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Genex Kidston Connection Project:
Draft Environmental Assessment Report
Powerlink Queensland

Appendix D

Hydrology Technical Report

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Kidston Connection Project Environmental Assessment Report

Powerlink Queensland

31-Aug-2018

Flood Hydrology and Hydraulics Technical Appendix

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Client: Powerlink Queensland

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1.0 Introduction

This technical appendix provides a summary of the potential flooding along the transmission line alignment to inform the surface water assessment associated with the proposed Infrastructure Designation. The document also provides flood extents for the Copperfield River and Mount Fox substations at either end of the transmission line.

Flood extents at the Copperfield River and Mount Fox substations are determined for the 0.5% Annual Exceedance Probability (AEP) flood event. At all other locations the 1% AEP flood extents are provided. Flood extents are provided for third-order streams or higher. Where possible this study leverages previous studies undertaken along the alignment to estimate the 1% AEP flood.

2.0 Previous Studies

Relevant previous flood and drainage investigations to localities along the transmission line are as follows.

2.1 Queensland Flood Mapping Program: Flood Investigation Burdekin Basin 2015

The Queensland Flood Mapping Program was developed as part of the Queensland State Government's response to the Queensland Floods Commission of Enquiry. As part of these works, basin flood mapping of numerous river basins was conducted at a high level throughout Queensland (KBR, 2015). A high-level TUFLOW GPU model was developed for the 1% AEP and the Probable Maximum Flood (PMF) of the entire Burdekin Basin (KBR, 2015). The results of the Burdekin Basin flood modelling are leveraged throughout this study to discuss flood impacts and extents for the Project.

3.0 Available Data

3.1 Terrain

The following Digital Elevation Model (DEM) data for the assessment was sourced from Elevation Foundation Spatial Data (ELVIS):

- Shuttle Radar Topography Mission (SRTM) ~1 second arc with a resolution of 30m
- 1m LiDAR DEM of the Kidston Mine.

The above datasets were combined into a single elevation layer for all catchments within the study. The elevation data is used to determine catchment areas for all third order (or higher) streams along the alignment.

3.2 Transmission Line

Shapefiles of the Kidston to Mount Fox Transmission line, transmission line structures, the location of the Copperfield River Substation and Mount Fox Substation was provided by Powerlink for this study.

3.3 Hydraulic and Hydrology Data

The Department of Natural Resource management (DNRM) Floodcheck mapping service was used to identify any existing and available data related to flooding in along the transmission line alignment.

A GIS dataset identifying the stream order data for the watercourses in the study area was available from the Queensland Spatial Catalogue (QSpatial). This dataset was based on Geoscience Australia's 1:100,0000 drainage network of Queensland where streams are connected and directionalised according to the Strahler method (DNMRE, 2010). Stream order was only available for streams in the

Burdekin Basin. Stream order in the Gilbert Basin was assessed as part of this study for areas where the transmission line crosses in the Gilbert Basin.

For the Gilbert Basin, stream gauge data in the study area was sourced from the Queensland Water Monitoring Portal for the purpose of estimating flood flows for higher order streams at the Draft Alignment. Details of the gauges are provided in **Section 5.1.1.2**. A Flood Frequency Analysis (FFA) of the gauge data was used to derive the 1% AEP Peak flow for the gauged catchments. The Regional Flood Frequency Estimation (RFFE) online utility was used for flow estimation within the ungauged catchments.

For the Burdekin Basin, 1% AEP flood extents taken from those created as part of the Queensland flood mapping program: Flood Investigation Burdekin Basin 2015 (KBR, 2015). Flood depth data was available from QSpatial as a raster dataset.

4.0 Substations

4.1 Copperfield River Substation

The Copperfield River substation is situated at the top of a small local catchment with no nearby significant drainage lines. Therefore major waterway flooding for the substation is expected to be negligible. Inflows will be from local runoff rather than associated with riverine flooding.

4.1.1 Hydrology

The size of the catchment draining to the nearest drainage path (including the substation) is approximately 24.32ha and is limited to an area to the west of Gilberton Road. Subsequently rational method calculations were used to estimate the peak discharge from the catchment.

CRC-Forge was used to obtain 0.5% AEP rainfall intensities for the catchment. The Bransby-Williams equation was used to estimate the time of concentration (19min). The runoff coefficient was estimated by using the methods outlined in the *TMR Road Drainage Manual* (DTMR, 2015). The parameters that were used in the rational method calculation are provided in Table 1 below.

Table 1 Rational method parameters for calculation of peak discharge

Parameter	Units	Value
Catchment Area	ha	24.32
Longest Flow path	metres	505
Catchment Slope	m/m	0.020
Time of Concentration	minutes	19
Rainfall Intensity (0.5% AEP, 15min)	mm/hr	184.9
Runoff Coefficient	%	95%
Peak Discharge	**m^3/s**	**12.5**

The runoff coefficient for the 0.5% AEP event was scaled from the 50 year runoff coefficient developed using the TMR Road Drainage Manual. A scaling factor for the 0.1% AEP (1.05) was adopted for the 0.5% AEP.

Sensitivity analysis shows that the peak discharge can vary between 10 to 12.5 m^3/s, depending on assumptions used. The most conservative value was adopted for this assessment.

4.1.2 Hydraulics

A cross-section through the Copperfield River Substation using high-resolution LIDAR data available for the mine was used to approximate the water level for the 0.5% critical duration storm (Figure 1).

Total flow to the catchment outlet was calculated and applied to the cross section which is situated further upstream, where the substation is closest to the local drainage line. The cross section was input into Bentley Flowmaster which was used to calculate the water surface elevation provided an assumed water surface slope and roughness value (0.008m/m and a Manning's n of 0.08 respectively). A sensitivity analysis was undertaken by lowering the water surface slope by 20% and increasing Manning's n by 20% to result in a higher water level.

Designs of the substation are not yet available and AECOM was provided with a shapefile outline of the substation. The intersection of the cross section and the shapefile was marked on profile as outlined in Figure 2. The 0.5% AEP flood event results in only 0.6m of water depth, corresponding to a water surface elevation of 544.9m AHD at the cross section location. The minimum natural surface elevation in the location of the substation is 544.3m AHD, approximately 1.4 metres above the 0.5% AEP flood elevation. The sensitivity analysis resulted in a water depth of 0.7m, 0.1m above the base case event. It is likely that construction of the substation will require cut and fill which would most likely further raise the base of the substation above this value.

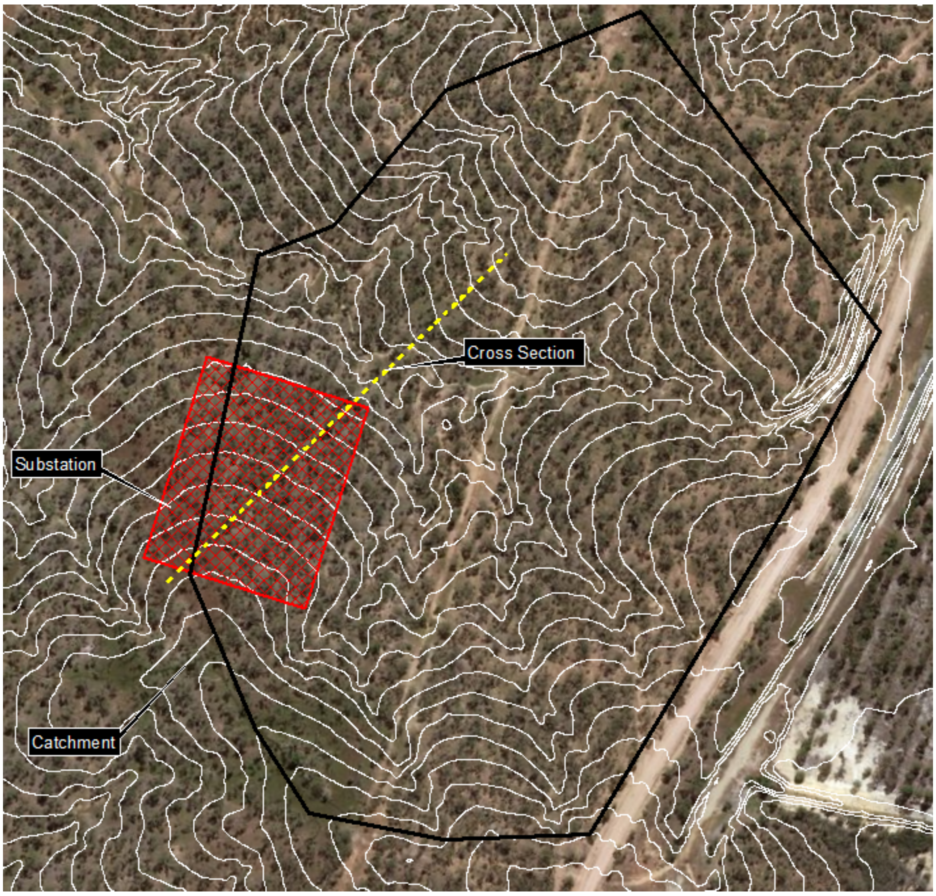

Figure 1 Location of substation and cross-section used for flood assessment

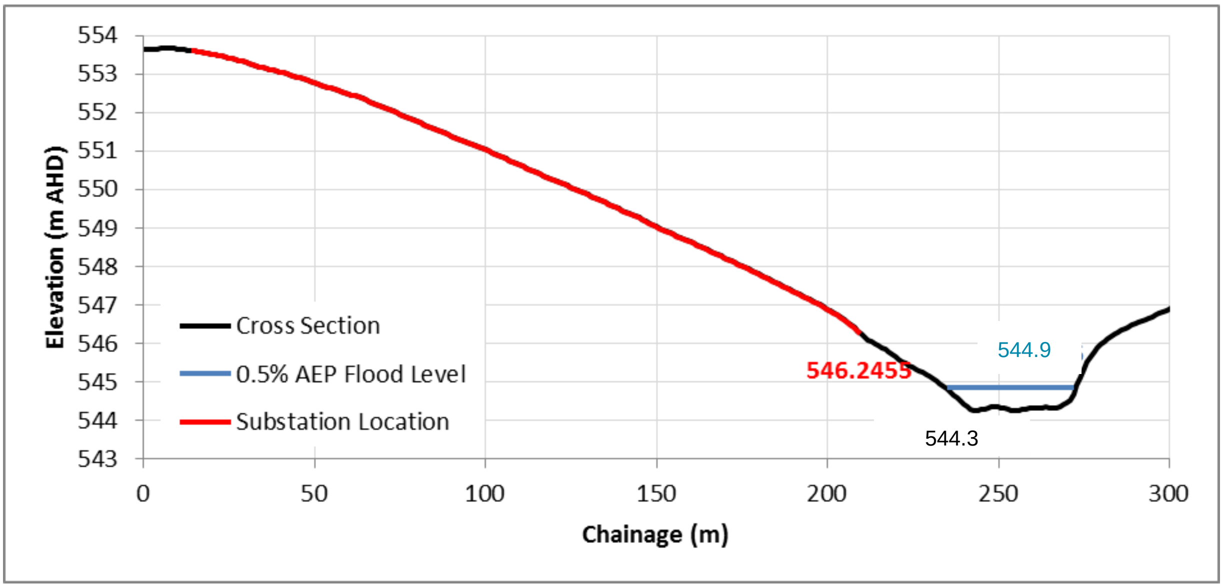

Figure 2 Cross Section through the Substation and nearby drainage line

4.2 Mount Fox Substation

The Mount Fox Substation is located away from any major waterways and therefore the risks of flooding are minimal. The substation is situated close to the catchment divide of a tributary of Michael Creek and a tributary of Douglas Creek within the Burdekin Basin.

The previous flood model results of the 1% AEP as and probable maximum flood (PMF) for the entire basin (KBR, 2015) were compared with ground levels and the substation location. The Mount Fox substation lies outside the flood extents provided for the PMF in Figure 3 and is estimated to be well above the flood level as illustrated in Figure 4. Therefore the flood risk to the substation is minimal.

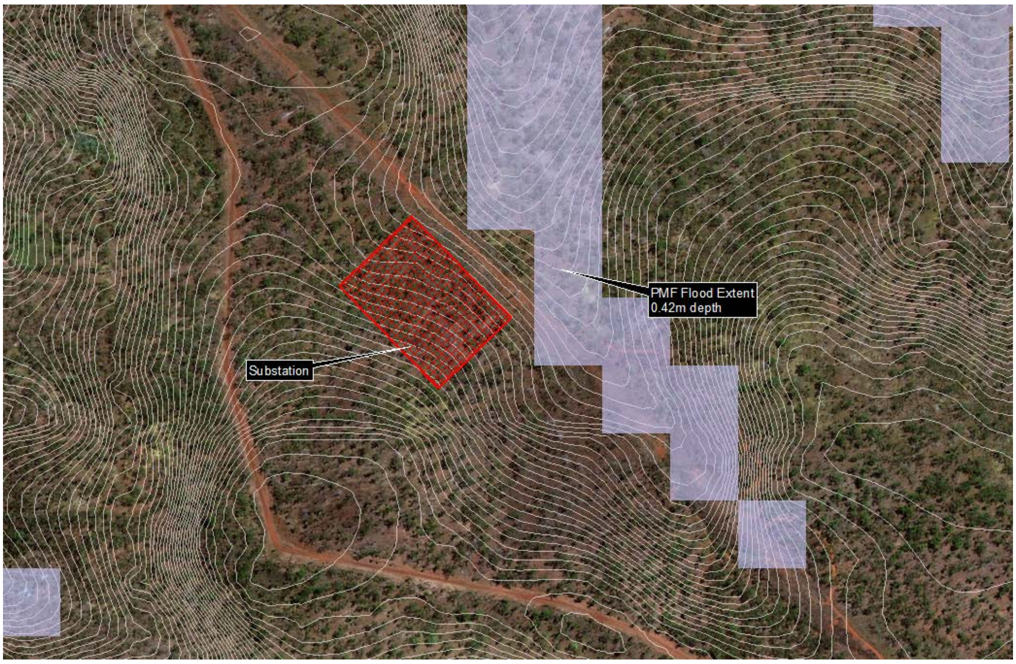

Figure 3 Mount Fox substation showing the flood extents for the PMF flood event

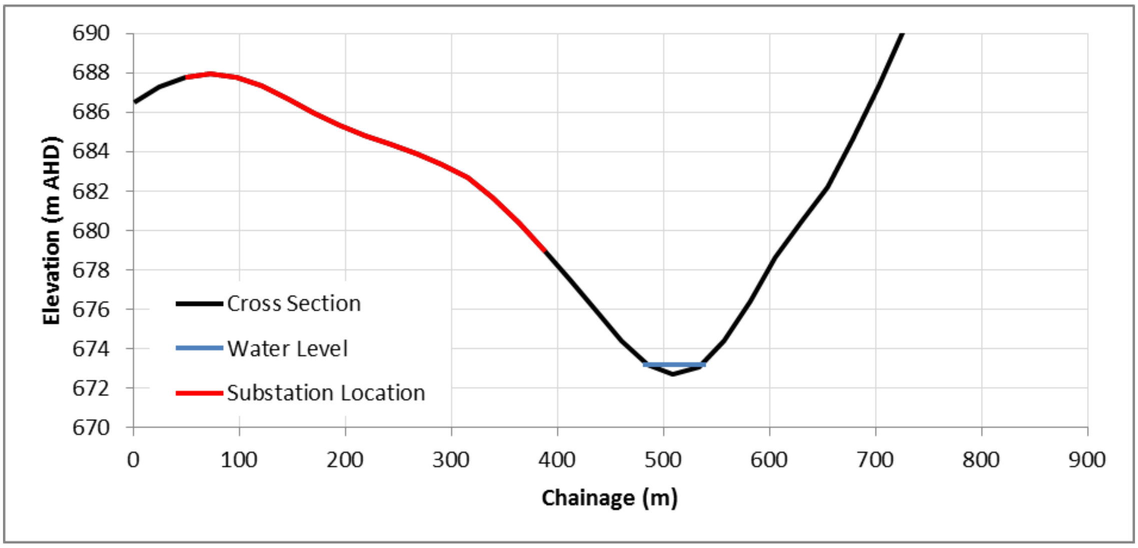

Figure 4 Cross section through the Mount Fox substation showing approximate flood elevations for the PMF flood event

5.0 Watercourse Crossings of the Transmission Line

The flood extents of the major watercourse crossings[1] were assessed at a high level to provide guidance of potential project impacts and inform infrastructure positioning.

5.1 Gilbert Basin

All flood estimates for the Gilbert Basin (except for the Copperfield River) have been derived using SRTM 30m grid data. This data has a low vertical accuracy (±10m). The flood levels quoted in this section are indicative only and should only be considered in relation to the SRTM derived ground levels.

