

## Appendix E    Hydrology Report



# Hydrology Report

## Banana Range Wind Farm Connection

JBS&G Australia Pty Ltd

29 September 2025



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## Project Details

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# 1 INTRODUCTION

## 1.1 Project Description

EDF Renewables is a developer, owner and operator of utility scale grid connected renewable generation and energy storage projects. It is developing the Banana Range Wind Farm (BRWF) project west of Biloela in Central Queensland which comprises up to 41 wind turbines with a power output of approximately 230 MW.

The BRWF project has received approval at both State and Federal levels in accordance with the Planning Act (including State Code 23 Wind Farm Development) and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cth). Construction is expected to commence in 2026 with operation planned from 2028. The expected operational lifespan of the BRWF is then 50 years.

Powerlink is progressing works to deliver a new transmission line, approximately 44 km in length, to connect the Banana Range Wind Farm (BRWF) to the broader transmission network. The BRWF Connection Project involves constructing a new 275 kV transmission line from a new substation proposed at the BRWF project site at the northern foothills of the Banana Range (about 20 km west of Biloela), to Powerlink's existing Calvale Substation, near Callide Power Station. Additionally, to support the new transmission line, upgrade works are required to occur at the existing Calvale Substation.

As such, the BRWF Connection Project (the 'Project') comprises the following components:

- A 44 km 275 kV double circuit transmission line from the existing Calvale Substation to the proposed BRWF Project (via the proposed Mount Benn Substation);
- A 275 kV substation proposed on Lot 47 on SP232217 (the proposed Mount Benn Substation); and
- An expansion of the Calvale Substation to accommodate 3 additional diameters.

Figure 1-1 illustrates the Project, including the location of the transmission line alignment, the proposed transmission structures and the proposed BRWF substation.

## 1.2 Purpose of this report

Water Technology (WT) has been engaged by JBS&G Australia Pty Ltd (JBS&G) on behalf of Powerlink Queensland (Powerlink) to complete a desktop hydrology investigation report to support the development of the proposed BRWF Connection Project.

## 1.3 Assessment Scope

This desktop hydrology investigation report includes the following scope of works:

- Description of the catchment hydrology of the various watercourses that intersect the Project;
- Description of the available flood modelling that intersects the Project;
- Identification of flood constraints on the Project, including:
  - Identification of which towers may be impacted by flooding; and
  - Description of the flood characteristics in the vicinity of towers that are flood affected where current flood model results are available.
- Recommendations for further work including a flood impact assessment to demonstrate that the development will not increase risk to natural hazard. This assessment will also be completed to provide additional flood behaviour information to the design team that will inform the design.

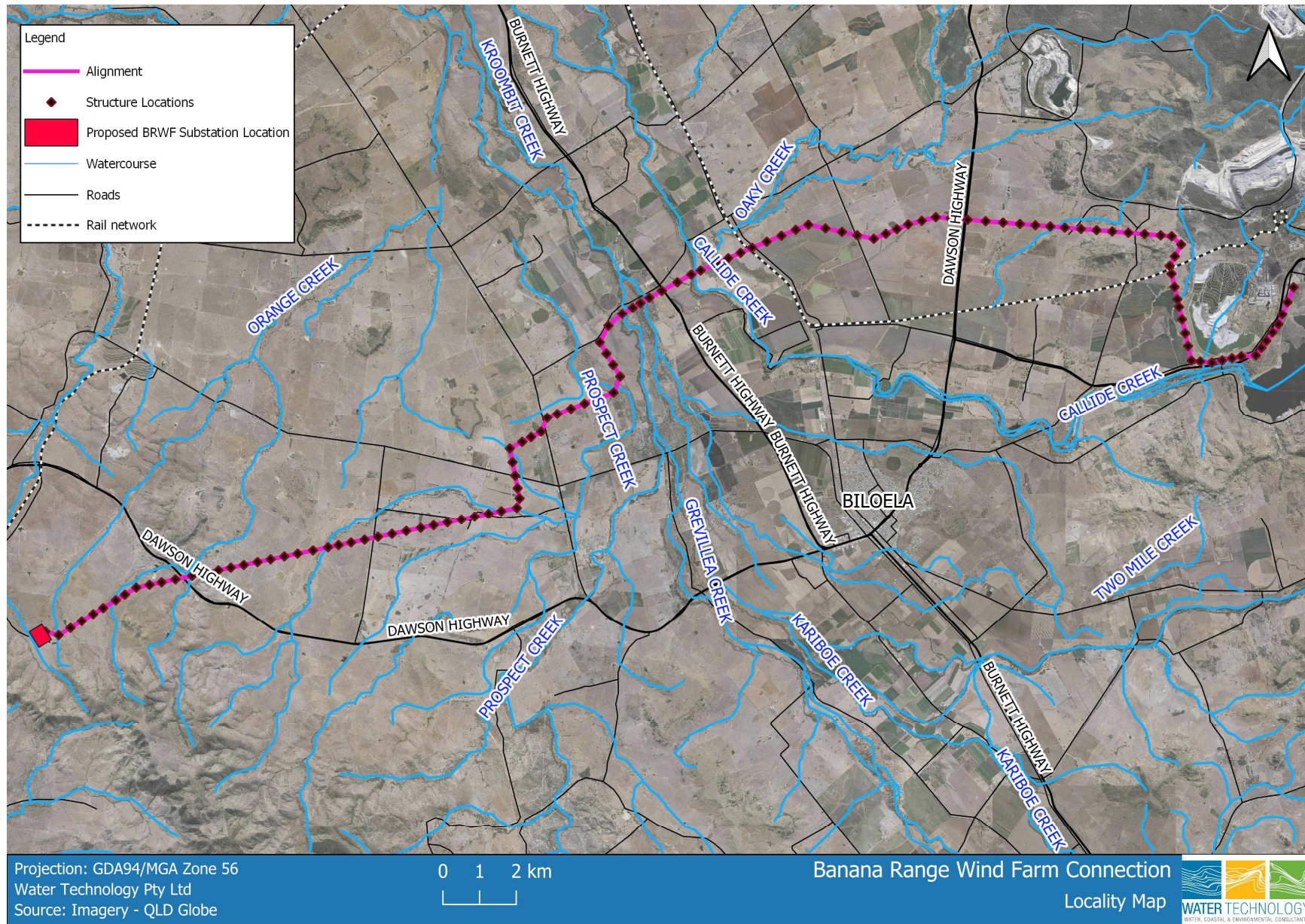


## 1.4 Available Data

The following data was provided for this assessment:

- WaterRIDE flood results files for the Banana Shire Flood Study (KBR, 2017) provided by Banana Shire Council.
- Alignment and structure locations: “CP.02942 - BRange Wind Farm - Current Alignment Option\_2023-10-16.kmz” provided by JBS&G.
- Substation location: “UTL\_Powerlink\_BRWFSubstationArea\_500x400\_GDA20z56.kmz” provided by JBS&G.
- LiDAR data flown in 2023 provided by JBS&G.
- Aerial photography taken in February 2023 provided by JBS&G.





