Coal Measures and Marburg Subgroup) groundwater samples.

3 – Median values of 5 Main Range Volcanics groundwater samples.

4 – Groundwater quality obtained from a Phase 2 Feasibility Design geotechnical investigation bore

Appendix F

Important Information Relating to this Report

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

APPENDIX F

Important Information Relating to this Report

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

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