5.1.1 Copperfield River

5.1.1.1 Hydrology

The 1% AEP peak flow at the transmission line crossing was estimated by scaling the 1% AEP peak flow predicted by the FFA of the available gauge data upstream of the transmission line. This method was used rather than the RFFE as the RFFE is less accurate for catchments greater than 1000 km^2. The main hydraulic control for the Copperfield River upstream of the proposed transmission line is the Copperfield Dam. The Copperfield Dam has a capacity of 24,000ML and was constructed on the Copperfield River in the early 1980s to service the Kidston mine site though a gravity feed pipeline (Genex, 2015 and DEWS, 2016). The dam has an uncontrolled spillway which is shown in Figure 5.

[1] For this study, a major watercourse crossing was assumed to have a stream order of three or higher

Figure 5 Copperfield Dam spillway (Genex, 2015)

5.1.1.2 Flood frequency analysis

Table 2 lists the details of the available gauges upstream of the crossing of the Copperfield River and the proposed transmission line crossing.

Table 2 Available Gauges upstream of the transmission line crossing

Gauge ID	Location	Catchment Area (km^2)	Period of Operation	Years of Record
917115A	Copperfield River at Spanner Waterhole	1,199	14/12/1983 - present	35
917110A	Copperfield River at Middle Creek Gap	1,212	06/01/1969 – 01/06/1986	17
917116A	Copperfield River at Kidston Dam Headwater	1,250	24/01/1985 – 06/05/2015	34
917118A	Copperfield River at Kidston Dam Tail Water	1,252	28/11/1984 – 05/05/2015	34

Gauges 917116A and 917118A recorded peak flows are controlled by the Copperfield Dam. Gauges 917115A and 917110A are upstream of the Copperfield Dam and are not influenced by the Copperfield Dam. The FFA for gauge 917116A was used to check the flood attenuation impact of the dam. The rating curve for gauge 917116A is more accurate than the other gauges as the spillway cross-section (Figure 5) is well defined (DEWS, 2016) and does not change with time. Gauge 917118A was not included in the FFA.

The available years of record for the FFA was increased by combing data from Gauges 917115A and 917110A. These gauges are 2 km apart, have similar catchment areas and there are no tributaries feeding the Copperfield River between the gauges. The recorded peak flows for the larger of the two gauged catchments (Copperfield River at Middle Creek) was used for the overlapping period of the gauges. Figure 6 shows the results for FFA undertaken in TUFLOW Flike 2016.

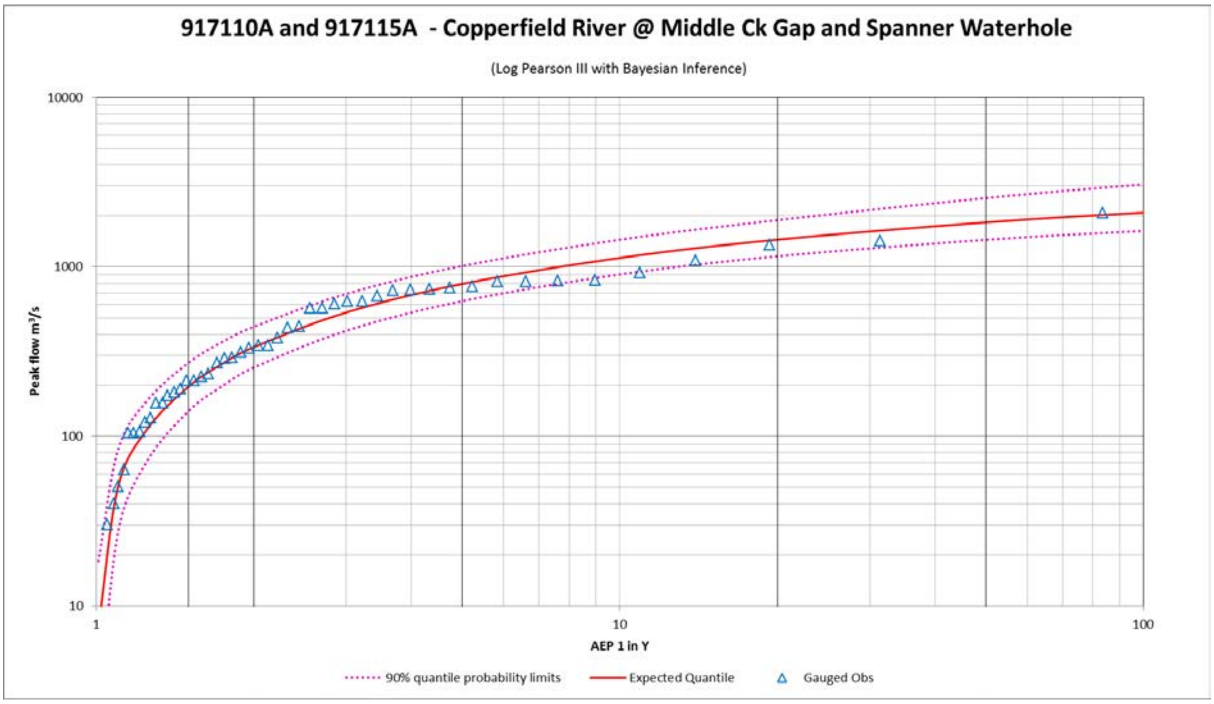

Figure 6 FFA Plot for Gauges 917115A and 917110A

The relatively narrow 90% confidence limits to the expected quantile shows that there is confidence in the expected 1% AEP peak flow of 2089 m^3/s.

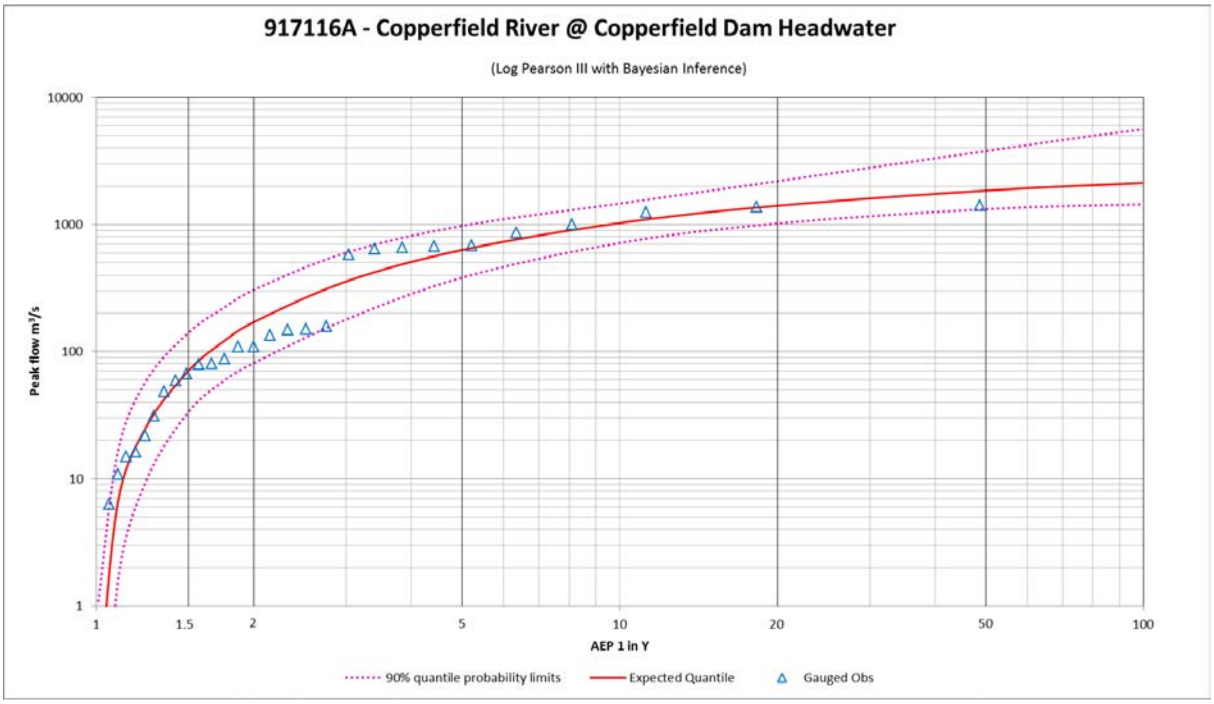

Figure 7 FFA Plot for Gauges 917116A

The expected peak flow of 2121 m^3/s at gauge 917118A is consistent with the increase in catchment area between gauge 917115A and gauge 917116A if the Copperfield Dam is at full supply level. The expected peak flow of 2121 m^3/s was used to estimate the peak flow at the transmission line crossing of the Copperfield River.

5.1.1.3 Peak flow estimation

As there is no gauge at the crossing of the transmission line, the peak flow was estimated by scaling the expected 1% AEP discharge by catchment area. Details of the gauged catchment of 917116A and the catchment up to the crossing of the transmission line are listed in Table 3.

Table 3 Details of gauged catchment 917115A and the catchment up to the transmission line crossing

Catchment	Catchment Area (km^2)	Shape Factor
917116A – Copperfield River at Kidston Dam Headwater	1,250	0.8
Transmission Line at Copperfield River	1,632	0.8

The catchment shape factor is defined as the shortest distance between the catchment centroid and catchment outlet divided by the square root of the catchment area. Narrower catchments have larger shape factors than wider catchments and tend to have lower peak discharges when other factors such as catchment slope, catchment area, soil infiltration and rainfall intensity are held constant. Figure 8 was created by Ladson (2016) using the RFFE online utility to demonstrate the shape factor's influence on the flood estimate from the RFFE.

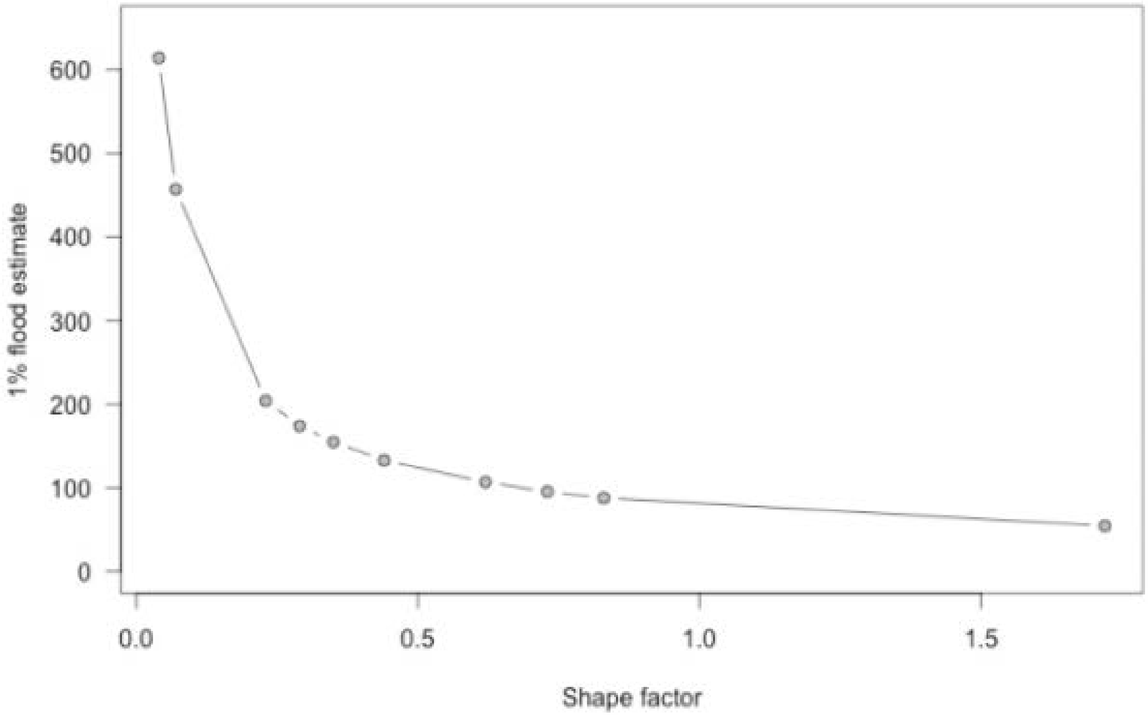

Figure 8 1% AEP flood estimate as a function of catchment shape factor when keeping all other factors constant (Ladson, 2016)

Figure 8 illustrates that the RFFE more accurately estimates floods for catchments with similar shape factors or shape factors over 0.5. The shape factors for the catchments in Table 3 are the same. This means that there is more confidence in the estimated peak discharge for the catchment up to the transmission line. Additionally, there are no major tributaries to the Copperfield River between the outlet of the gauged catchment and the catchment up to the transmission line. Table 4 lists the estimated peak flow for the catchment up to the transmission line crossing.

Table 4 Estimated peak flow to the catchment up to the transmission line

Catchment	Estimate Peak Flow (m^3/s)
Transmission Line at Copperfield River	2,843 (2,770)

5.1.1.4 Hydraulics

A steady state one-dimensional HEC-RAS model was developed to understand the hydraulic characteristics for the 1% AEP event of the Copperfield River at the transmission line crossing. Cross sections were developed approximately 50m to 100m upstream and downstream of the transmission line from the available LiDAR. Inspection of aerial imagery shows a moderately vegetated creek, extending to more heavily vegetated overbanks. For this reason, the Manning's 'n' for the creek was set at 0.05 for the main channel, and 0.07 for the overbanks.

The 1% AEP flood extents are show below in **Figure 9**.

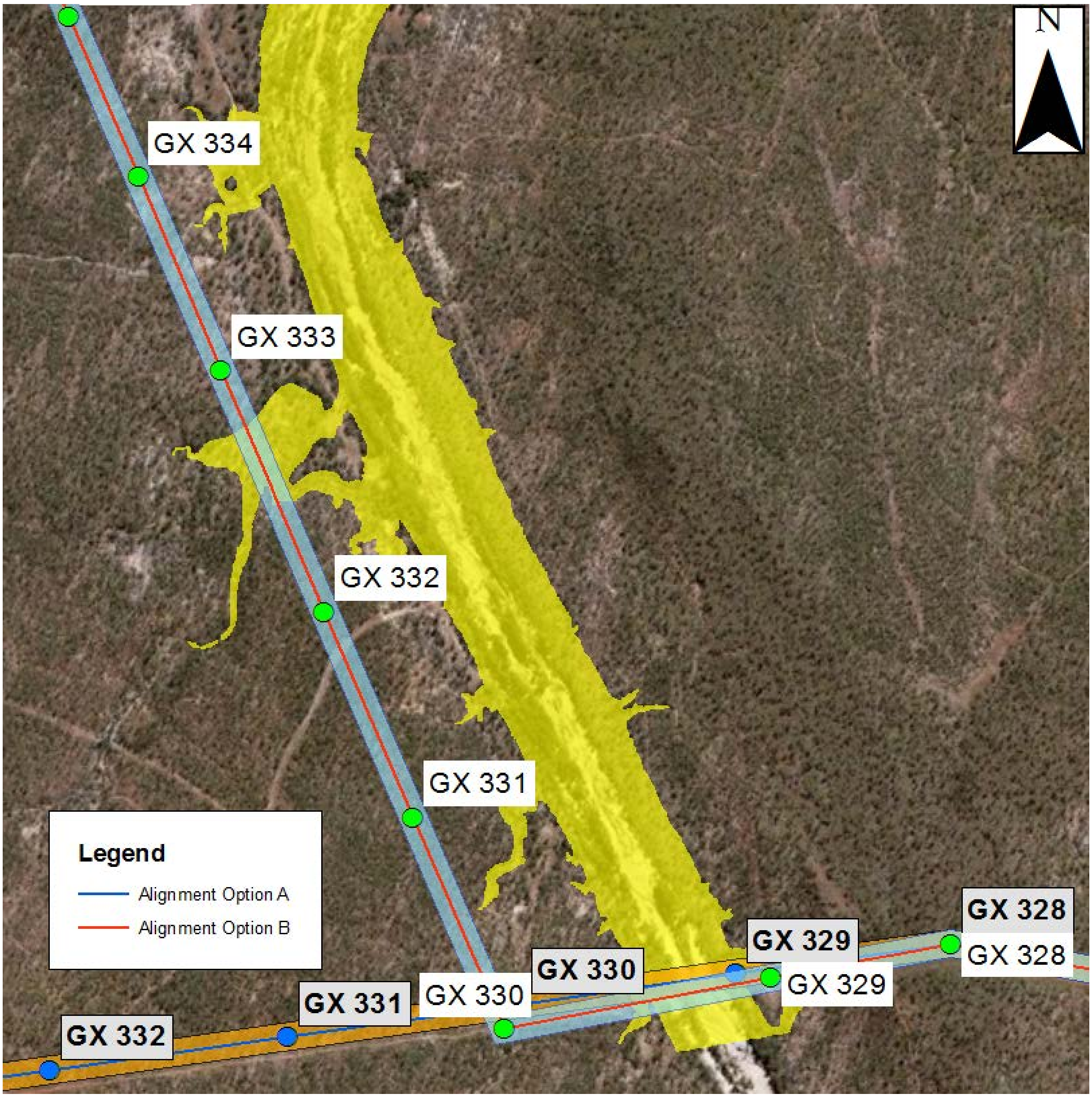

Figure 9 1% AEP Flood Extents – Copperfield River

An elevation profile of the modelled 1% AEP event at the transmission line crossing is show below in **Figure 10.**