**Figure 1-1 Banana Range Wind Farm Connection Locality Map**



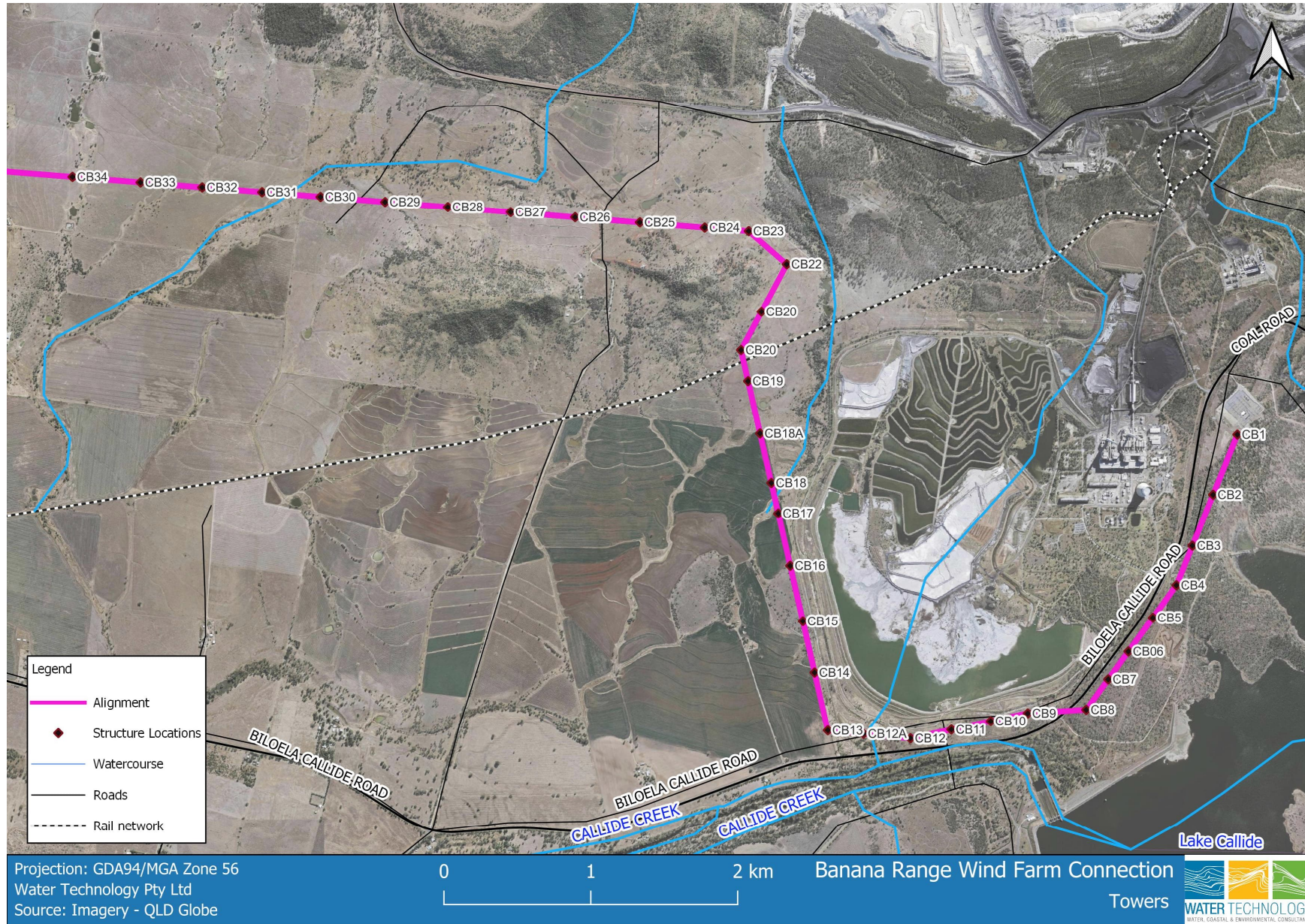


Figure 1-2 Towers CB1 to CB34



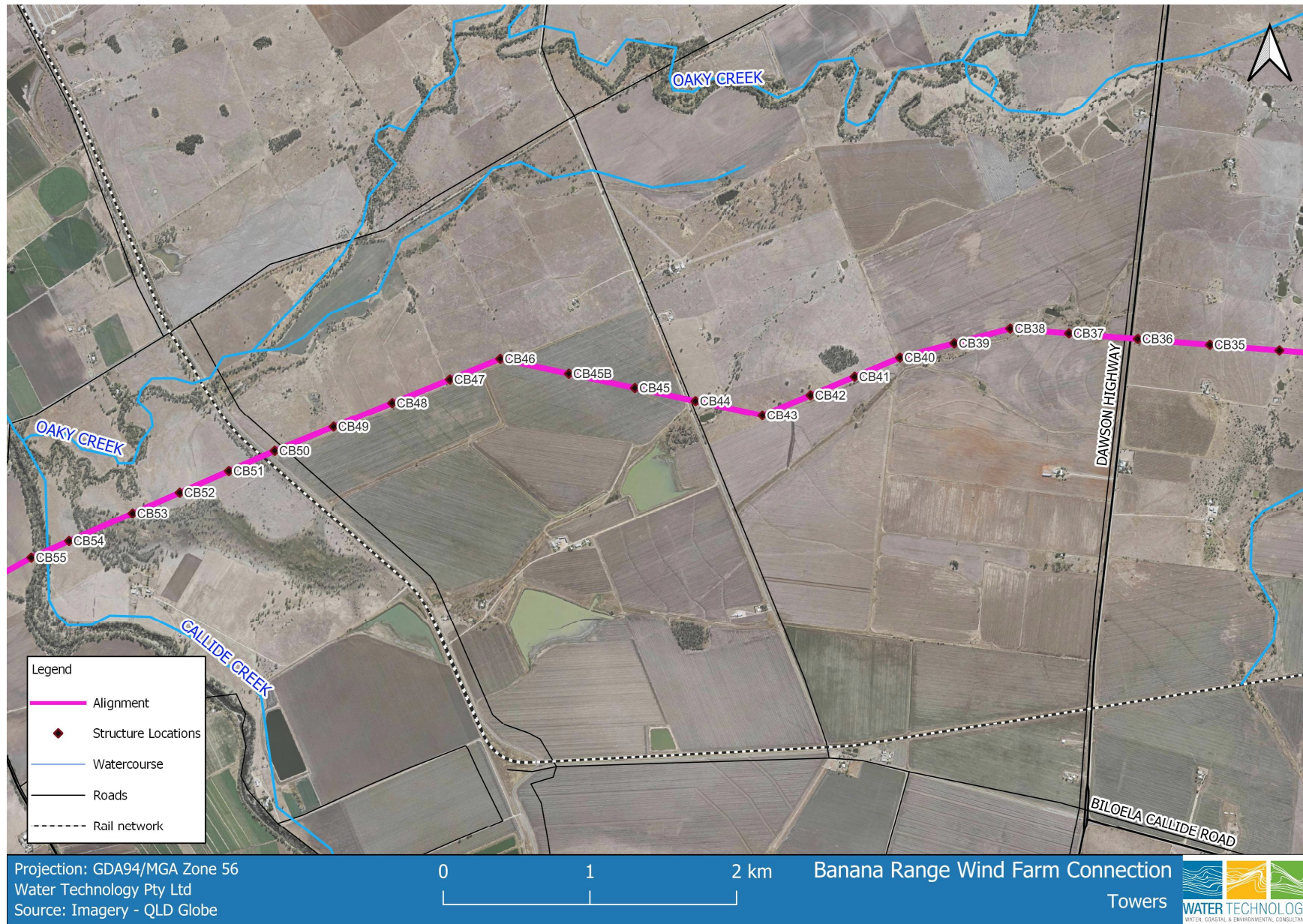


Figure 1-3 Towers CB35 to CB55



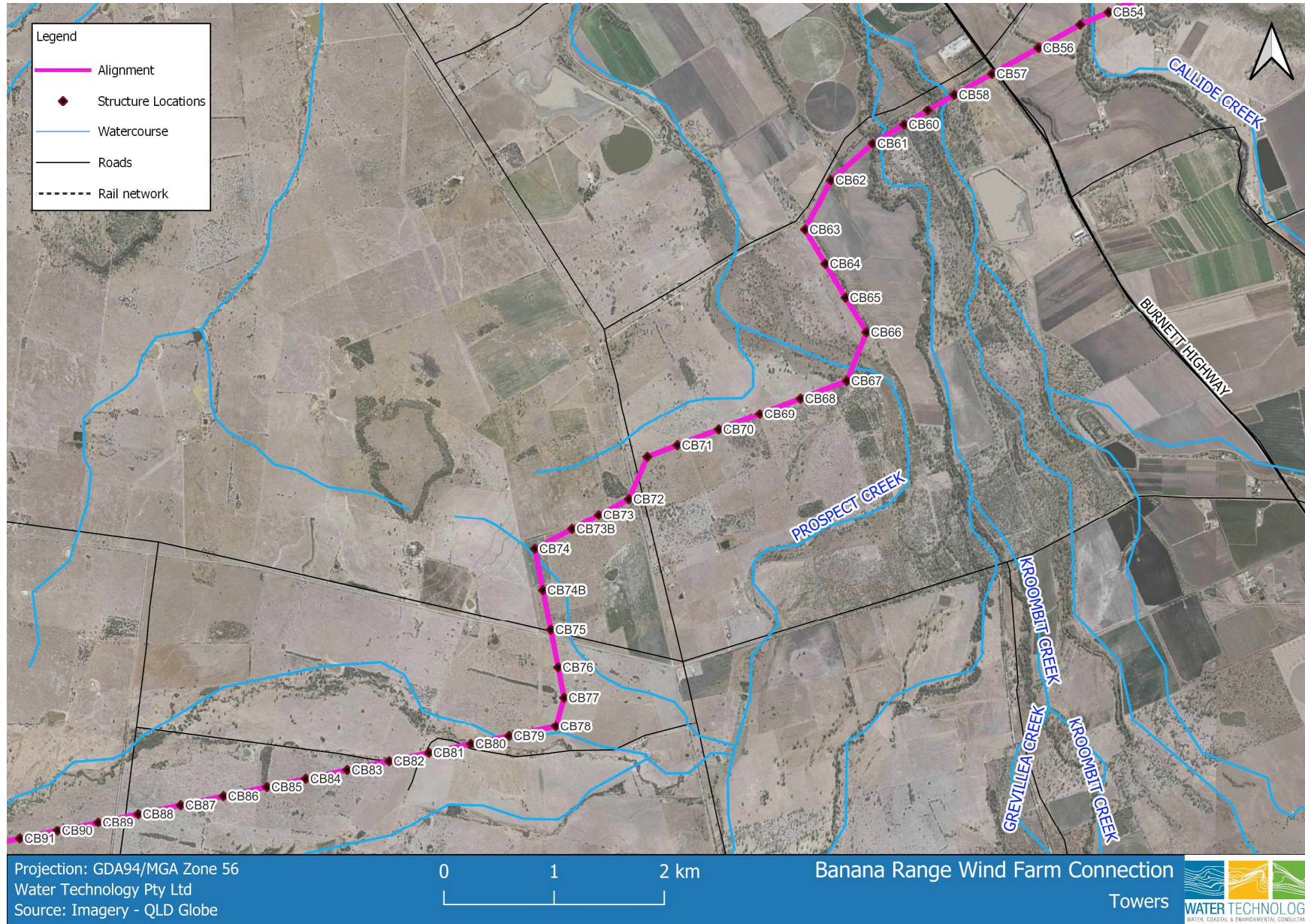
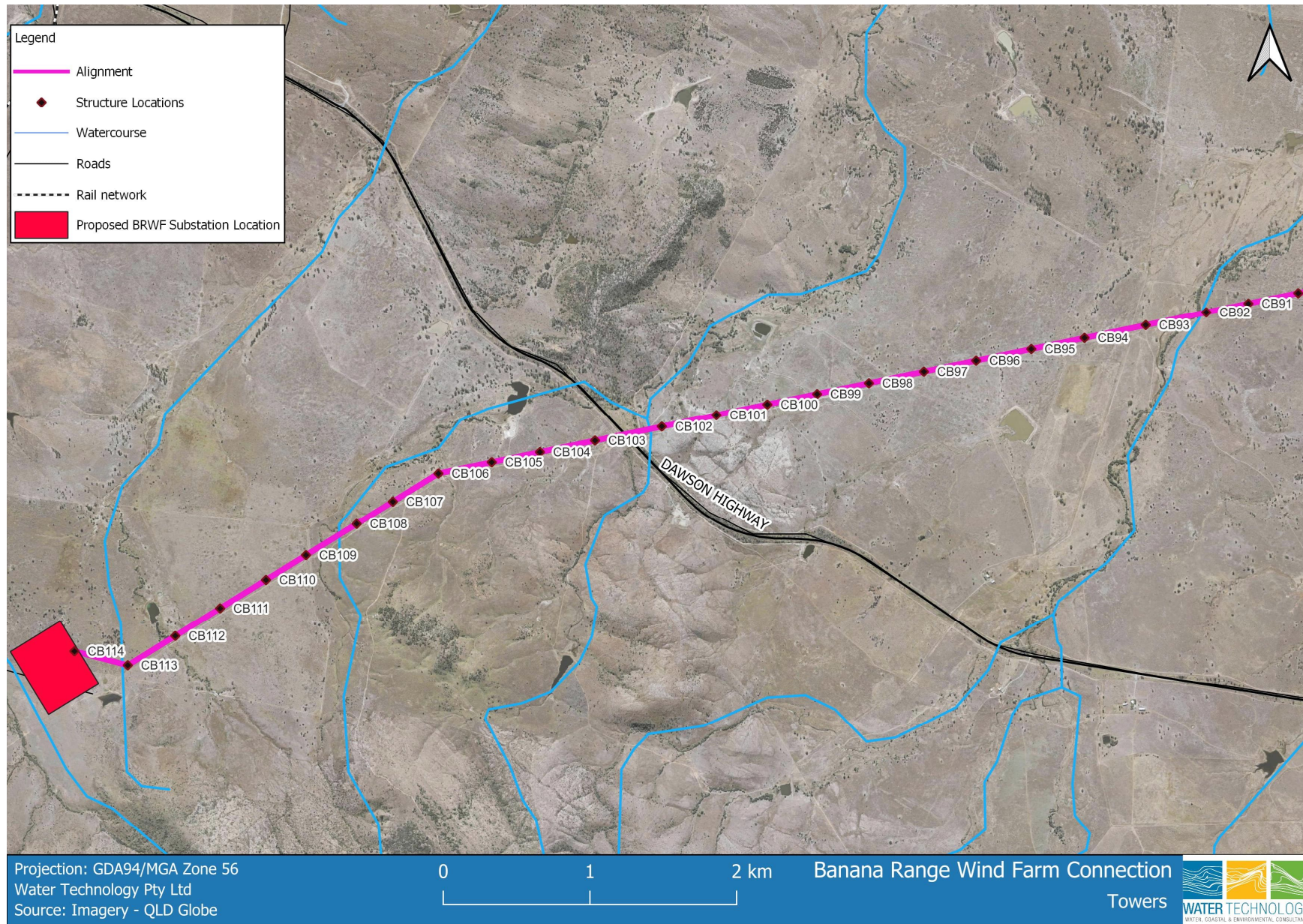


Figure 1-4 Towers CB54 to CB91





**Figure 1-5 Towers CB91 to CB113**





## 2 CATCHMENT HYDROLOGY

The Project is located within the Fitzroy River sub-basin which lies within the broader Fitzroy Basin. The Fitzroy Basin spans over 142,000 km<sup>2</sup> and is the largest catchment draining to the Great Barrier Reef (DES, 2013).