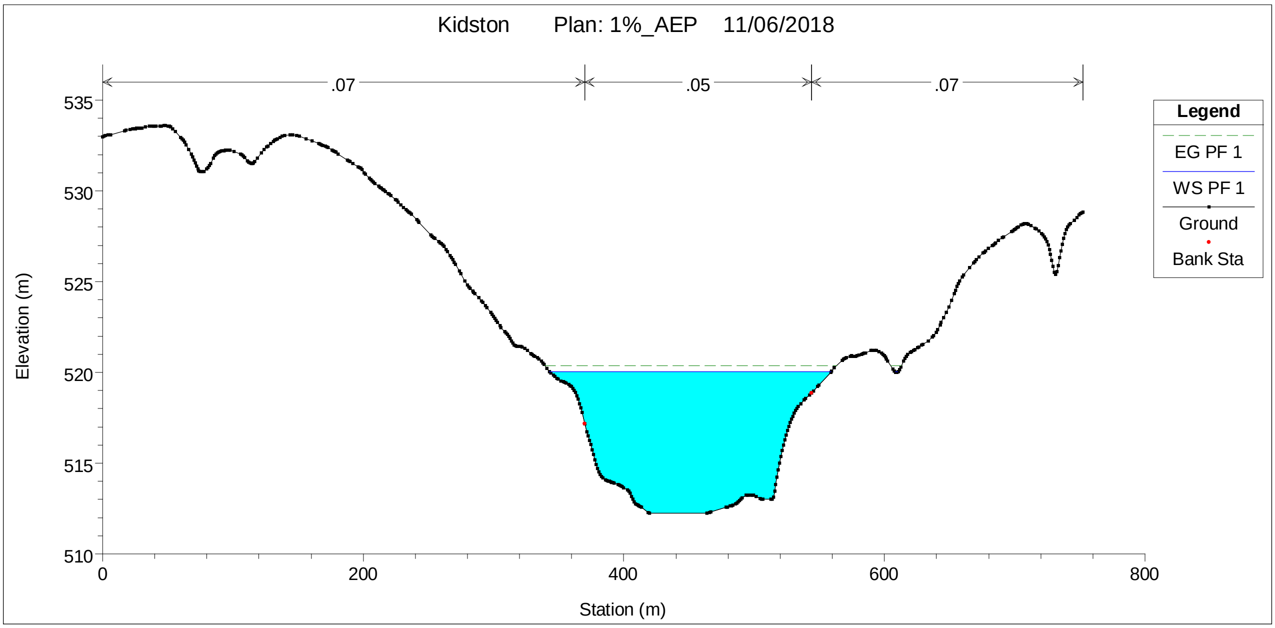

Figure 10 1% AEP Flood Elevation Profile – Copperfield River

As seen above, flood flows for the 1% AEP event are confined to the immediate area around the main channel of the Copperfield River at the proposed location of the transmission line.

5.1.2 East Creek

The 1% AEP peak flow was determined using the online RFFE utility and is presented in **Figure 11**.

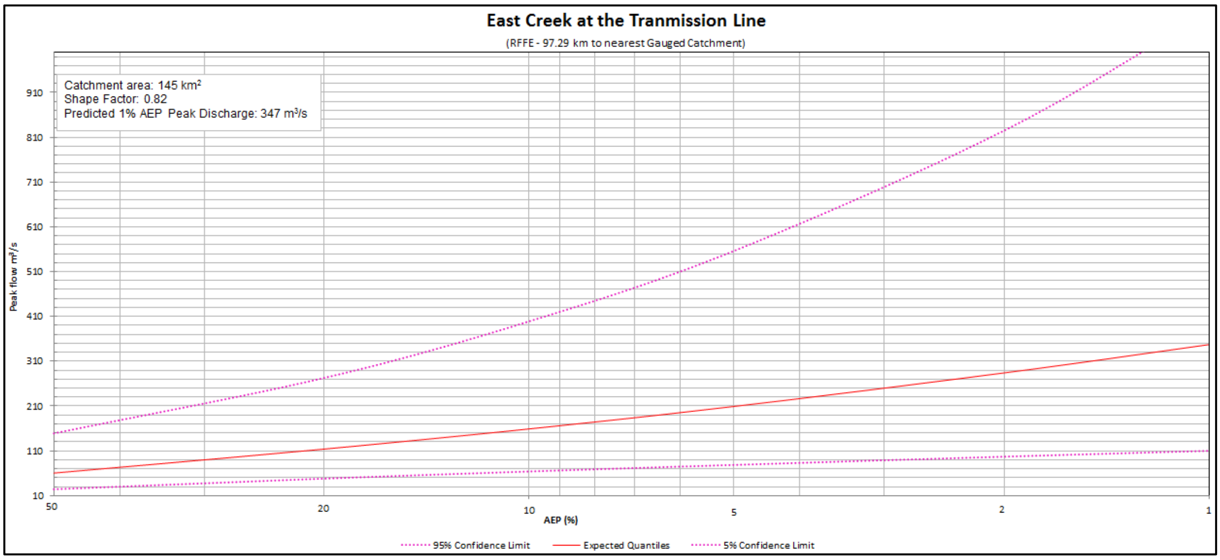

Figure 11 RFFE plot for the East Creek Crossing

A steady state one-dimensional HEC-RAS model was developed to understand the hydraulic characteristics of East Creek at the transmission line crossing, for the 1% AEP event. The available 30 SRTM DEM was used for the base topography. Cross sections were developed approximately 50m to 100m upstream and downstream of the transmission line. Inspection of aerial imagery shows a moderately vegetated creek, extending to more heavily vegetated overbanks. For this reason, the Mannings 'n' for the creek was set at 0.045 for the main channel, and 0.07 for the overbanks. The 1% AEP flood extents are show below in **Figure 12** with 100m chainages overlaid.

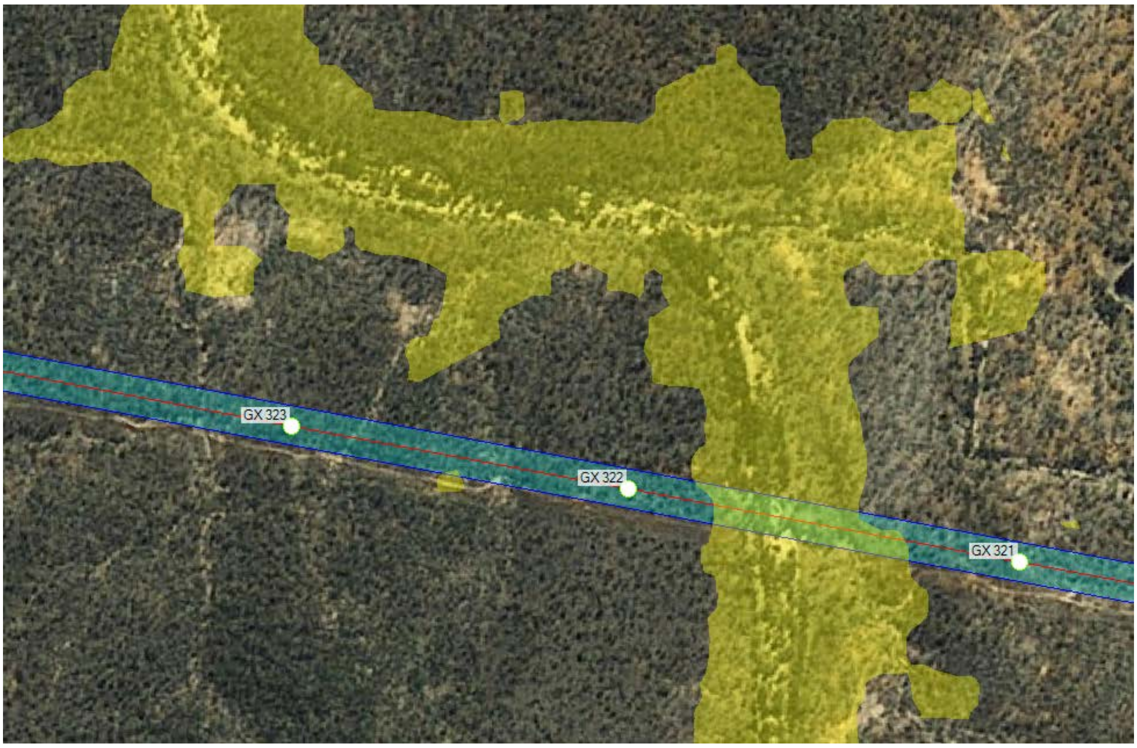

Figure 12 1% AEP Flood Extents for the transmission line at East Creek

5.1.3 Walkers Creek

The 1% AEP peak flow was determined using the online RFFE utility and is presented in **Figure 13**.

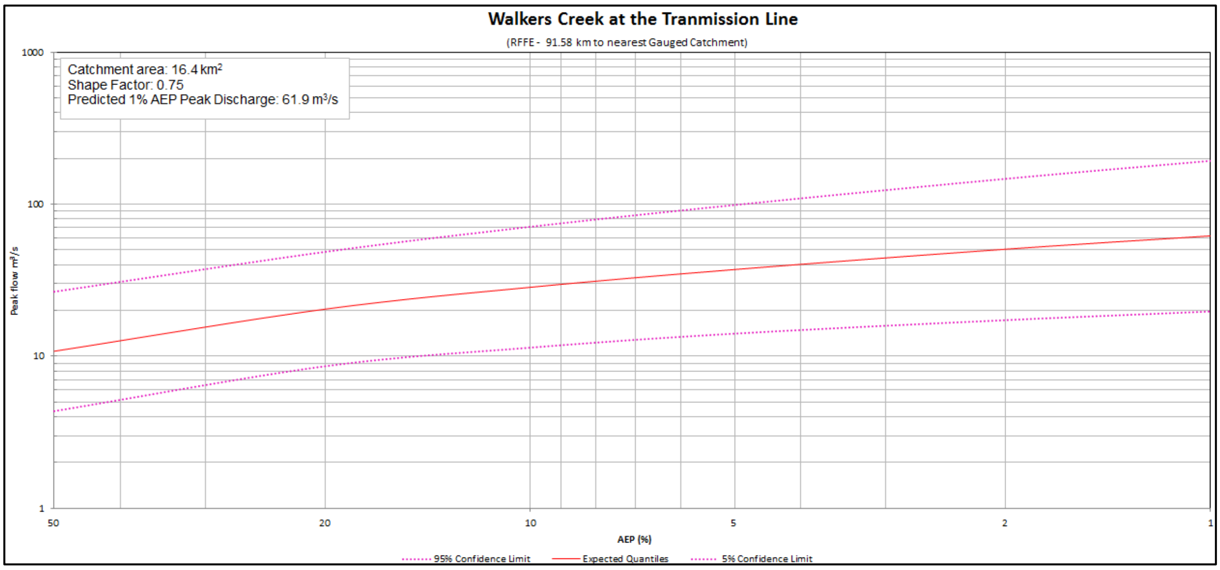

Figure 13 RFFE plot for the Walkers Creek Crossing

A steady state one-dimensional HEC-RAS model was developed to understand the hydraulic characteristics of East Creek at the transmission line crossing, for the 1% AEP event. The available 30 SRTM DEM was used for the base topography. Cross sections were developed approximately 50m to 100m upstream and downstream of the transmission line. Inspection of aerial imagery shows a moderately vegetated creek, extending to more heavily vegetated overbanks. For this reason, the Mannings 'n' for the creek was set at 0.045 for the main channel, and 0.07 for the overbanks. The 1% AEP flood extents are show below in Figure 13.

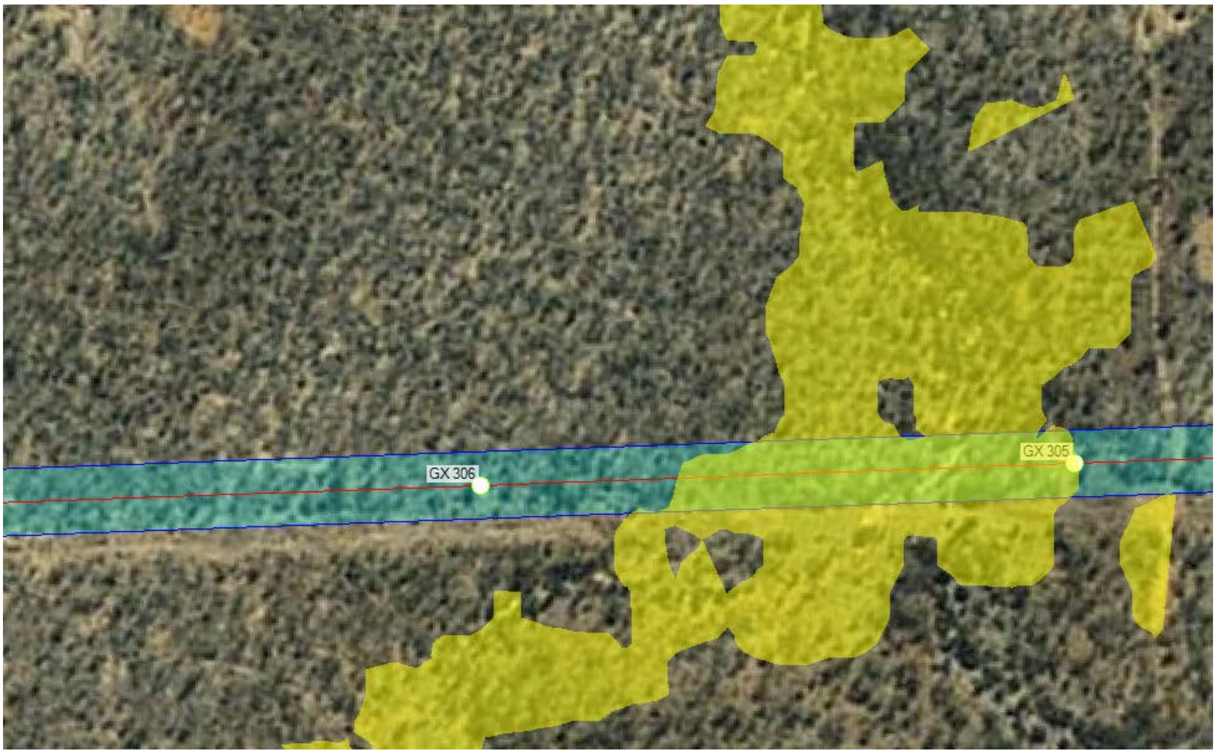

Figure 14 1% AEP Flood Extents for the transmission line at Walkers Creek

5.1.4 Einasleigh River and McKinnon's Creek

The 1% AEP peak flows were determined using the online RFFE utility and are presented in **Figure 15** and **Figure 16**.

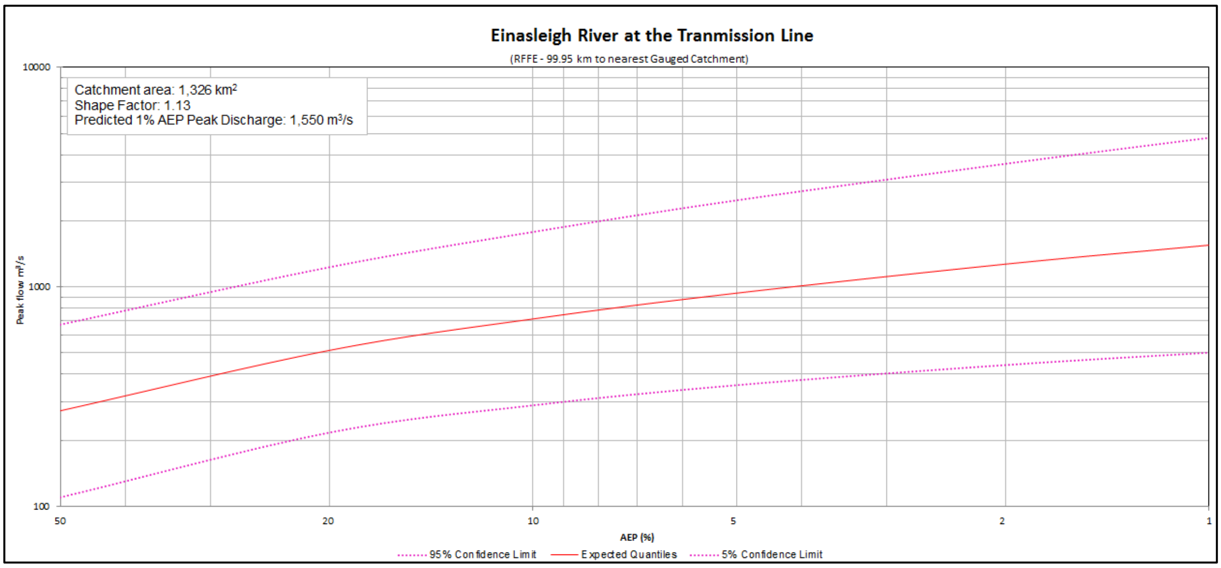

Figure 15 RFFE plot for the Einasleigh River Crossing

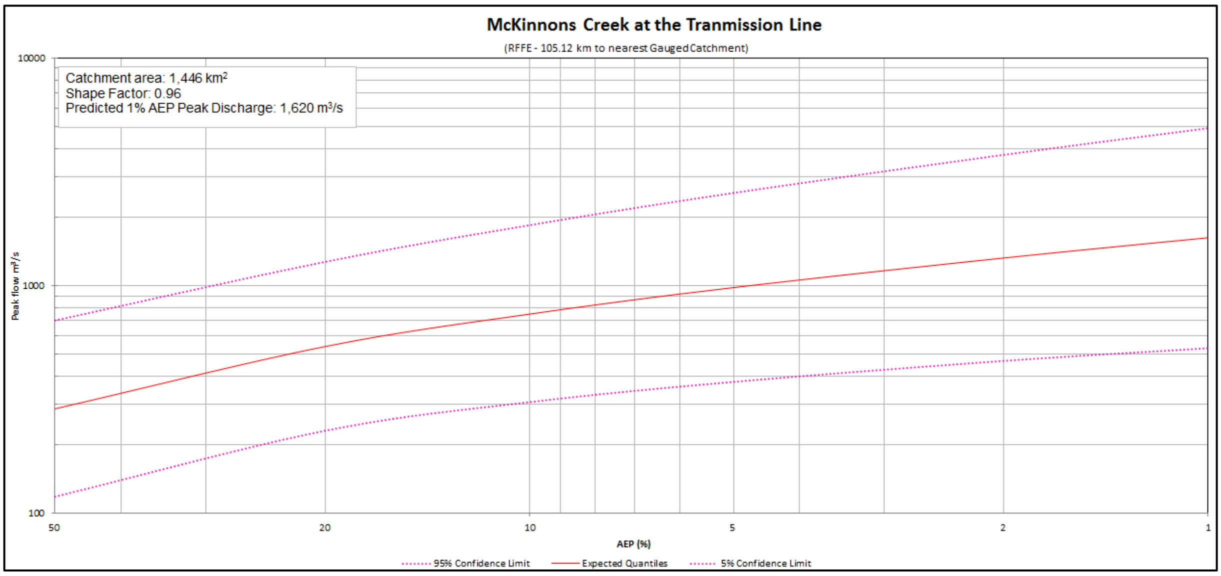

Figure 16 RFFE plot for the McKinnon's Creek Crossing

A stream flow gauge (917108A) was available downstream of McKinnon's Creek and the FFA is presented in Figure 17.

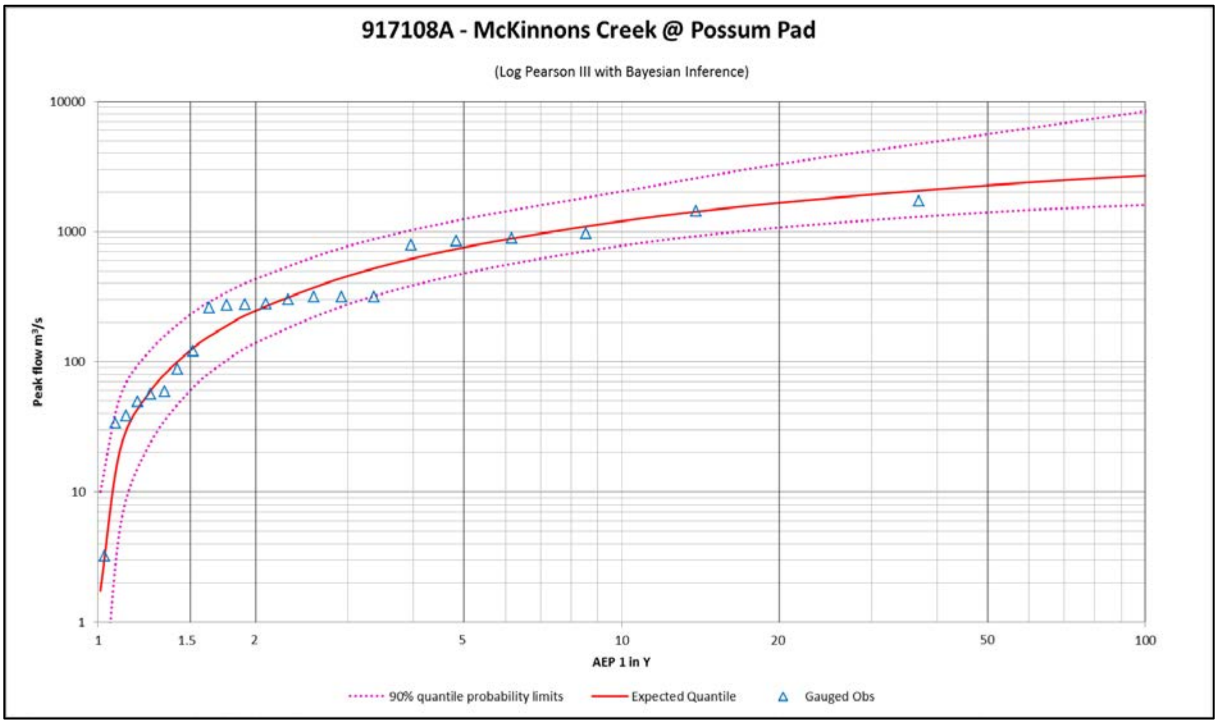

Figure 17 FFA Plot for Gauges 917108A

The predicted discharges in **Figure 15** and **Figure 16** have a lower level of accuracy as the catchment areas in are greater than the recommended maximum catchment area of 1,000 km^2 recommended for the RFFE.

Figure 17 shows that there is 22 years of data and the largest recorded stream flow has an AEP of greater than 2%. The shape factor of the catchment to gauge 917108A is 2.24 while the shape factor to the crossing of the transmission line at McKinnons is 0.96. There is a greater degree of uncertainty of the estimated 1% peak flow at the crossing of McKinnons Creek if the expected 1% AEP peak discharge in **Figure 17** was scaled by catchment area. Therefore, the RFFE in **Figure 16** for the McKinnons creek catchment up to the transmission line crossing was used.

A TUFLOW two-dimensional hydraulic model was developed along the transmission line from chainage 37.2 km to 43.9 km and includes the crossings with Einasleigh River to McKinnon's Creek. The available 30 m SRTM was used as the base topography and the model roughness was determined from the aerial imagery.

The predicted peak discharge for each waterway was applied as a constant inflow to the model with steady state flow conditions. The predicted peak discharge was applied separately for each waterway. The 1% AEP flood inundation extents in **Figure 18** is the maximum of both of these results.

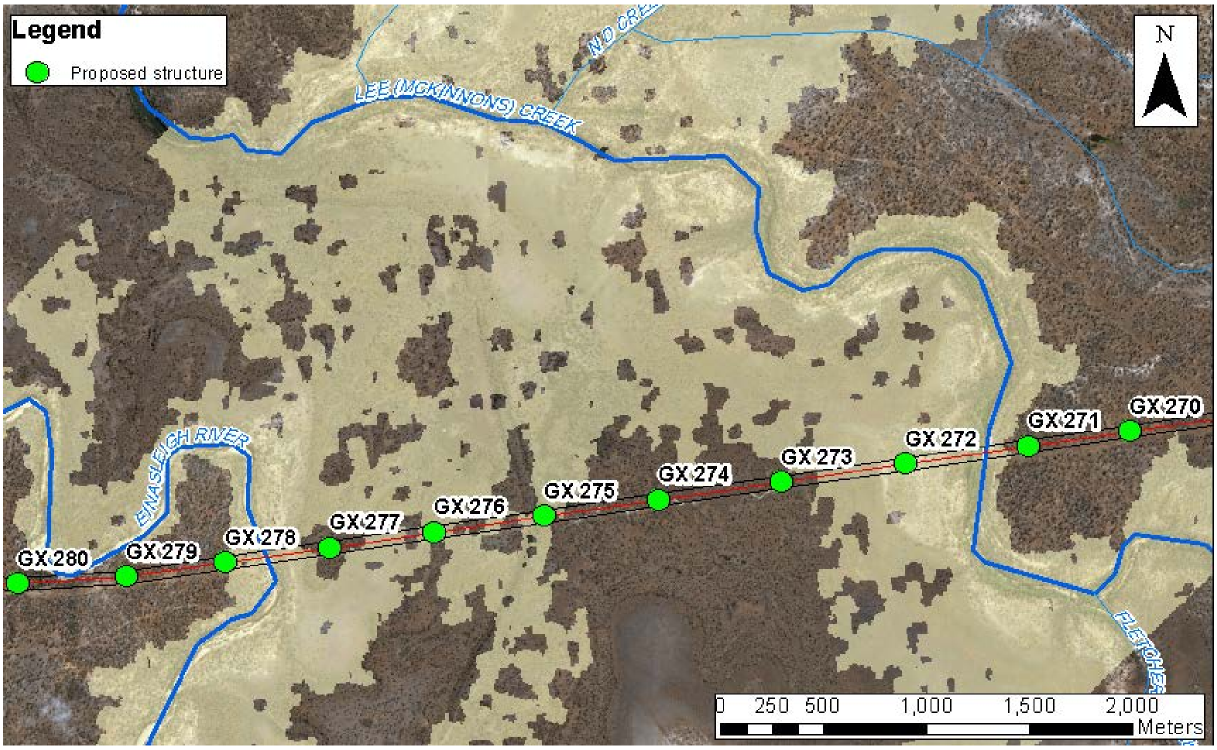

Figure 18 1% AEP Flood Extents for the transmission line at the Einasleigh River and McKinnons Creek

5.2 Burdekin Basin

5.2.1 Overview

The available Queensland flood mapping program - flood investigation Burdekin Basin 2015 mapping was used to identify the 1% AEP flood extents along the transmission line alignment. For the assessment, crossings with a stream order of 3 or more were identified using the available stream order GIS mapping layer.

5.2.2 Results

Table 5 provides a summary of flood overlay mapping at the Draft Alignment for higher order streams (3rd order or above). Flood extents for these crossings within the Burdekin Basin are illustrated within the mapping the Appendix A

Table 5 Summary of structures within the 1% AEP waterway flood extents

Waterway Name	Structures within 1% AEP Flood extents
Unnamed Creeks	GX 13
Unnamed Creek	-
Unnamed Creek	GX 17
Douglas Creek	-
Unnamed Creek	-
Unnamed Creek	GX 27
Unnamed Creek	GX 56
Unnamed Creek	-
Unnamed Creek	GX 65
Camel Creek	GX 77
Unnamed Creek	-
Perry Creek	GX 101 & GX 100
Unnamed Creek	GX 103 & GX 102
Unnamed Creek	-
Unnamed Creek	GX 116
Unnamed Creek	GX 118
Hopewell Ck/Burdekin River	GX 132, GX 131 & GX 130
Burdekin River	GX 142, GX 141, GX 140, GX 139 & GX 138
Gray Creek	-
Unnamed Creek	-
Greenvale Nickel Mine	-
Paddy's Creek	-
Paddy's Creek	GX 189 & GX 188
Unnamed Creek	GX 203

5.2.3 Flood Frequency Analysis

A FFA was also undertaken on a combined record from two DNRM monitoring stations on the Burdekin River 33km downstream from the Project. The purpose of the FFA was to highlight the major historical floods affecting the region in the Upper Burdekin catchment. The records from the two Burdekin River at Blue Range gauging stations (ID 120107A and 120107B) were combined to provide a record from 1952 until present. The ten largest floods during this time are provided in Table 6.

Table 6 Flood Frequency Analysis of historical floods from the Burdekin River at Blue Range

Rank	Peak Discharge (m3/s)	Year	Recurrence Interval	AEP
1	9660	1991	45	2.2%
2	8453	1956	41	2.4%
3	8447	2009	35	2.8%
4	6206	1953	18	5.5%
5	5772	1981	14	7.1%
6	5488	1974	12	8.3%
7	5290	1997	10	10.%
8	5159	1979	9	11.1%
9	4742	1998	8	12.5%
10	4211	1972	7	14.2%

6.0 Conclusions

Based on available data, the potential flooding along the transmission line and at the Copperfield River and Mount Fox substations was assessed.

The assessment indicated that the substations are not predicted to be inundated during the 0.5% AEP rainfall event and indicated that the structures (transmission towers) along the transmission line will be inundated during a 1% AEP rainfall event. More detailed hydraulic modelling is required to validate findings of the assessments.

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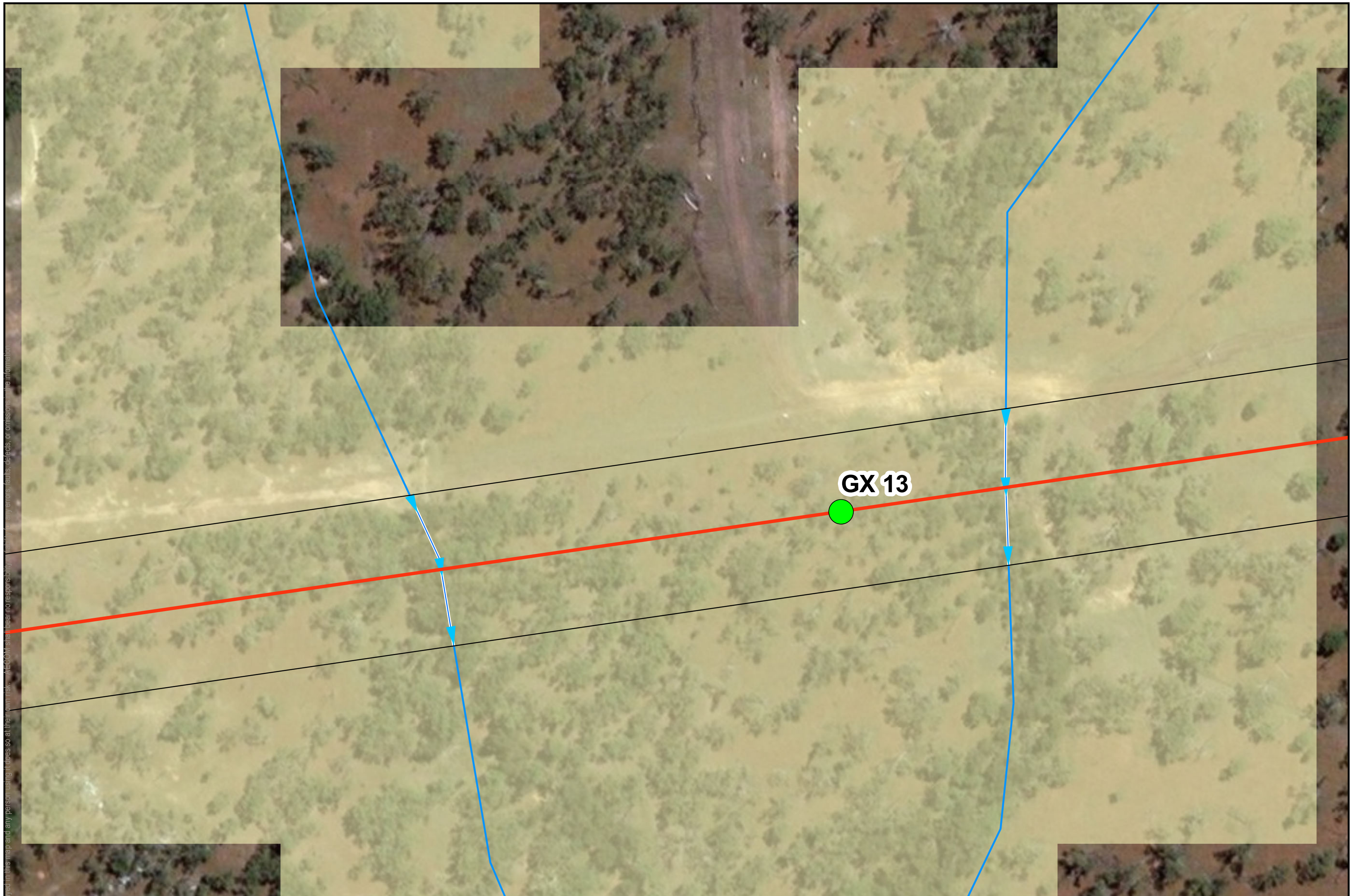
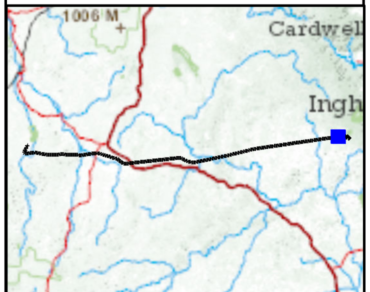
Appendix A