The proposed alignment traverses the Callide Creek and Kroombit Creek floodplain which spans roughly 6 km and flows to the north joining the Don River approximately 50 km to the north. The proposed BRWF substation is located outside of the Callide Creek and Kroombit Creek floodplain areas.

The following watercourses are located in the vicinity of the Project as illustrated in Figure 2-1:

- Callide Creek and associated tributaries;
- Two Mile Creek;
- Kroombit Creek;
- Grevillea Creek;
- Kariboe Creek;
- Prospect Creek and associated tributaries; and
- Orange Creek and associated tributaries.

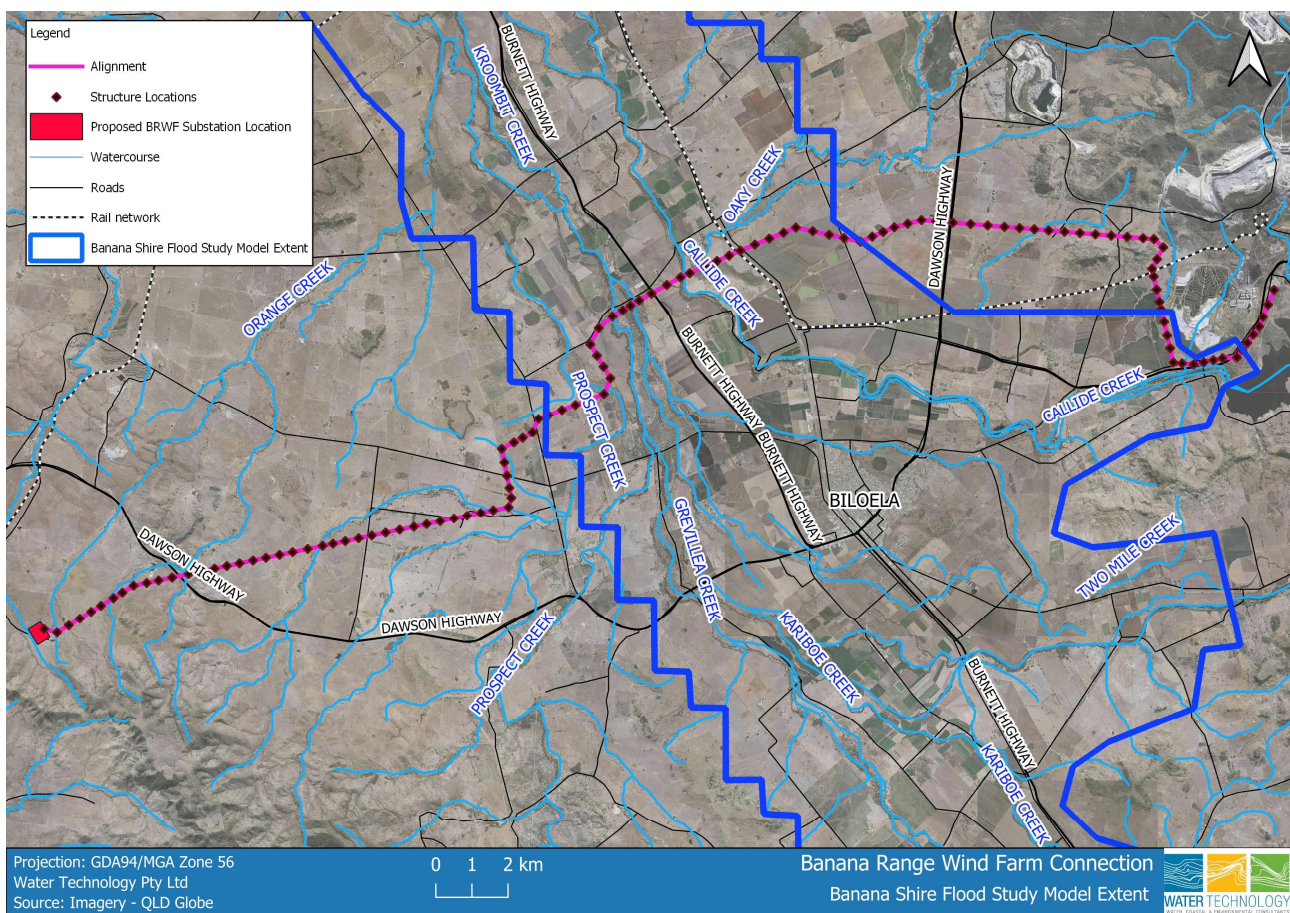


Figure 2-1 Hydrological Features and Topography



### 3 REGIONAL FLOODING

The *Banana Shire Flood Study* prepared for Banana Shire Council by Kellogg Brown & Root Pty Ltd (KBR) in 2017 (KBR, 2017) included detailed flood modelling within the Callide River and Kroombit Creek floodplains. The extent of the model, in relation to the Project, is shown in Figure 3-1.

The following tower structures are located within the extent of the Banana Shire Flood Study model:

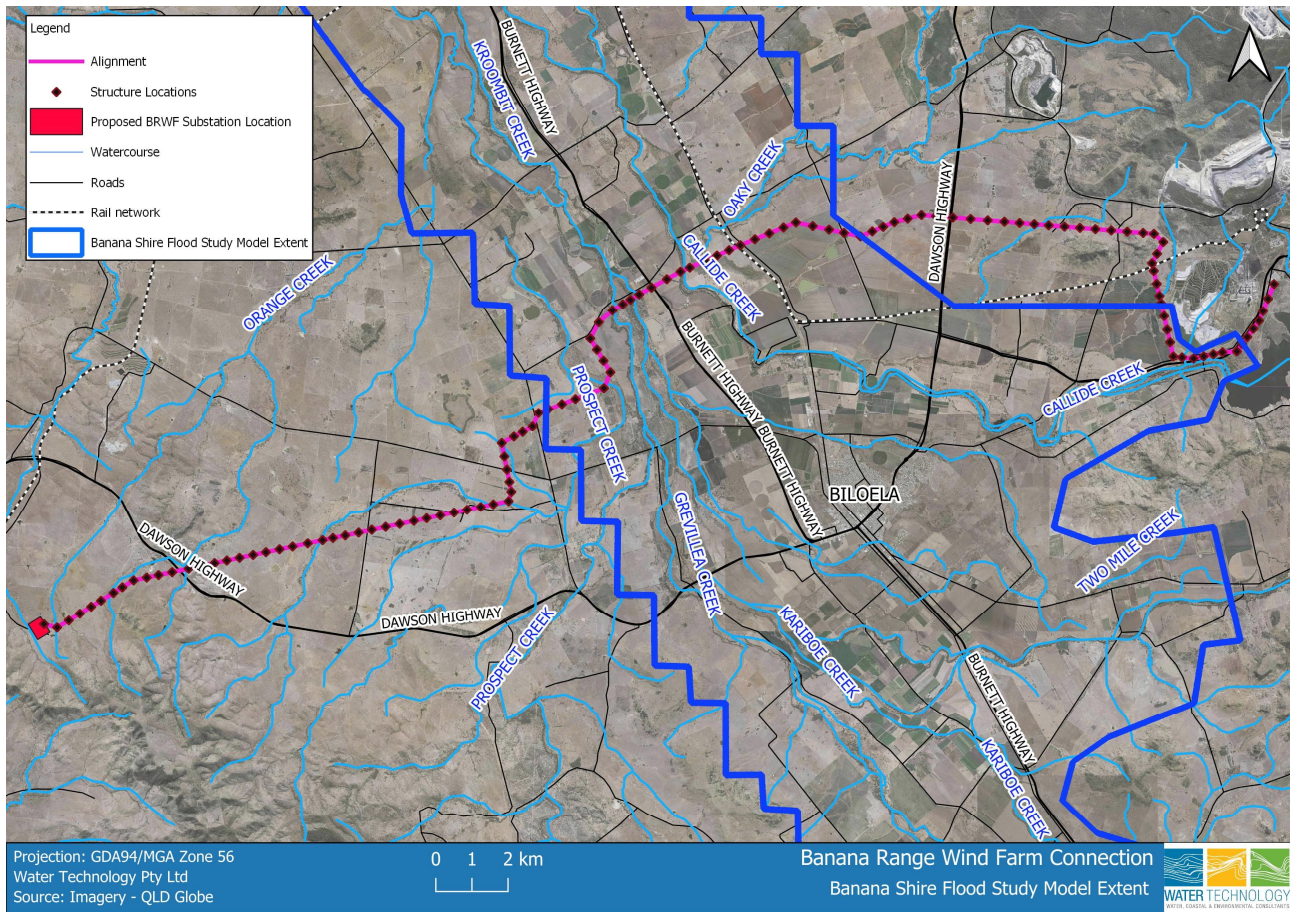
- CB7 to CB16, and
- CB43 to CB71.

Flood depth and velocity mapping for the 10%, 1% and 0.2% Annual Exceedance Probability (AEP) events are provided in Figure 3-2 to Figure 3-7 for CB7 to CB16 and Figure 3-8 to Figure 3-13 for CB43 to CB71.

As shown in the flood maps below, tower structures CB50 through to CB67 are affected by flooding of the Kroombit Creek/Callide Creek floodplain, while CB43 through to CB49 are outside of the flood extent.

Table 3-1 provides the flood depths, velocities and hazard extracted from the flood study model results at these tower structure locations to inform the design. The flood hazard classifications are presented in Table 3-2. It is noted that several towers are located in flood hazard category H5 (refer Table 3-2) where “*All buildings vulnerable to structural damage. Some less robust buildings subject to failure*”, and particular consideration would be required for the design of these towers to ensure they can withstand the modelled flood depths and velocities. One tower ‘CB59’ is located in hazard category H6 in the 0.2% AEP event where “*All building types considered vulnerable to failure.*”, and as such, further consideration of the location of this tower should be undertaken to reduce its hazard and vulnerability to failure, e.g. moving approximately 30m along the alignment to the south-west would reduce its 0.2% AEP hazard category from H6 to H5.