Burdekin Basin Flood Extents





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N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 15 30 60
metres
1:2,200 (when printed at A4)

LEGEND
- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents

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Environmental Assessment Report

Hydrology Appendix
1% AEP Flood Extents

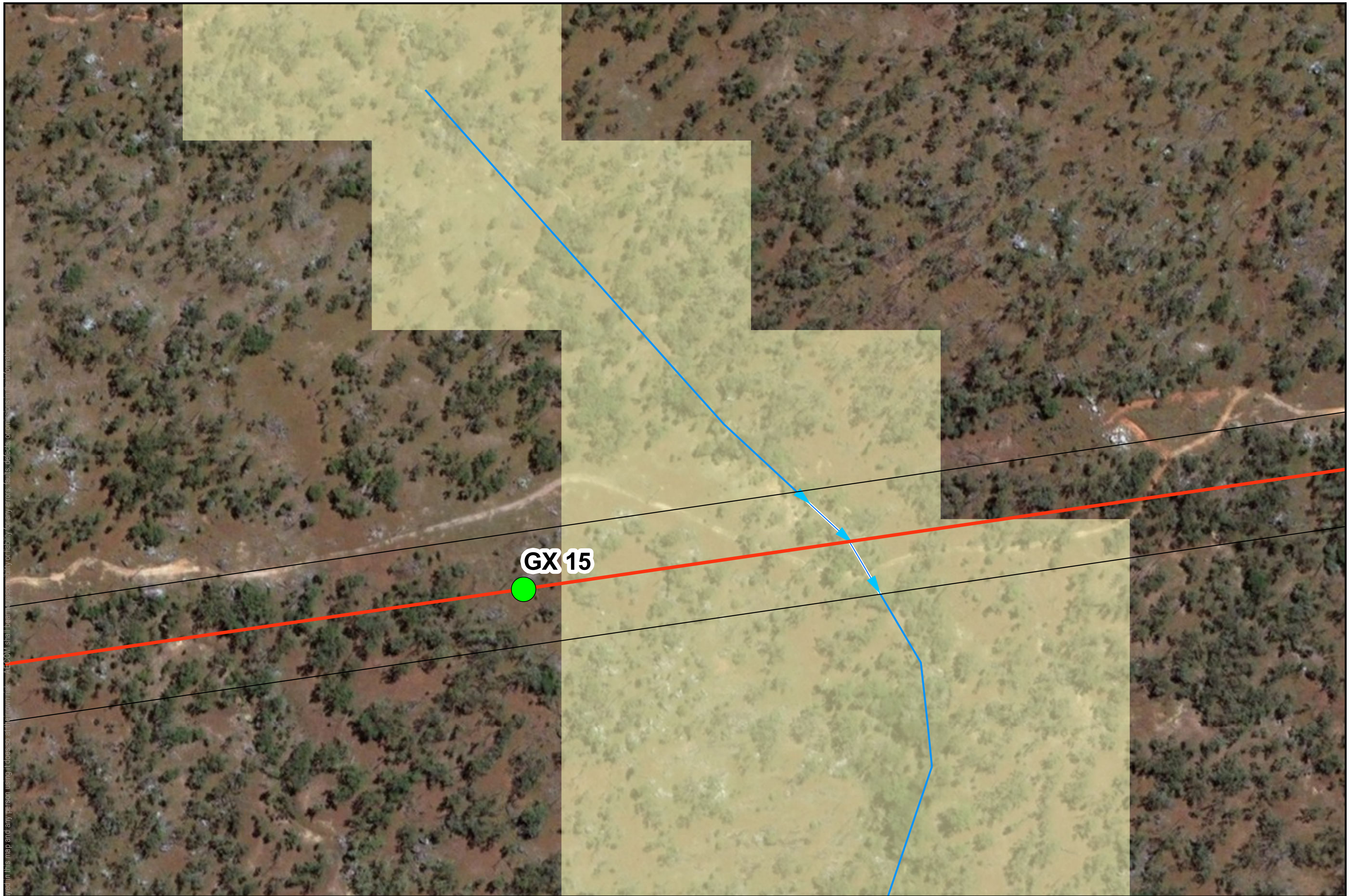
Unnamed Creeks

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A1

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

A4 size



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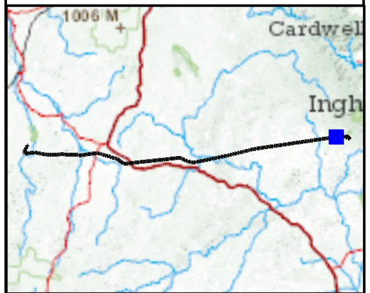
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 25 50 100
metres
1:3,000 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Connection Project
Environmental Assessment Report

Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A2

AECOM
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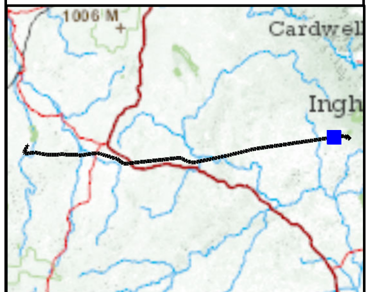
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 15 30 60
metres
1:1,900 (when printed at A4)

LEGEND

Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Hydrology Appendix
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Unnamed Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A3

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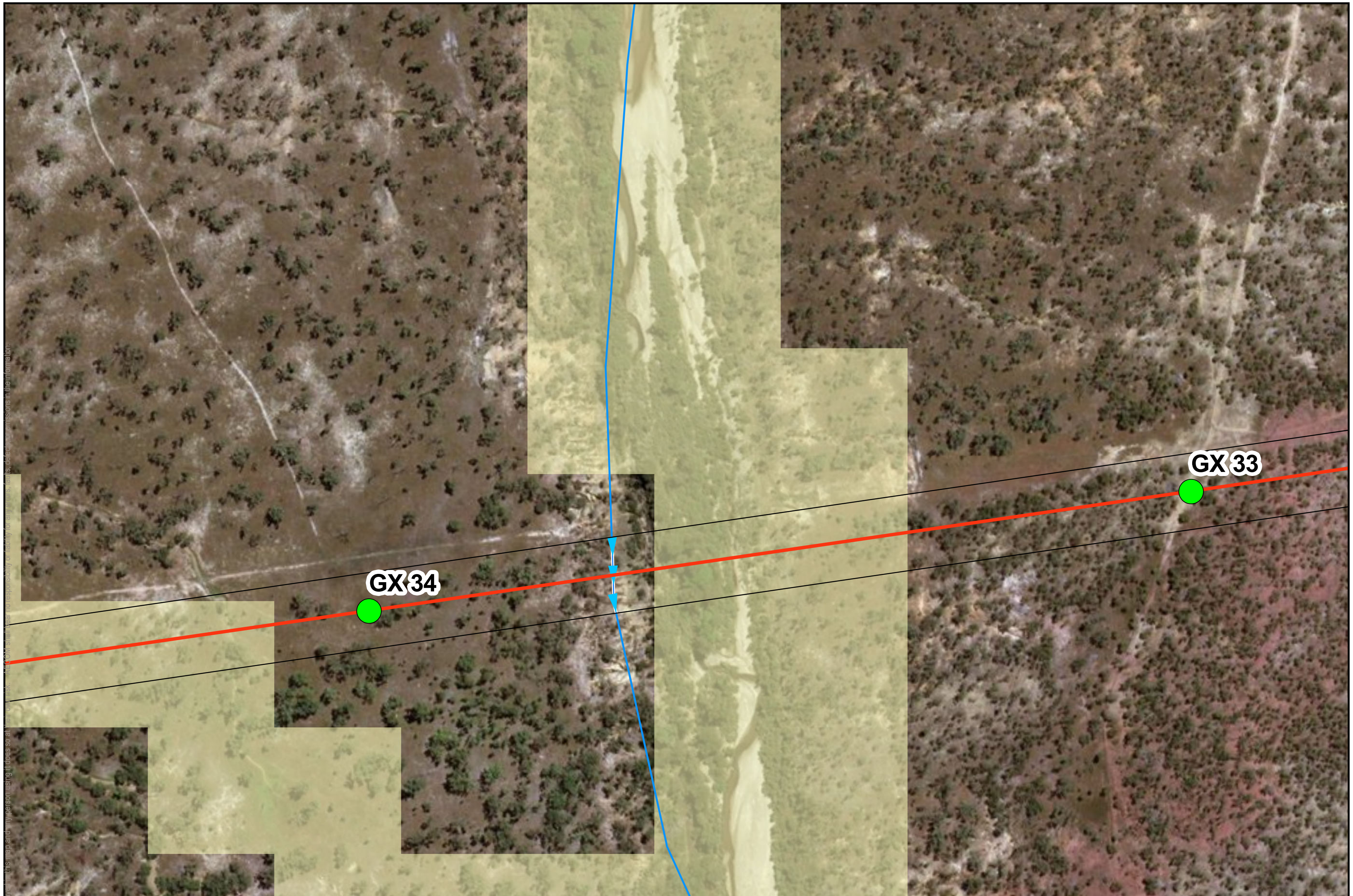
A4 size



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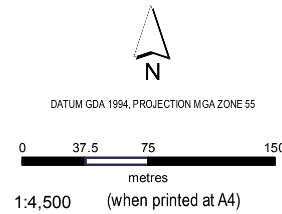
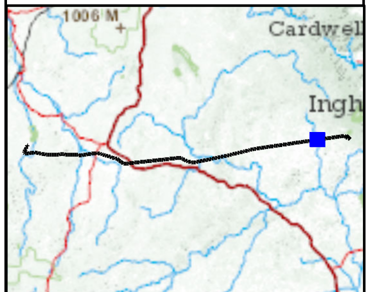


LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Douglas Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A4

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A4 size

AECOM
www.aecom.com

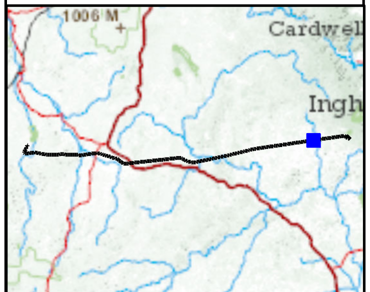
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 15 30 60
metres
1:2,200 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Environmental Assessment Report

Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A5

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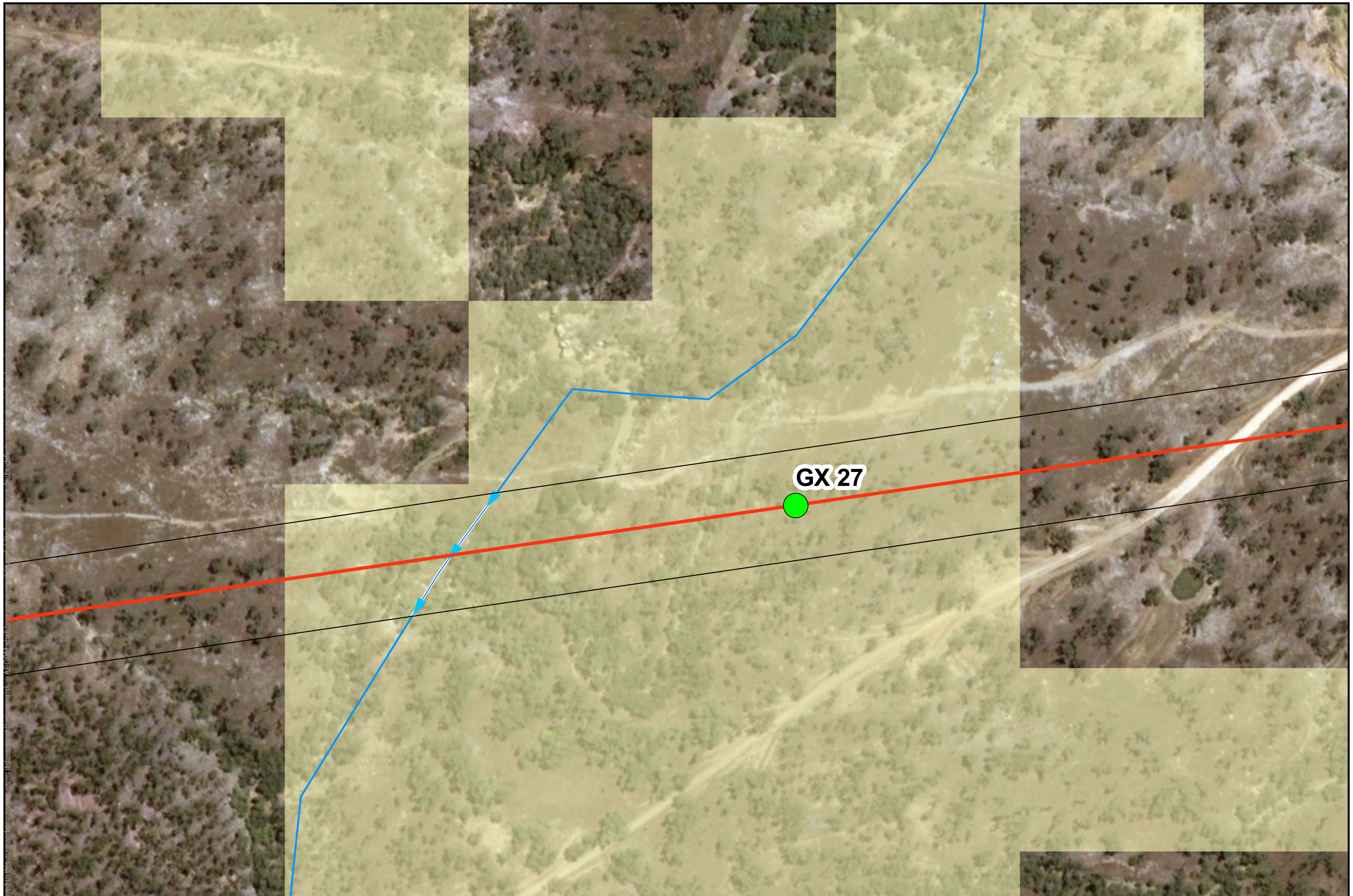

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N

DATUM GDA 1994, PROJECTION MGA ZONE 55

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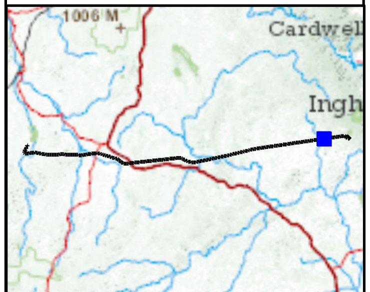
metres
1:3,100 (when printed at A4)

LEGEND
Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Unnamed Creek

PROJECT ID 60577456
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LAST MODIFIED 17-Jul-2018
VERSION 1

A6

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A4 size

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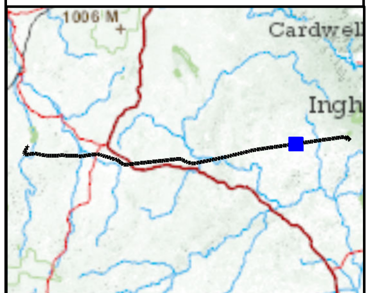
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 15 30 60
metres
1:2,200 (when printed at A4)

LEGEND

Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Unnamed Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A7

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

A4 size

AECOM
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N
DATUM GDA 1994, PROJECTION MGA ZONE 55

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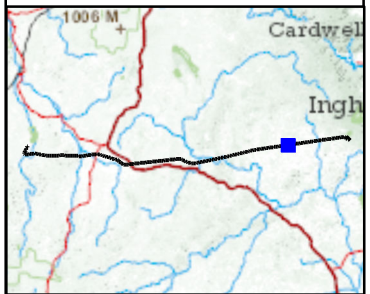
metres
1:3,000 (when printed at A4)

LEGEND
Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Hydrology Appendix
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Unnamed Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A8

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

A4 size

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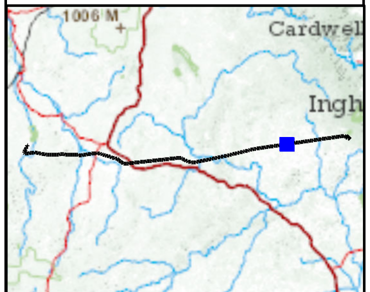
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 25 50 100
metres
1:3,000 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Environmental Assessment Report

Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A9

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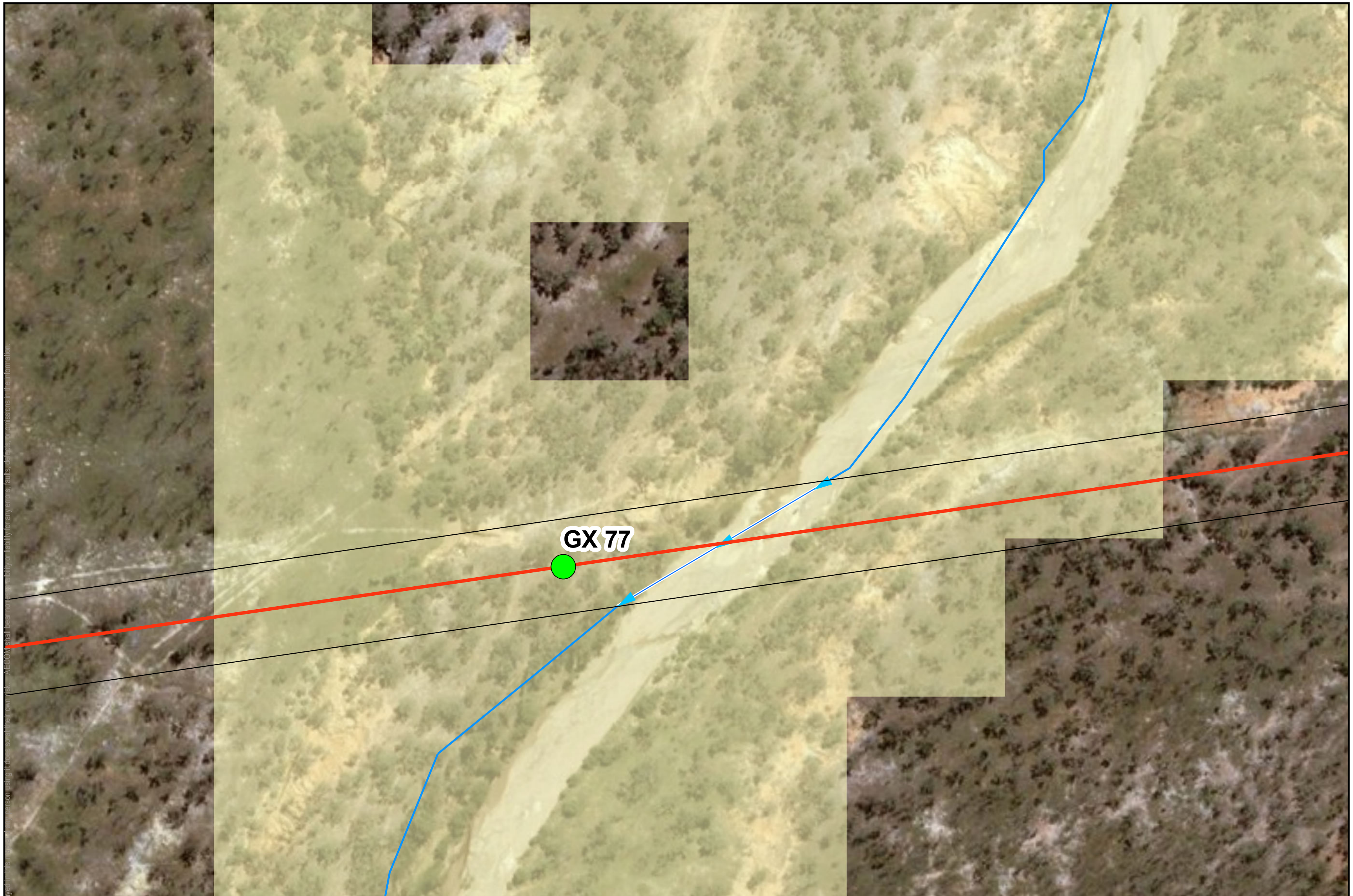

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N

DATUM GDA 1994, PROJECTION MGA ZONE 55

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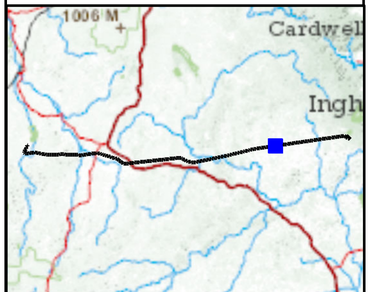
metres

1:3,600 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Hydrology Appendix
1% AEP Flood Extents

Camel Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A10

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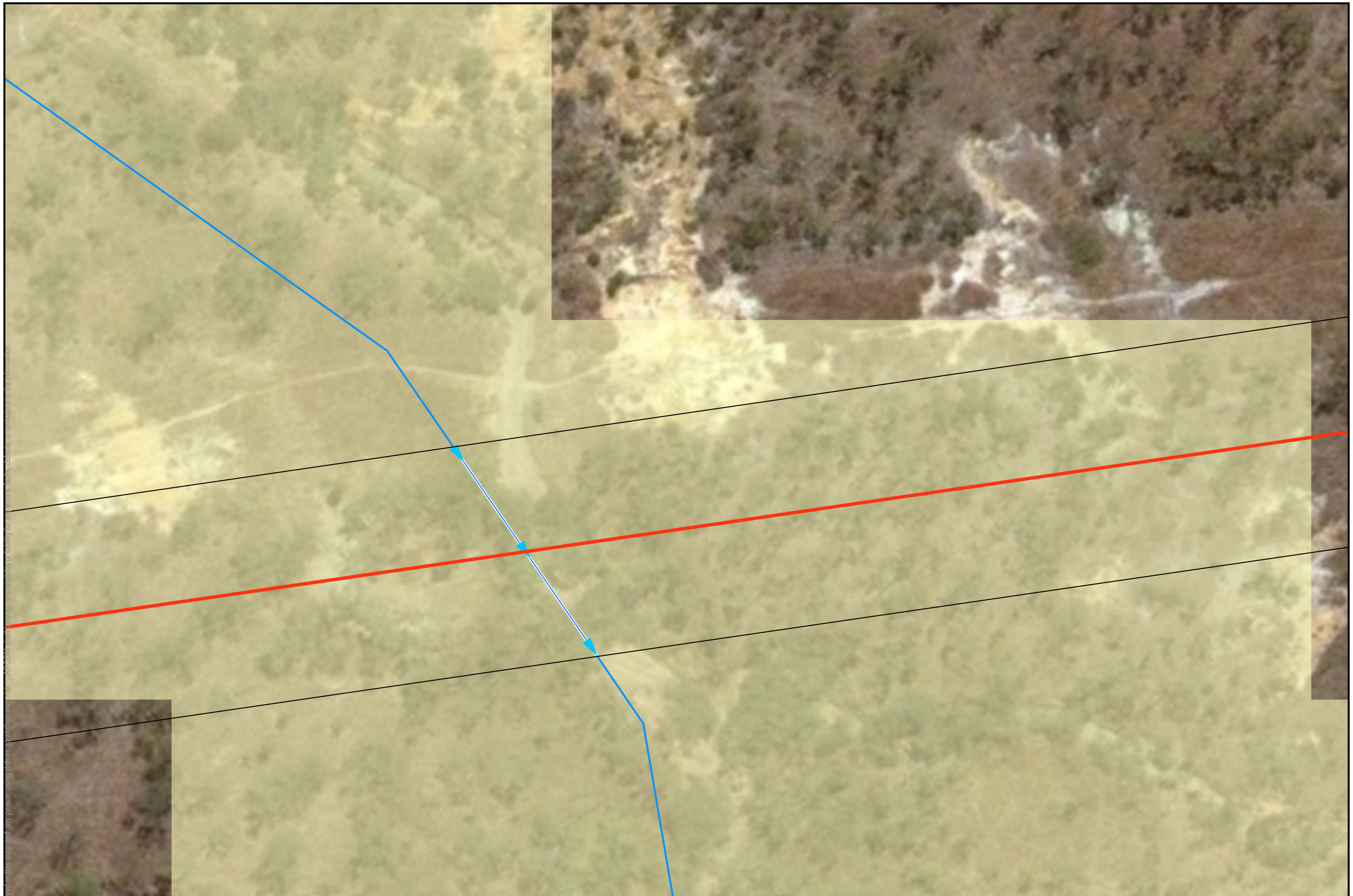
A4 size



AECOM
www.aecom.com

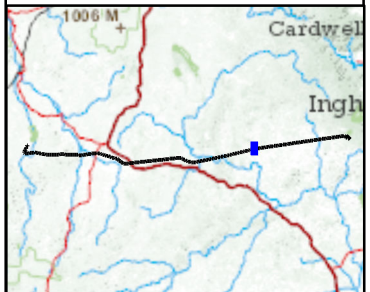
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 12.5 25 50
metres
1:1,500 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Connection Project
Environmental Assessment Report

Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A11

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

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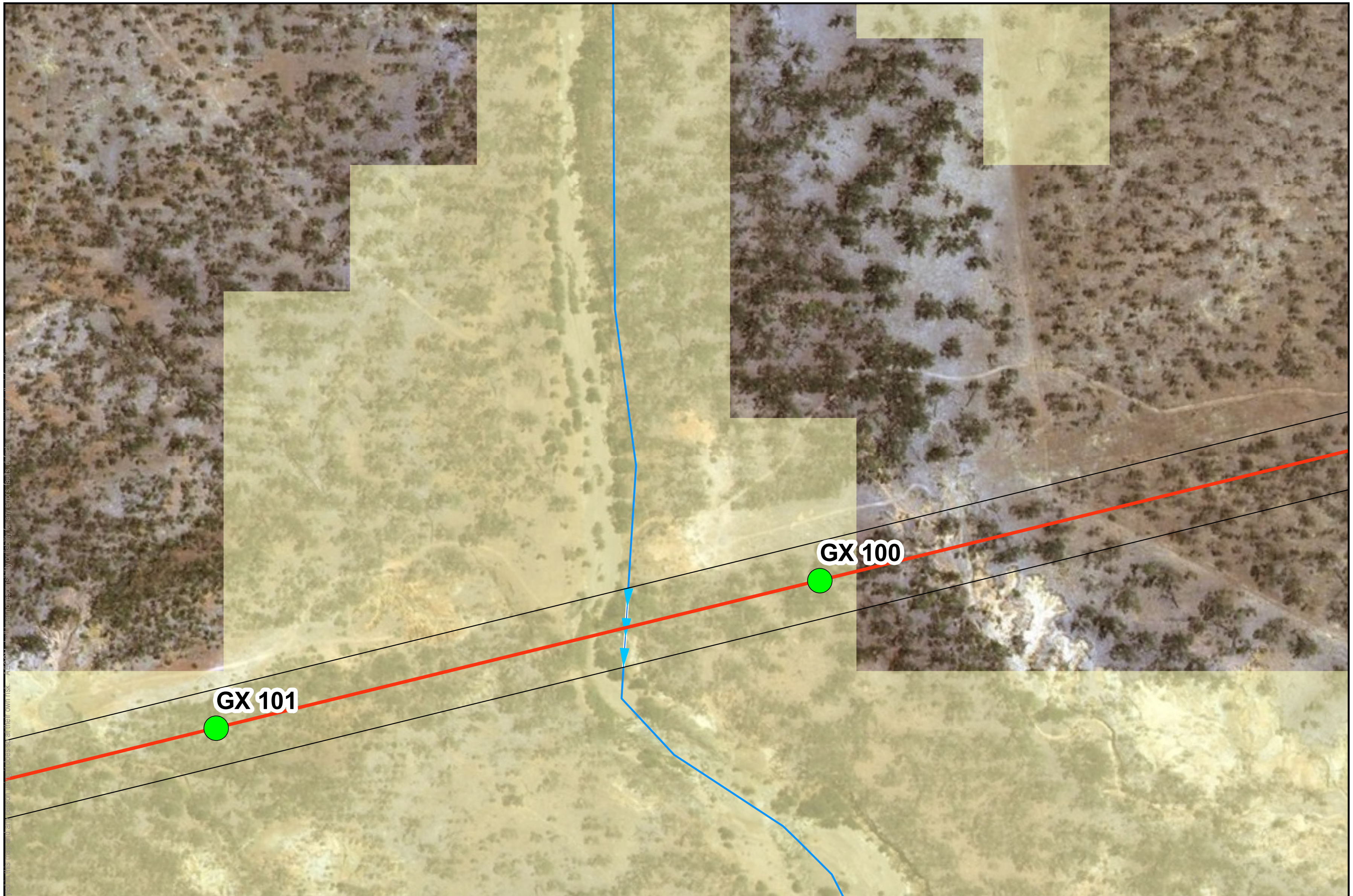

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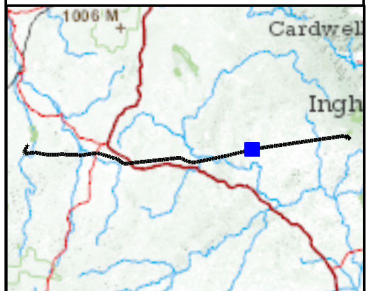
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 37.5 75 150
metres
1:4,500 (when printed at A4)

LEGEND
Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Hydrology Appendix
1% AEP Flood Extents

Perry Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A12

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

A4 size

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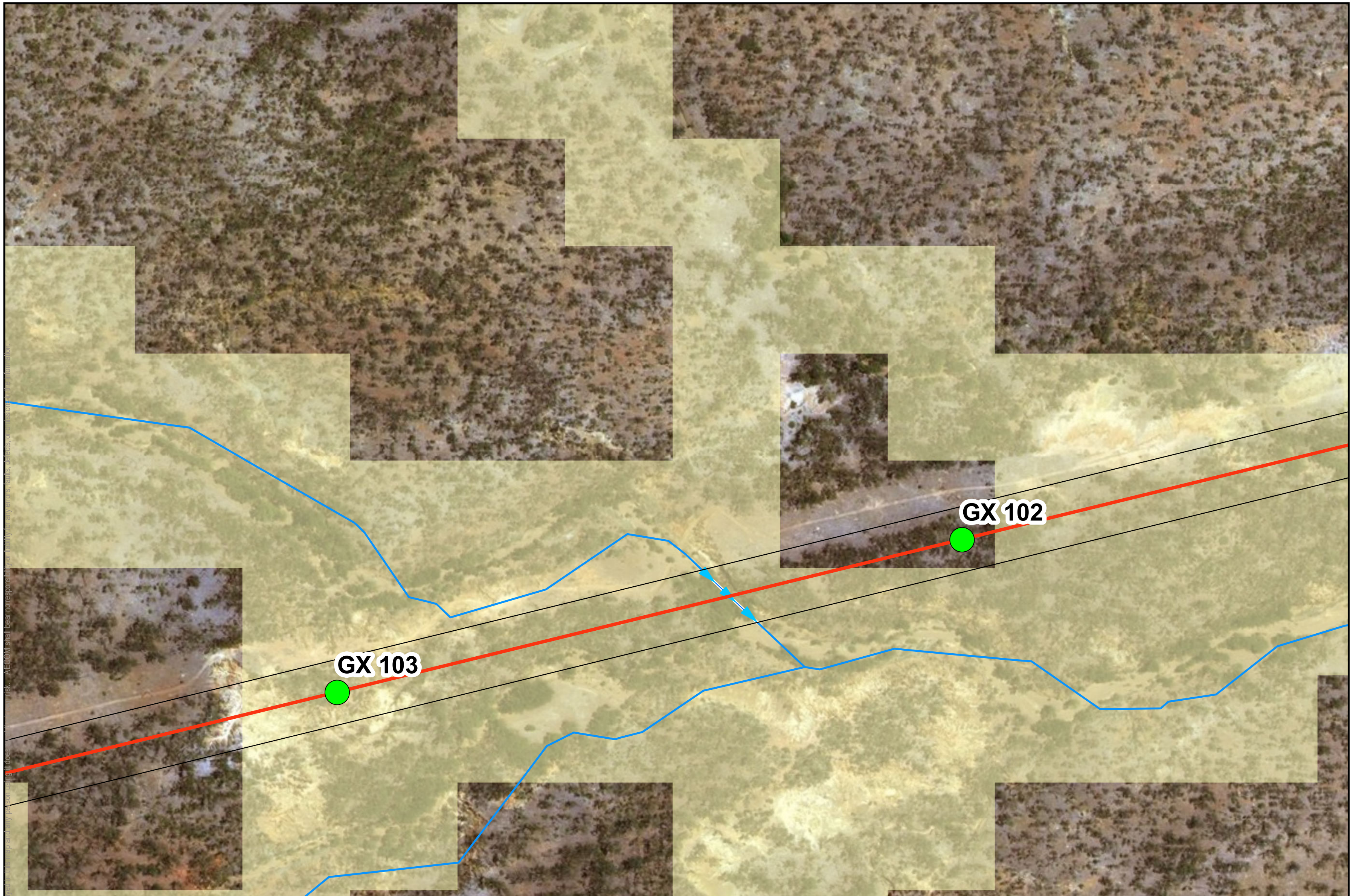