**Figure 3-1 Banana Shire Flood Study Model Extent**



**Table 3-1 Modelled Depths and Velocities at Structure Locations**

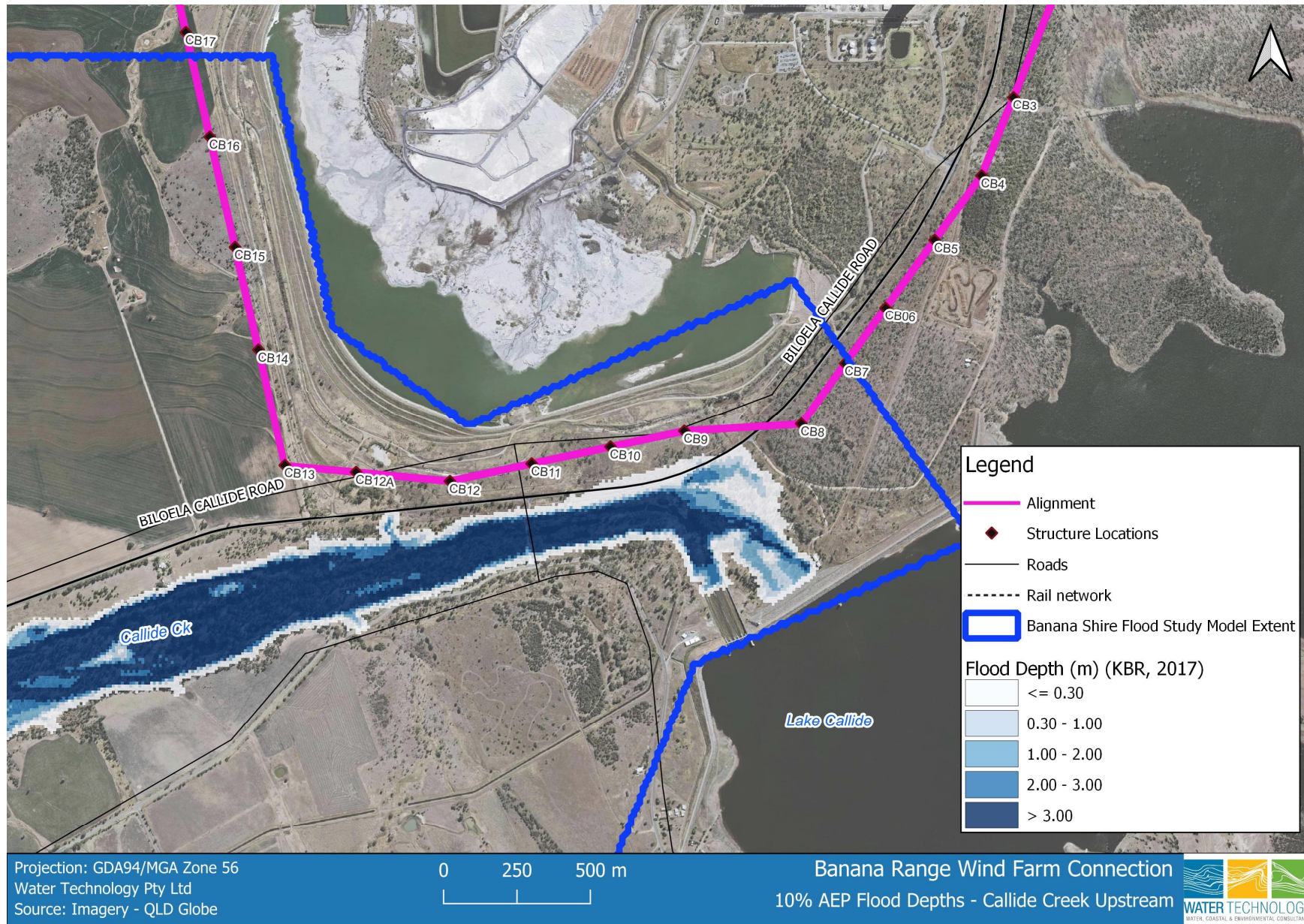
ID	10% AEP			1% AEP			0.2% AEP		
	Depth (m)	Velocity (m/s)	DxV (m <sup>2</sup> /s)	Depth (m)	Velocity (m/s)	DxV (m <sup>2</sup> /s)	Depth (m)	Velocity (m/s)	DxV (m <sup>2</sup> /s)
CB50	-	-	-	0.09	-	--	0.14	0.14	0.02
CB52	0.87	0.14	0.12	2.00	0.59	1.18	2.08	0.63	1.31
CB53	1.02	0.21	0.21	2.09	0.40	0.84	2.16	0.47	1.02
CB54	1.14	0.25	0.29	2.15	0.38	0.82	2.23	0.45	1.00
CB55	-	-	-	0.11	0.44	0.05	0.12	0.49	0.06
CB56	-	-	-	0.01	-	-	0.01	0.06	< 0.01
CB57	-	-	-	1.11	0.35	0.39	1.27	0.56	0.71
CB58	1.20	0.52	0.62	2.57	0.74	1.90	2.72	0.89	2.42
CB59	1.89	0.88	1.66	3.21	1.23	3.95	3.36	1.37	4.60
CB60	0.68	0.46	0.31	1.90	0.91	1.73	2.05	1.05	2.15
CB61	0.17	0.30	0.05	1.31	0.96	1.26	1.47	1.14	1.68
CB62	0.32	0.11	0.04	2.20	0.57	1.25	2.38	0.70	1.67
CB63	-	-	-	1.45	0.66	0.96	1.65	0.71	1.17
CB64	-	-	-	1.40	0.75	1.05	1.59	0.94	1.49
CB65	-	-	-	1.31	0.72	0.94	1.48	1.01	1.49
CB66	-	-	-	1.24	0.56	0.69	1.42	0.97	1.38
CB67	0.12	0.09	0.01	1.86	0.61	1.13	2.06	0.82	1.69

Note: Structures located within the Banana Shire Flood Study Model Extent that are located outside of the 10%, 1% and 0.2% AEP have been excluded from this table.

**Table 3-2 Hazard Classification (AIDR, 2017)**

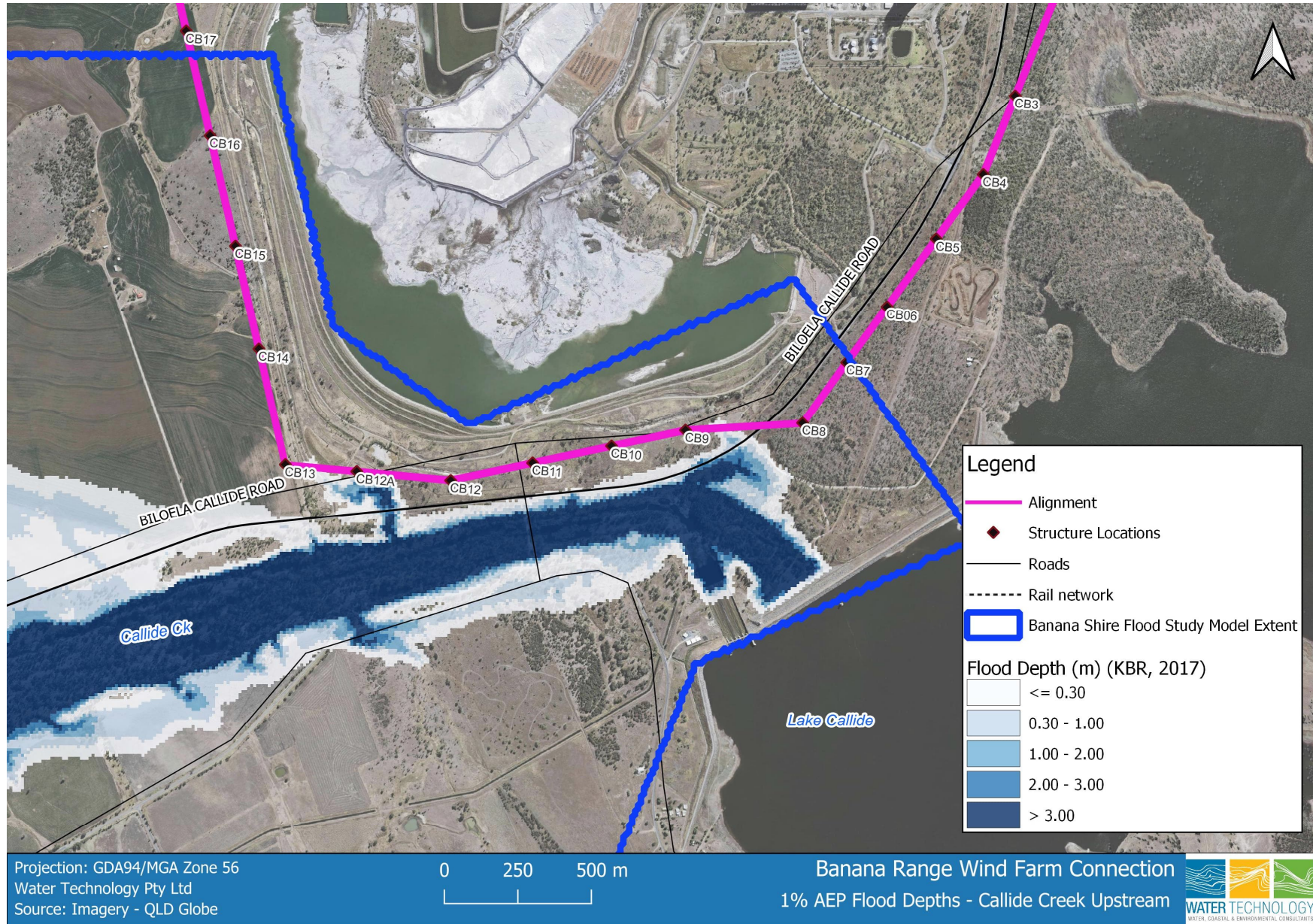
Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)	Description
H1	$D \cdot V \leq 0.3$	0.3	2.0	Generally safe for vehicles, people and buildings.
H2	$D \cdot V \leq 0.6$	0.5	2.0	Unsafe for small vehicles.
H3	$D \cdot V \leq 0.6$	1.2	2.0	Unsafe for vehicles, children and the elderly.
H4	$D \cdot V \leq 1.0$	2.0	2.0	Unsafe for vehicles and people.
H5	$D \cdot V \leq 4.0$	4.0	4.0	Unsafe for vehicles and people/ All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	$D \cdot V \geq 4.0$	-	-	Unsafe for vehicles and people. All building types considered vulnerable to failure.





**Figure 3-2 10% AEP Flood Depths – CB7 to CB16**





**Figure 3-3 1% AEP Flood Depths – CB7 to CB16**



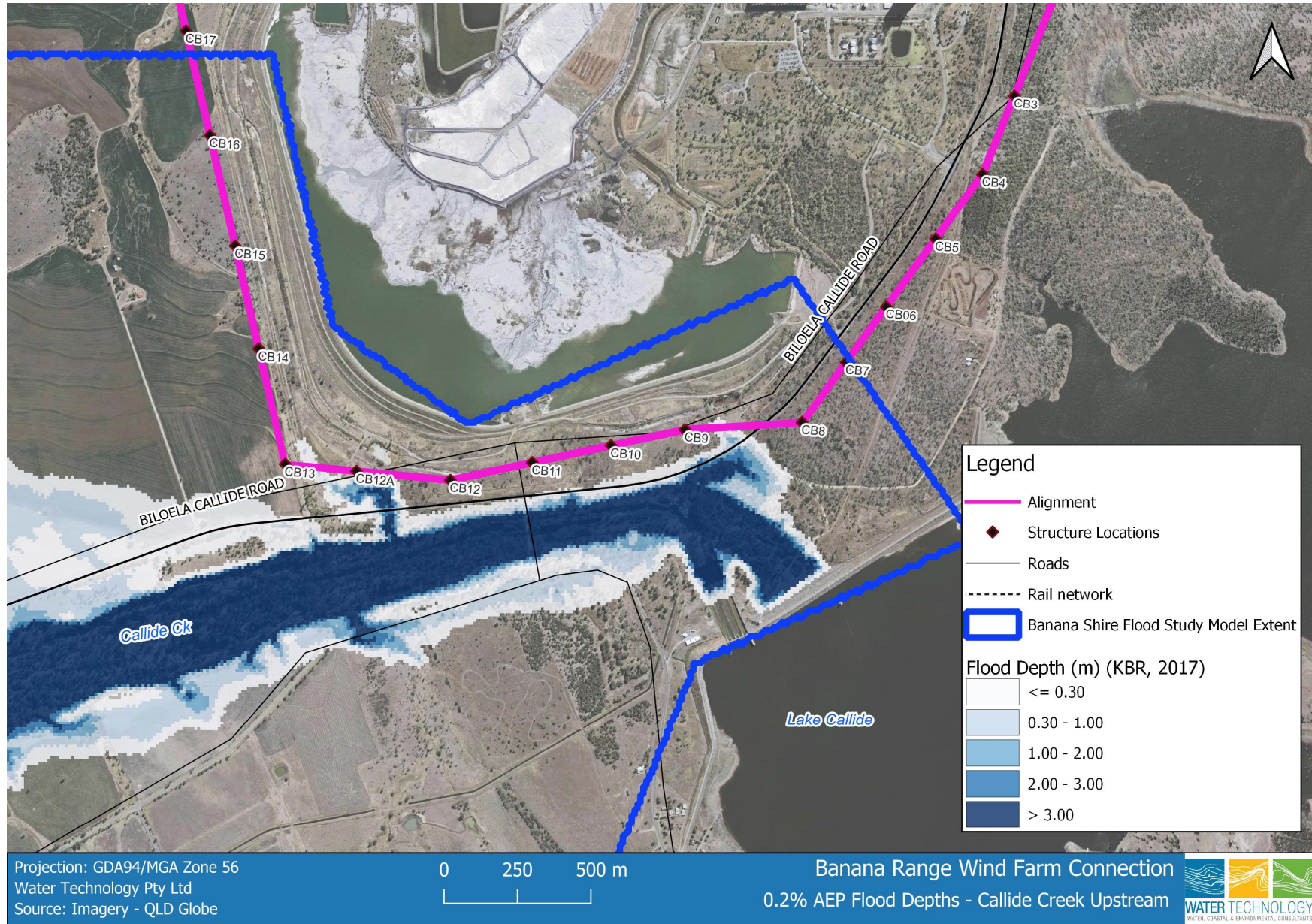


Figure 3-4 0.2% AEP Flood Depths – CB7 to CB16



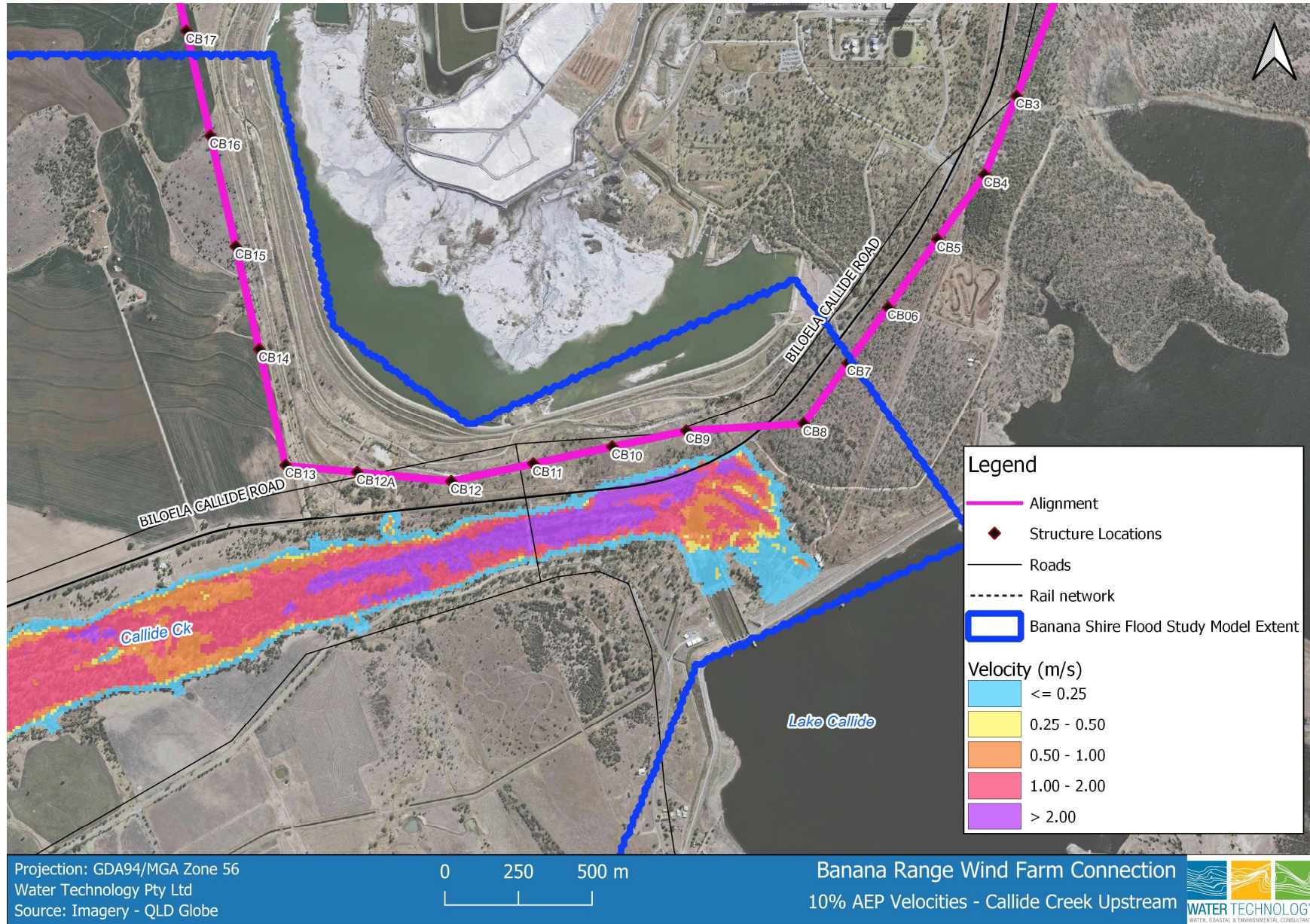


Figure 3-5 10% AEP Flood Velocities – CB7 to CB16



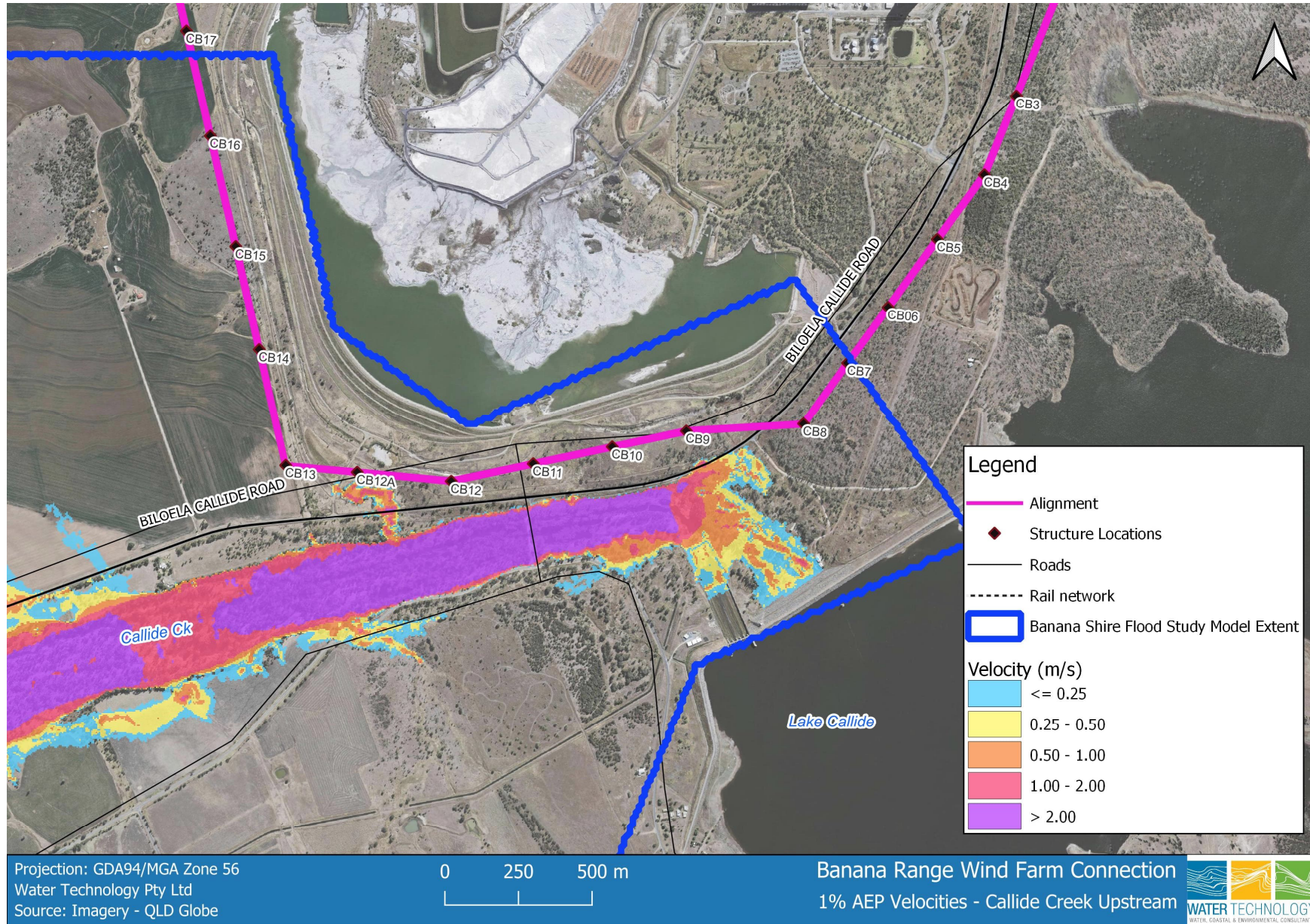
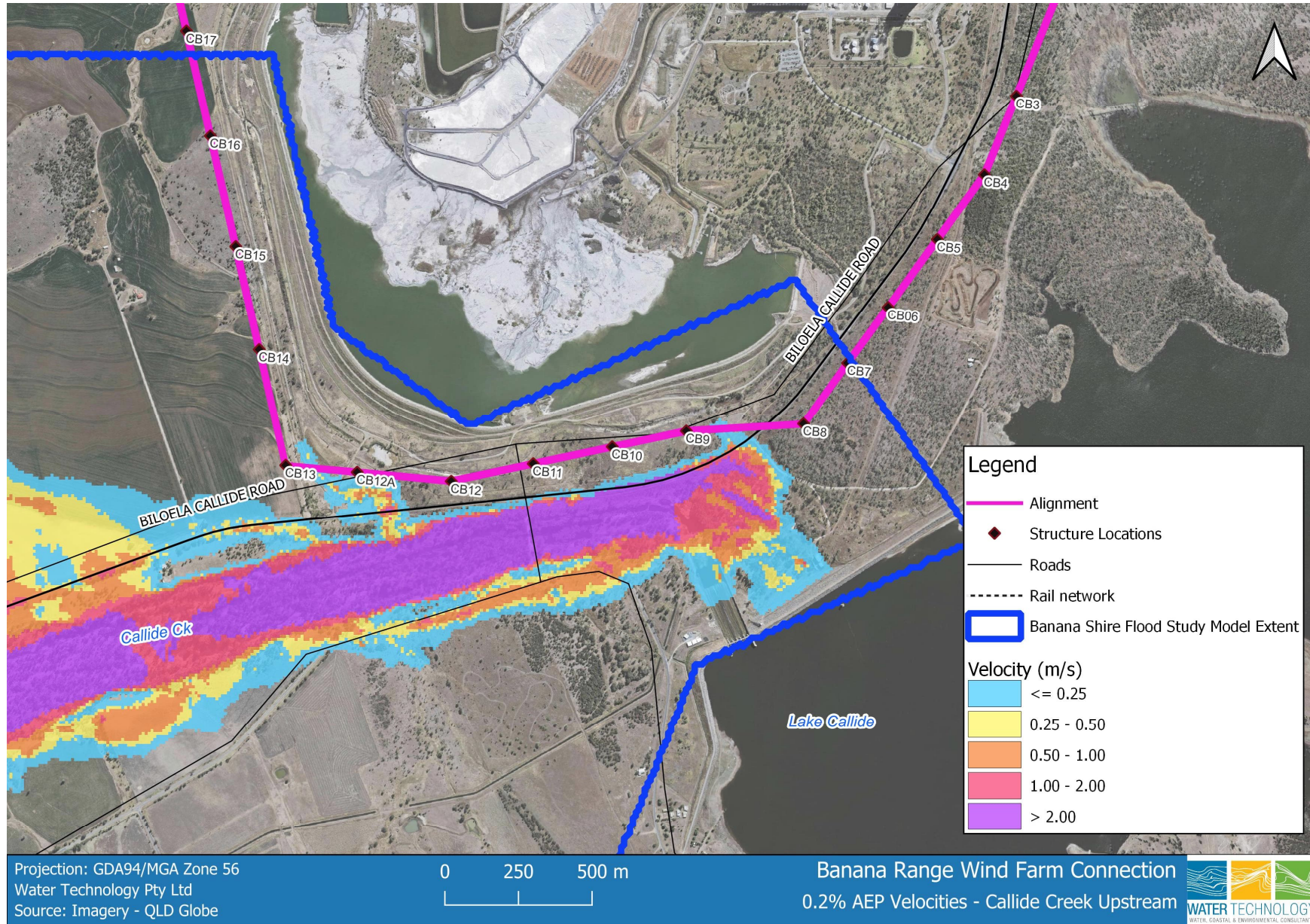