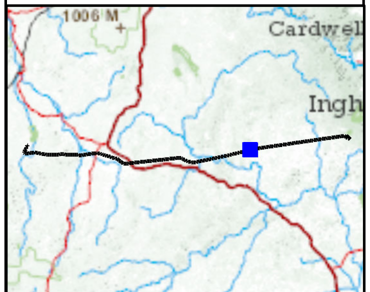
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 45 90 180
metres
1:5,300 (when printed at A4)

LEGEND

Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A13

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

A4 size

AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION MGA ZONE 55

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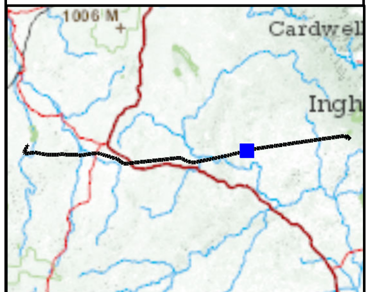
metres
1:1,500 (when printed at A4)

LEGEND
- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

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A14

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A4 size

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Connection Project Environmental Assessment Report

Hydrology Appendix 1% AEP Flood Extents

Unnamed Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A15

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Connection Project
Environmental Assessment Report

Hydrology Appendix
1% AEP Flood Extents

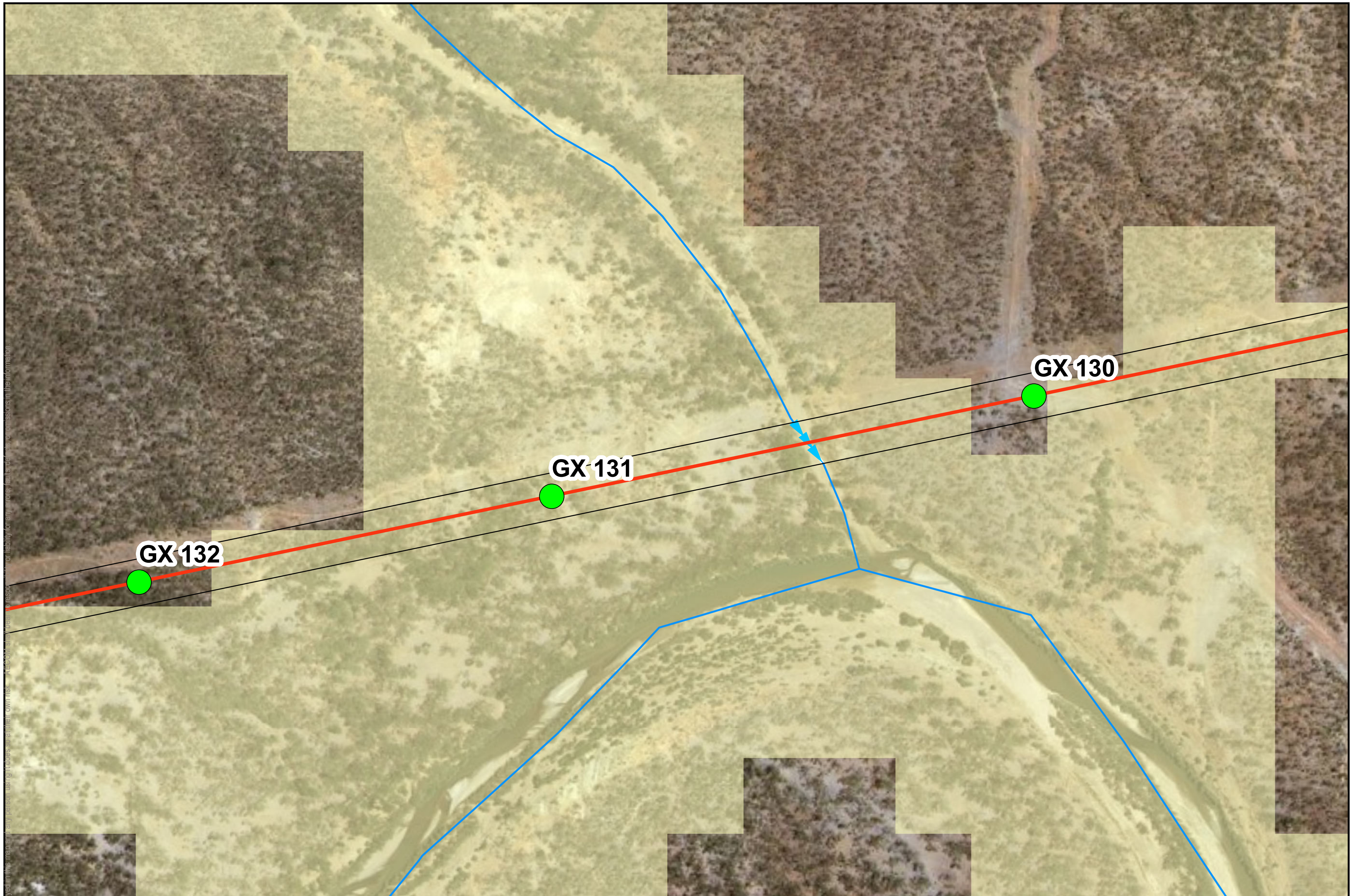
Unnamed Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A16

Filename: V:\605X\60577456_Kidston\4. Tech Work Area\4.99 GIS\TUFLOW_Build_3.mxd

A4 size



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N

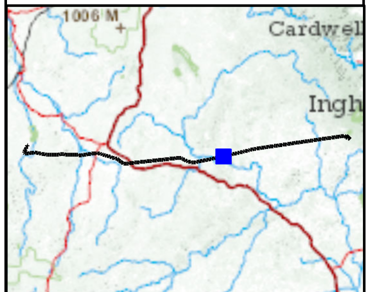
DATUM GDA 1994, PROJECTION MGA ZONE 55

0 65 130 260
metres

1:7,500 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



Connection Project
Environmental Assessment Report

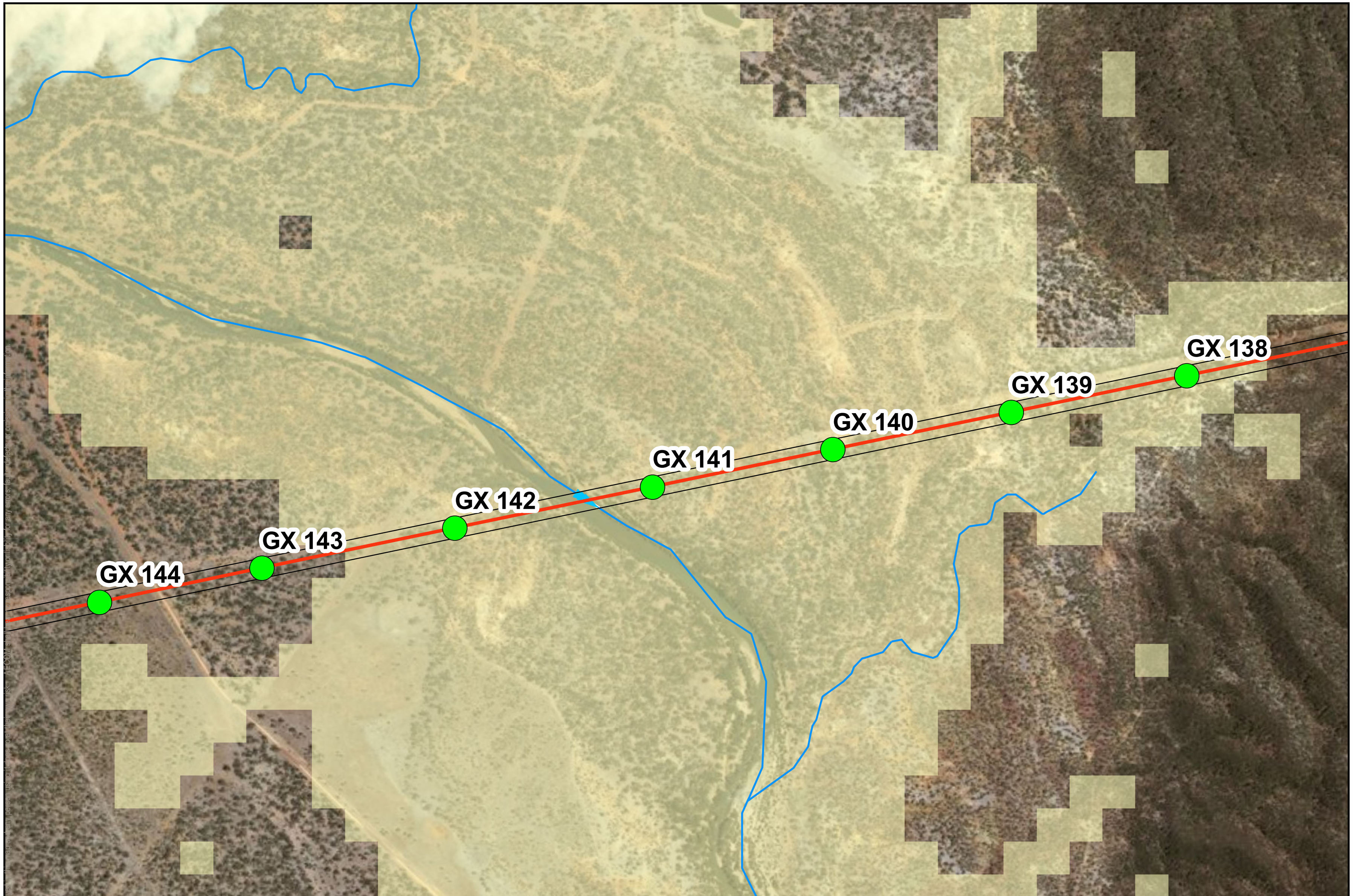
Hydrology Appendix
1% AEP Flood Extents

Hopewell Ck/Burdekin River

PROJECT ID	60577456
CREATED BY	floodmodellingtsv
LAST MODIFIED	17-Jul-2018
VERSION	1

A17

A4 size



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N

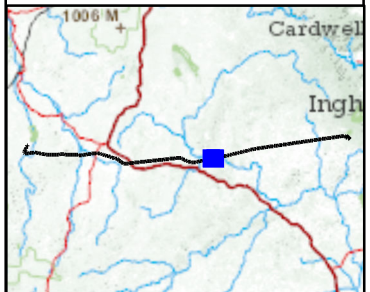
DATUM GDA 1994, PROJECTION MGA ZONE 55

0 150 300 600
metres

1:17,300 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Burdekin River

PROJECT ID 60577456
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VERSION 1

A18

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A4 size

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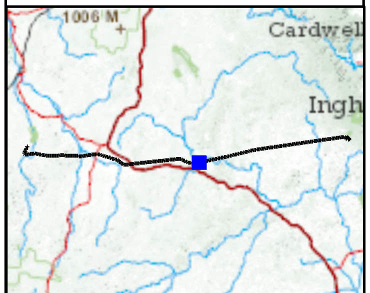
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 25 50 100
metres
1:3,000 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Gray Creek

PROJECT ID 60577456
CREATED BY floodmodellingtsv
LAST MODIFIED 17-Jul-2018
VERSION 1

A19

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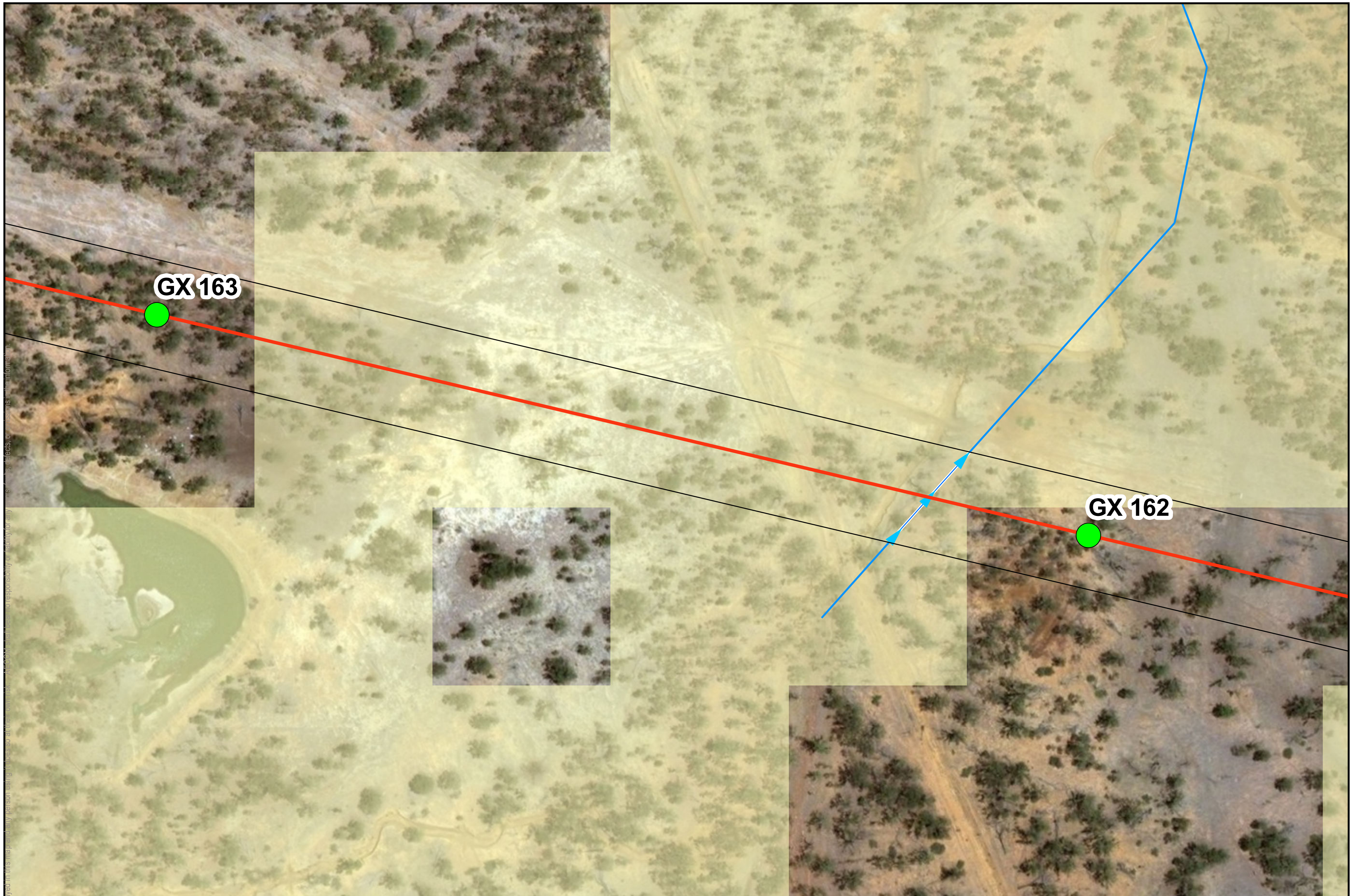
A4 size



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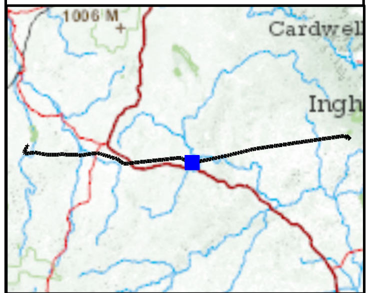
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 25 50 100
metres
1:3,200 (when printed at A4)

LEGEND
- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Unnamed Creek

PROJECT ID	60577456
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VERSION	1