Figure 3-6 1% AEP Flood Velocities – CB7 to CB16





**Figure 3-7 0.2% AEP Flood Velocities – CB7 to CB16**



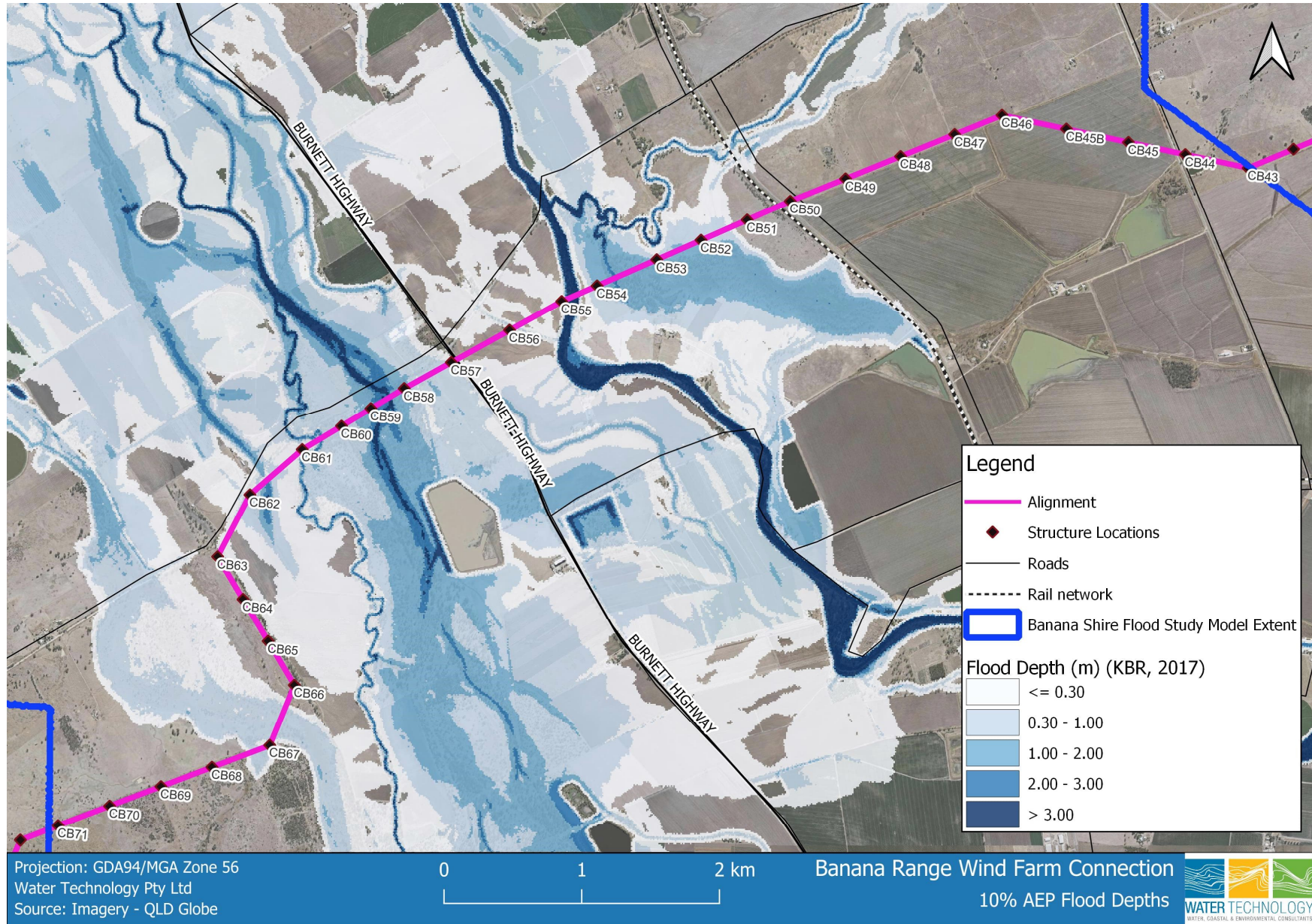
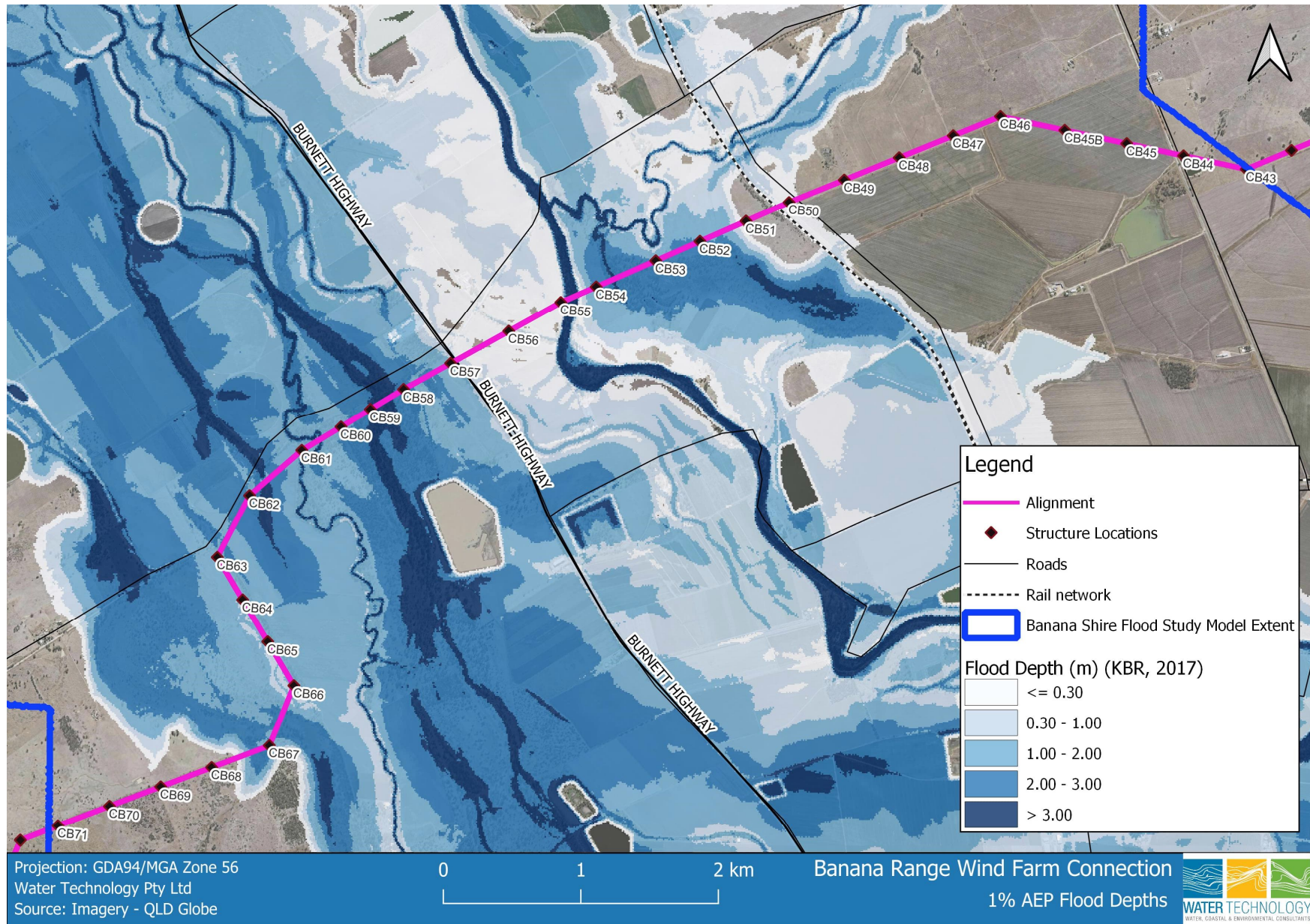


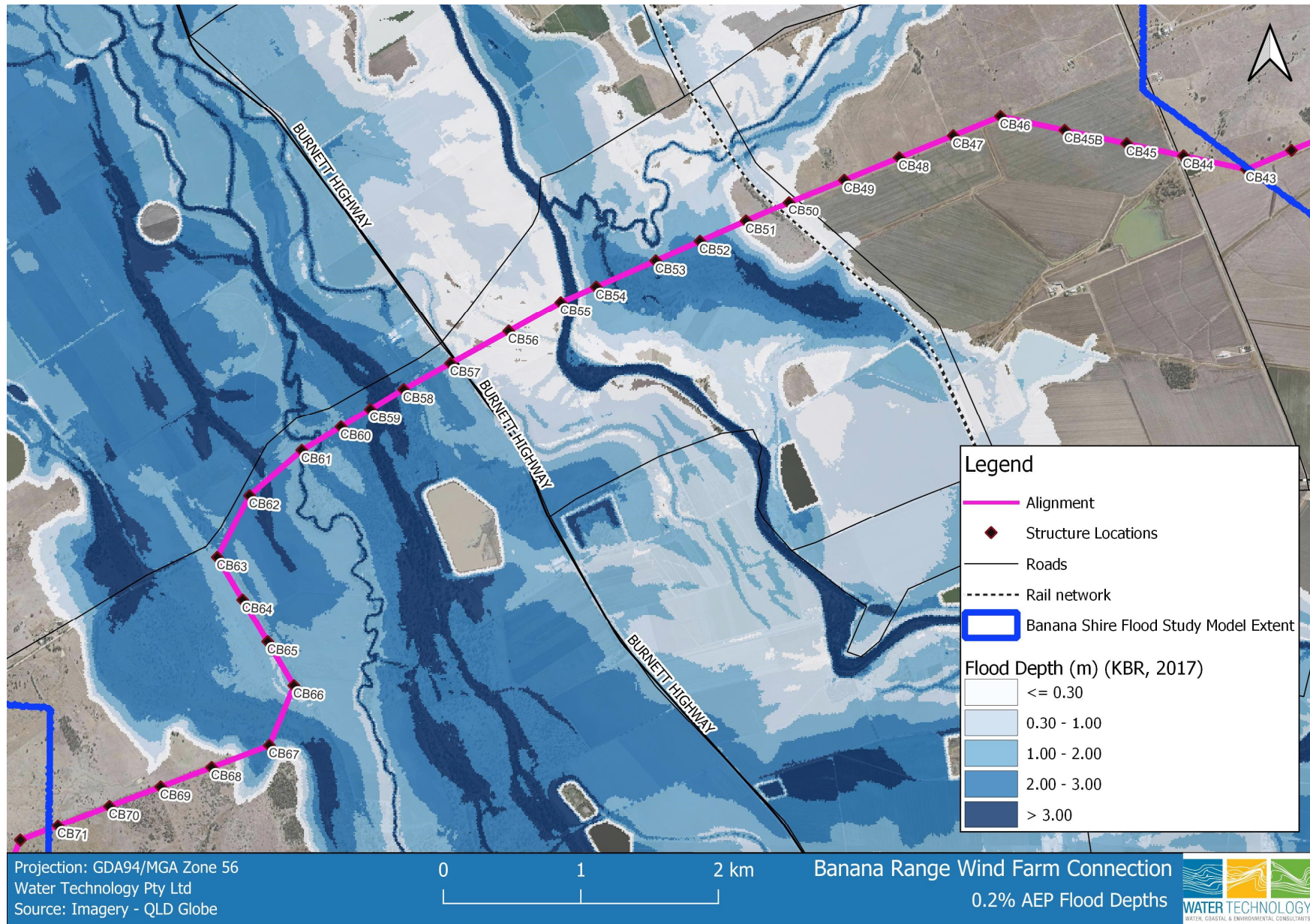
Figure 3-8 10% AEP Flood Depths – CB43 to CB71





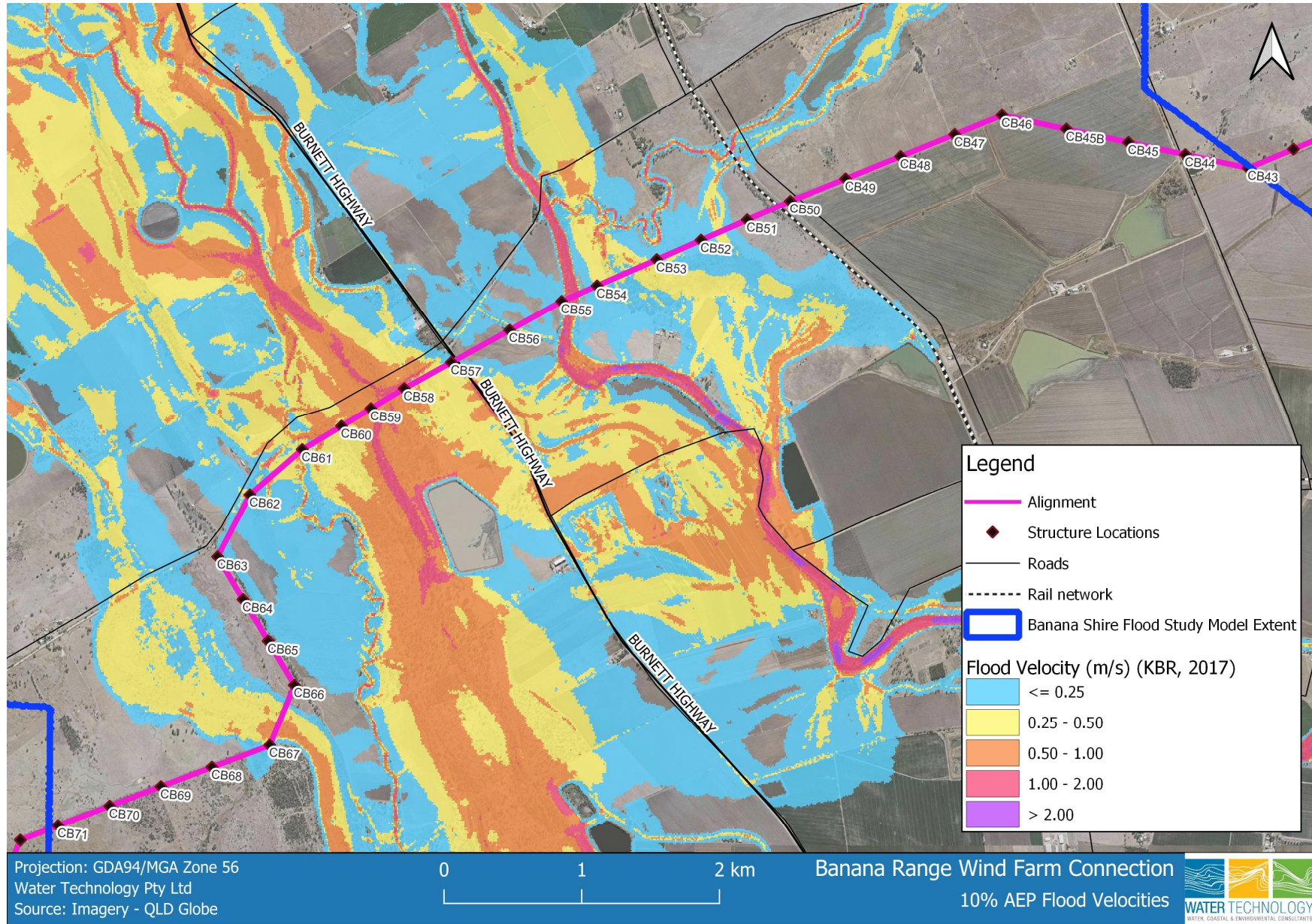
**Figure 3-9 1% AEP Flood Depths– CB43 to CB71**





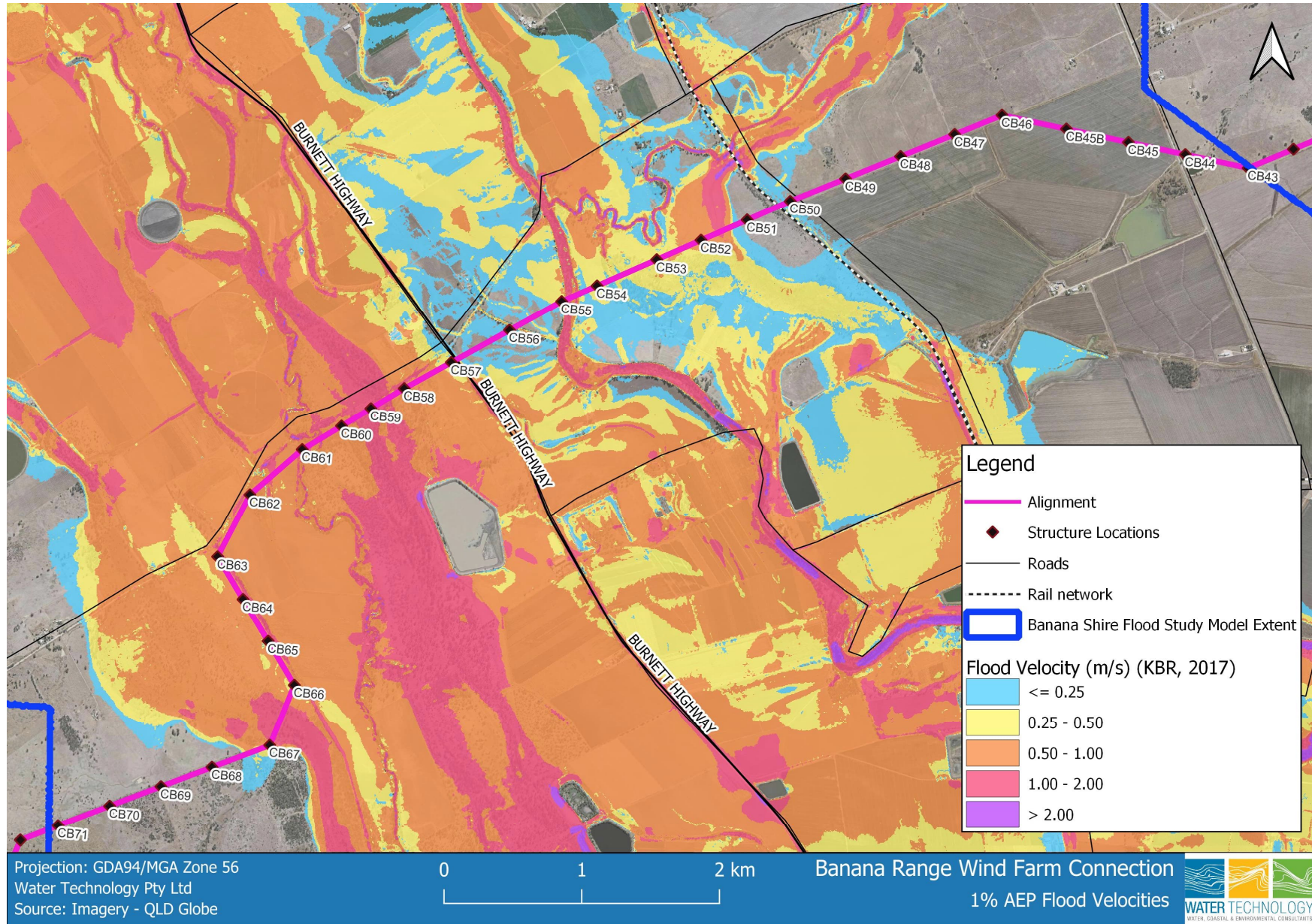
**Figure 3-10 0.2% AEP Flood Depths– CB43 to CB71**