A20

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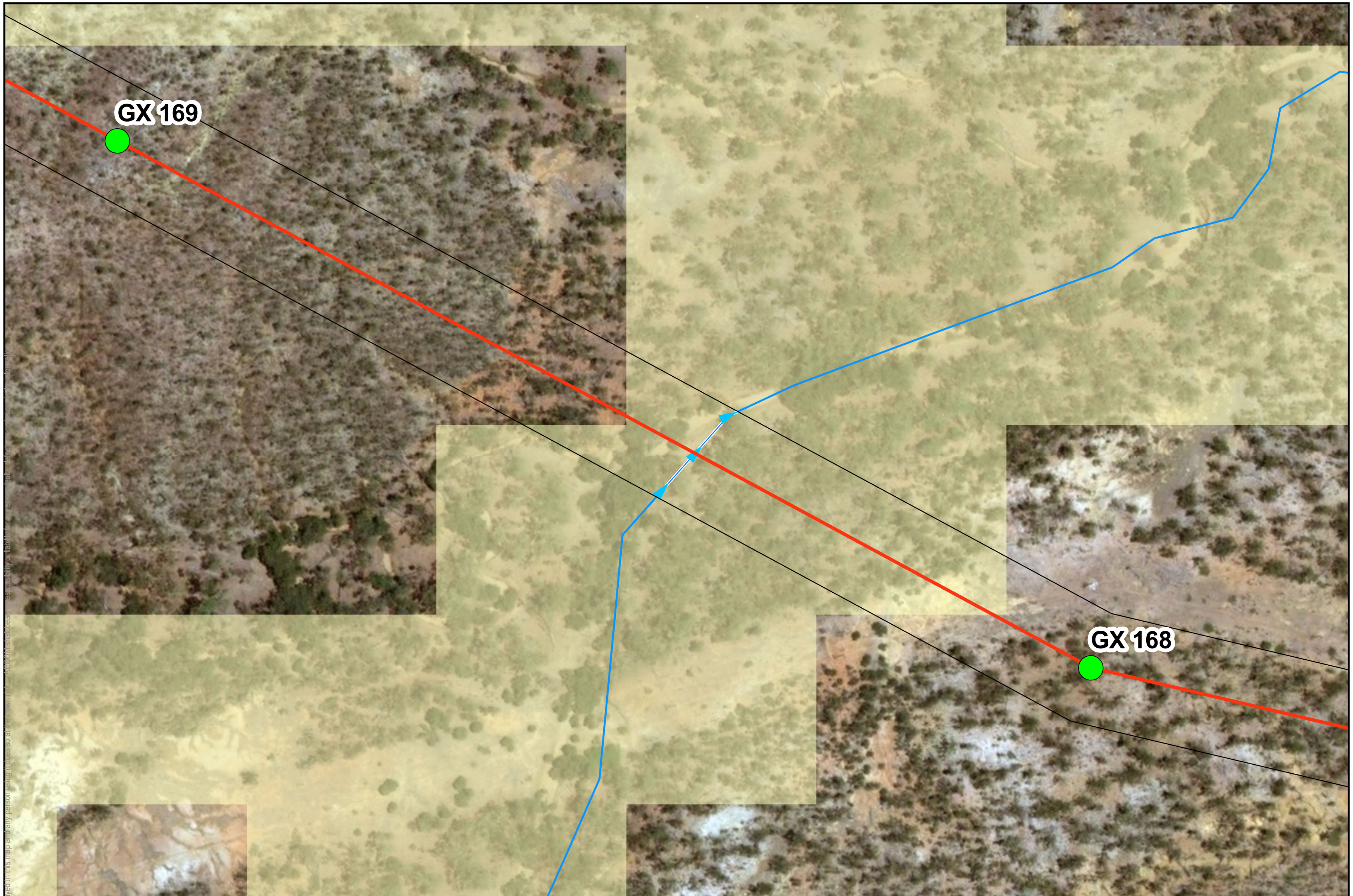
A4 size



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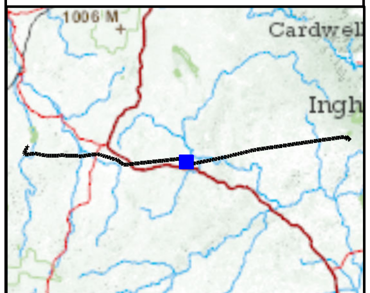
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 25 50 100
metres
1:3,000 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Unnamed Creek

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VERSION 1

A21

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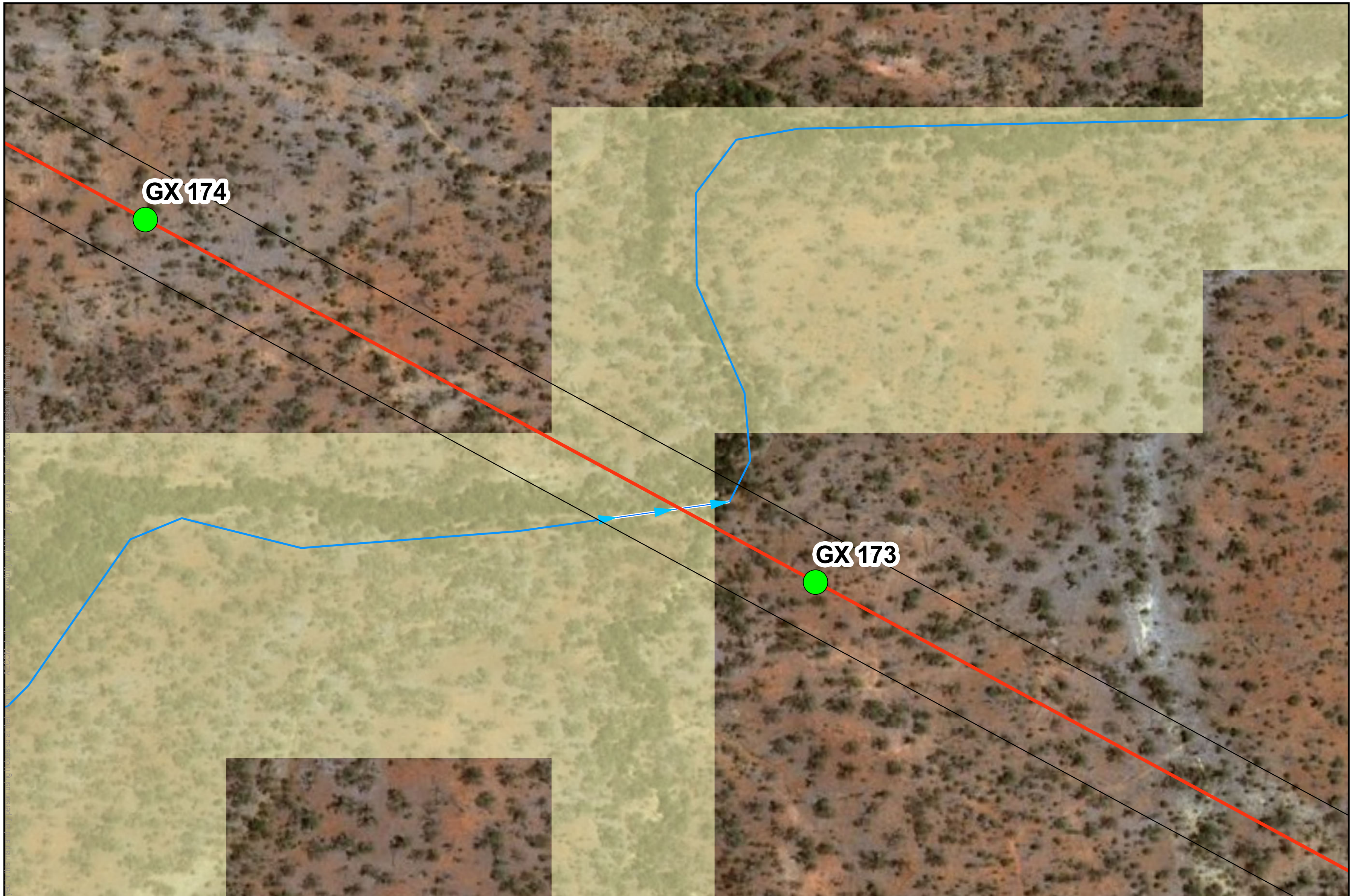
A4 size



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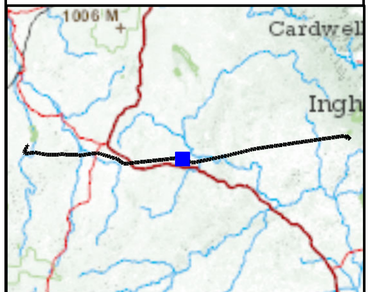
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 30 60 120
metres
1:3,500 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Hydrology Appendix
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Unnamed Creek

PROJECT ID	60577456
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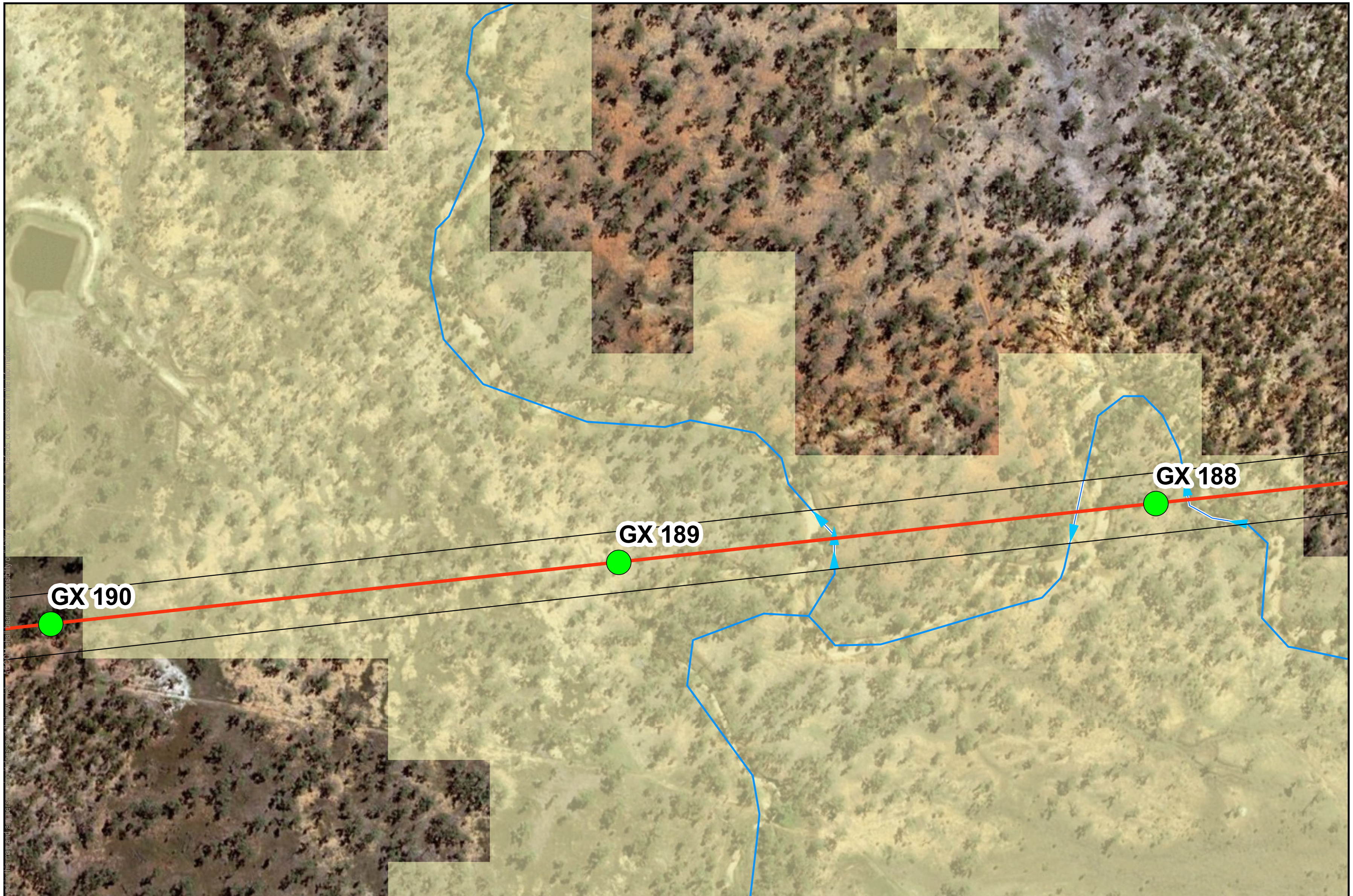
LAST MODIFIED	17-Jul-2018
VERSION	1

A22



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N

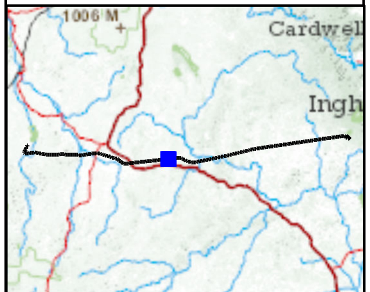
DATUM GDA 1994, PROJECTION MGA ZONE 55

0 45 90 180
metres

1:5,600 (when printed at A4)

LEGEND

- Proposed structure
- Transmission Line
- Transmission Line Corridor
- Watercourse
- Flood Extents



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Hydrology Appendix
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Paddy's Creek

PROJECT ID	60577456
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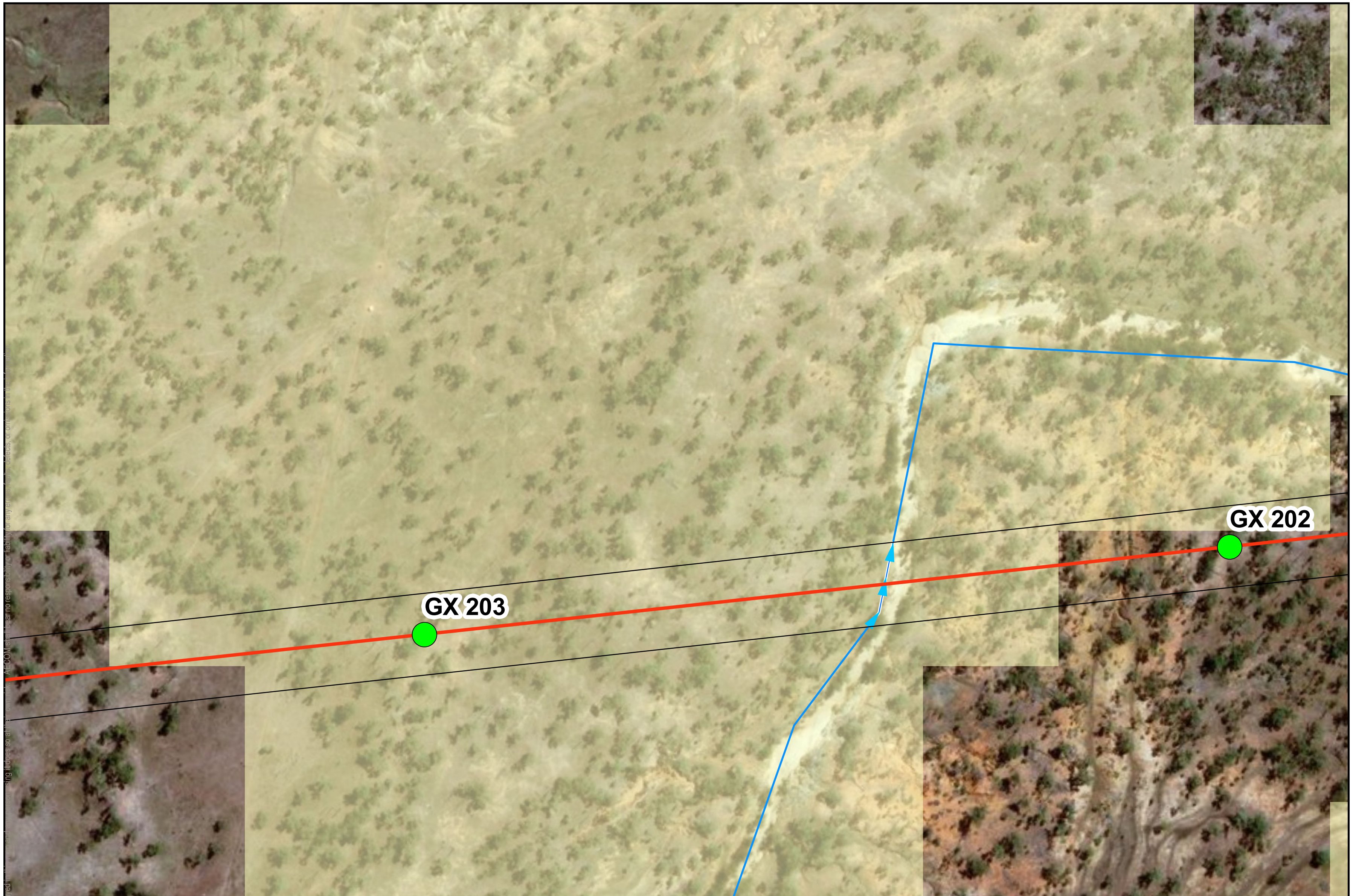
VERSION	1

A23

A4 size



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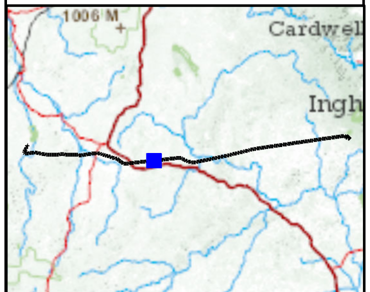
N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 35 70 140
metres
1:4,200 (when printed at A4)

LEGEND
Proposed structure
Transmission Line
Transmission Line Corridor
Watercourse
Flood Extents



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Hydrology Appendix
1% AEP Flood Extents

Unnamed Creek

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VERSION 1

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A4 size