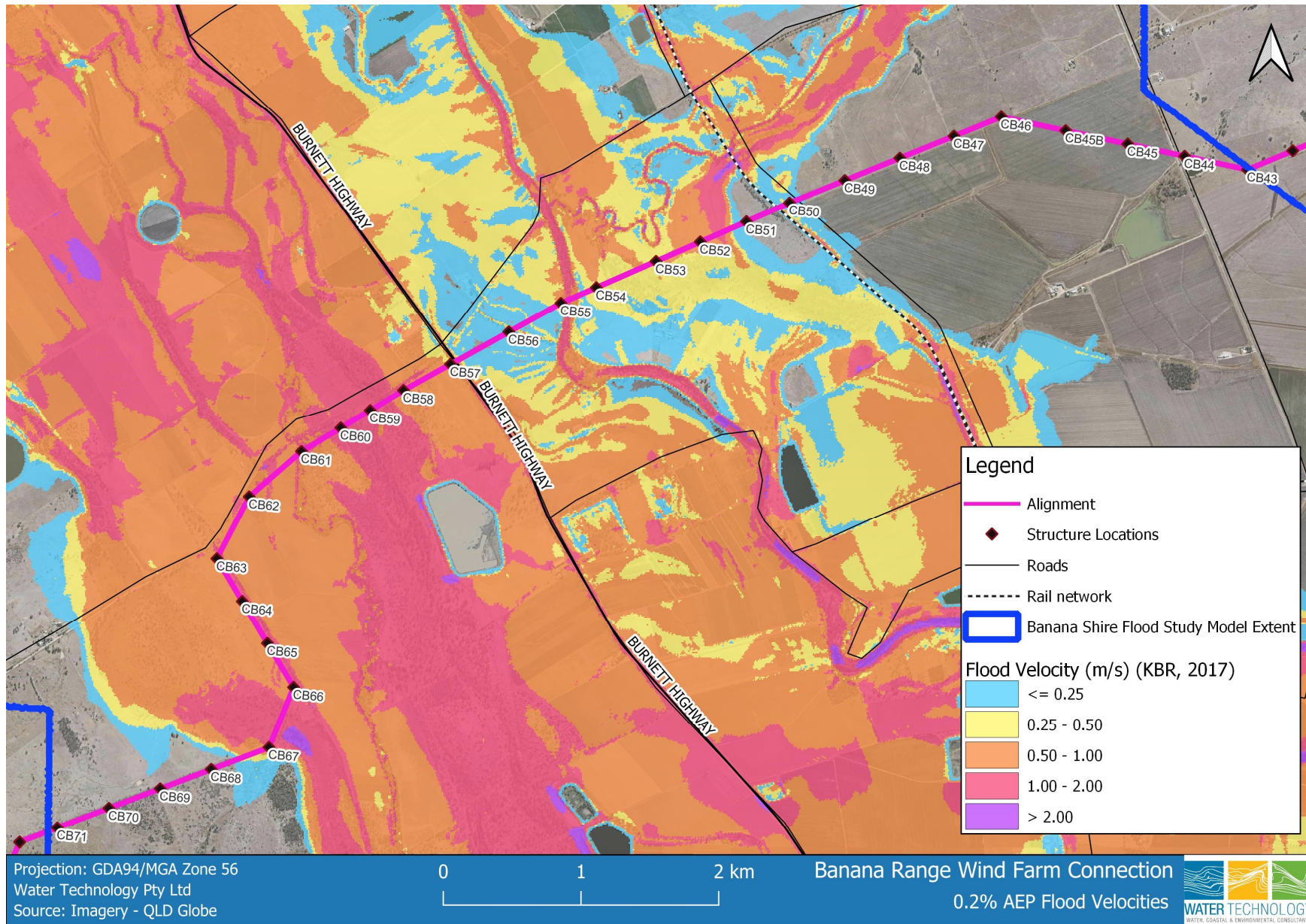
**Figure 3-11 10% AEP Flood Velocities– CB43 to CB71**





**Figure 3-12 1% AEP Flood Velocities– CB43 to CB71**





**Figure 3-13 0.2% AEP Flood Velocities– CB43 to CB71**





## 4 LOCAL CATCHMENT FLOODING

### 4.1 Basin Wide Flood Modelling

Detailed flood modelling is not available for the local catchments outside of the Banana Shire Flood Study Model Extent (KBR, 2017). Basin level flood modelling undertaken for the *Flood Mapping for the Fitzroy River Basin* (KBR, 2015) is available from the Department of Resources FloodCheck application. Indicative flood extents for the 'extreme' event (Probable Maximum Flood (PMF)) obtained from this application are illustrated in Figure 4-1 and Figure 4-2. The PMF event represents the largest conceivable flood that could occur at a location.

The FloodCheck information identifies several tower structures that may be affected by local flood events, as shown in Table 4-1. However, the proposed BRWF Substation is located outside the extreme flood extent provided in FloodCheck. Further investigation would be required to confirm the flooding extents and depth, and to estimate velocity and flood hazard at these locations as the FloodCheck information only provides indicative flood extents and depths based on hydraulic modelling with a very coarse resolution of 100 metres.

**Table 4-1 Basin Level Flood Mapping – Flood Depths at Structures**

Structure ID	1% AEP Flood Depth (m)	Extreme (PMF) Flood Depth (m)	Structure ID	1% AEP Flood Depth (m)	Extreme (PMF) Flood Depth (m)
<b>CB1</b>	-	0.10	<b>CB81</b>	0.50	1.10
<b>CB17</b>	-	0.13	<b>CB82</b>	0.14	0.57
<b>CB30</b>	-	0.10	<b>CB83</b>	-	0.12
<b>CB31</b>	0.17	0.38	<b>CB90</b>	-	0.17
<b>CB32</b>	0.18	0.38	<b>CB91</b>	-	0.2
<b>CB34</b>	0.34	0.49	<b>CB92</b>	0.35	0.67
<b>CB38</b>	0.28	0.55	<b>CB93</b>	0.23	0.56
<b>CB44*</b>	0.25	0.50	<b>CB94</b>	0.48	0.79
<b>CB71B</b>	0.11	0.26	<b>CB95</b>	-	0.12
<b>CB72</b>	-	0.20	<b>CB96</b>	0.12	0.26
<b>CB74B</b>	0.13	0.23	<b>CB97</b>	-	0.17
<b>CB76</b>	0.16	0.32	<b>CB103</b>	-	0.17
<b>CB79</b>	0.20	0.63	<b>CB106</b>	-	0.19
<b>CB80</b>	0.33	0.94	<b>CB112</b>	0.25	0.40

Note: Structures located within the Banana Shire Flood Study flood extents (as described in Section 3) or located outside the FloodCheck extreme event (PMF) flood extents have been excluded from this table.

\*CB44 is located within the Banana Shire Flood Study Model area but is not mapped within the flood extent. Therefore, depths at this location have been extracted from the basin level flood mapping.

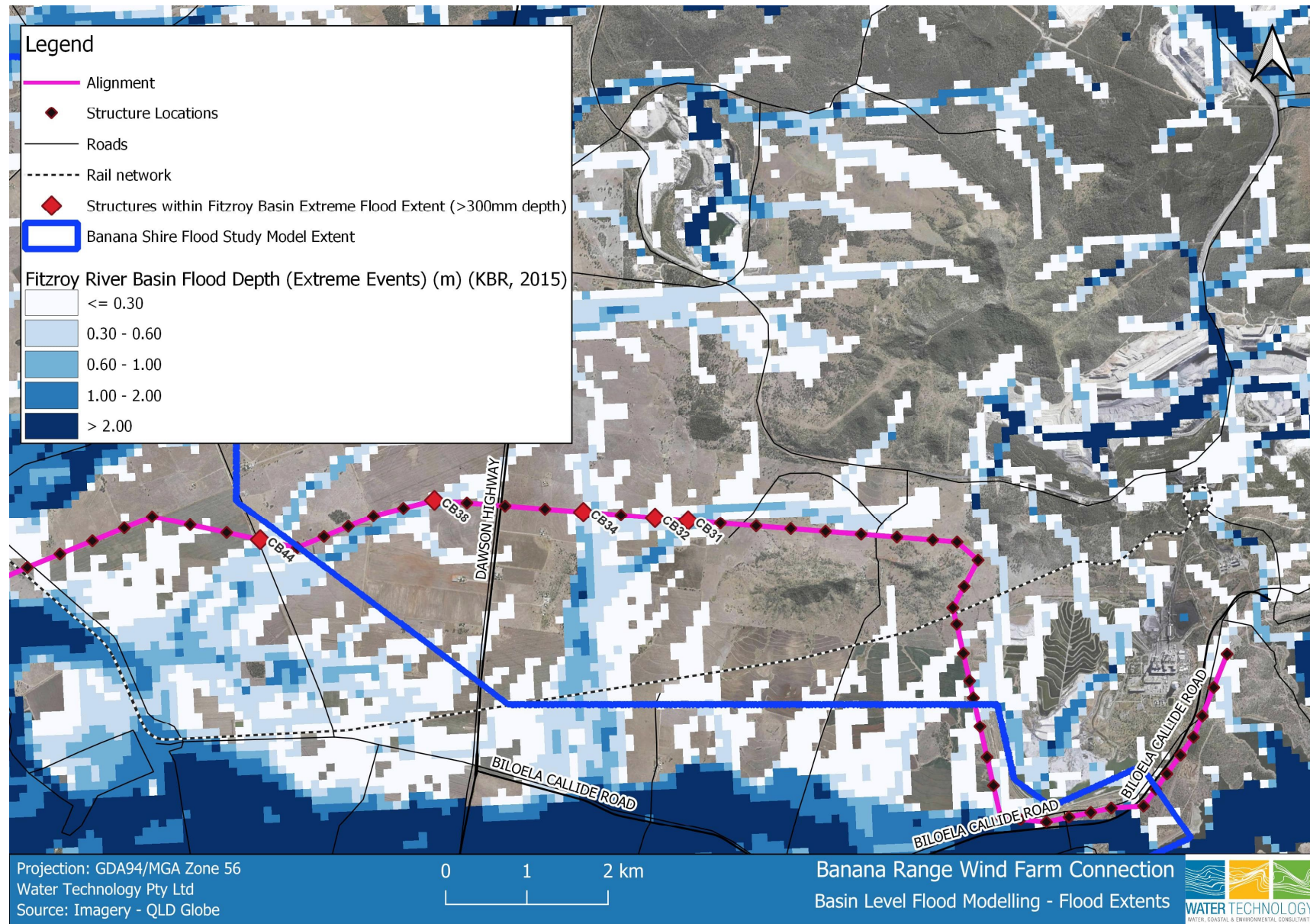
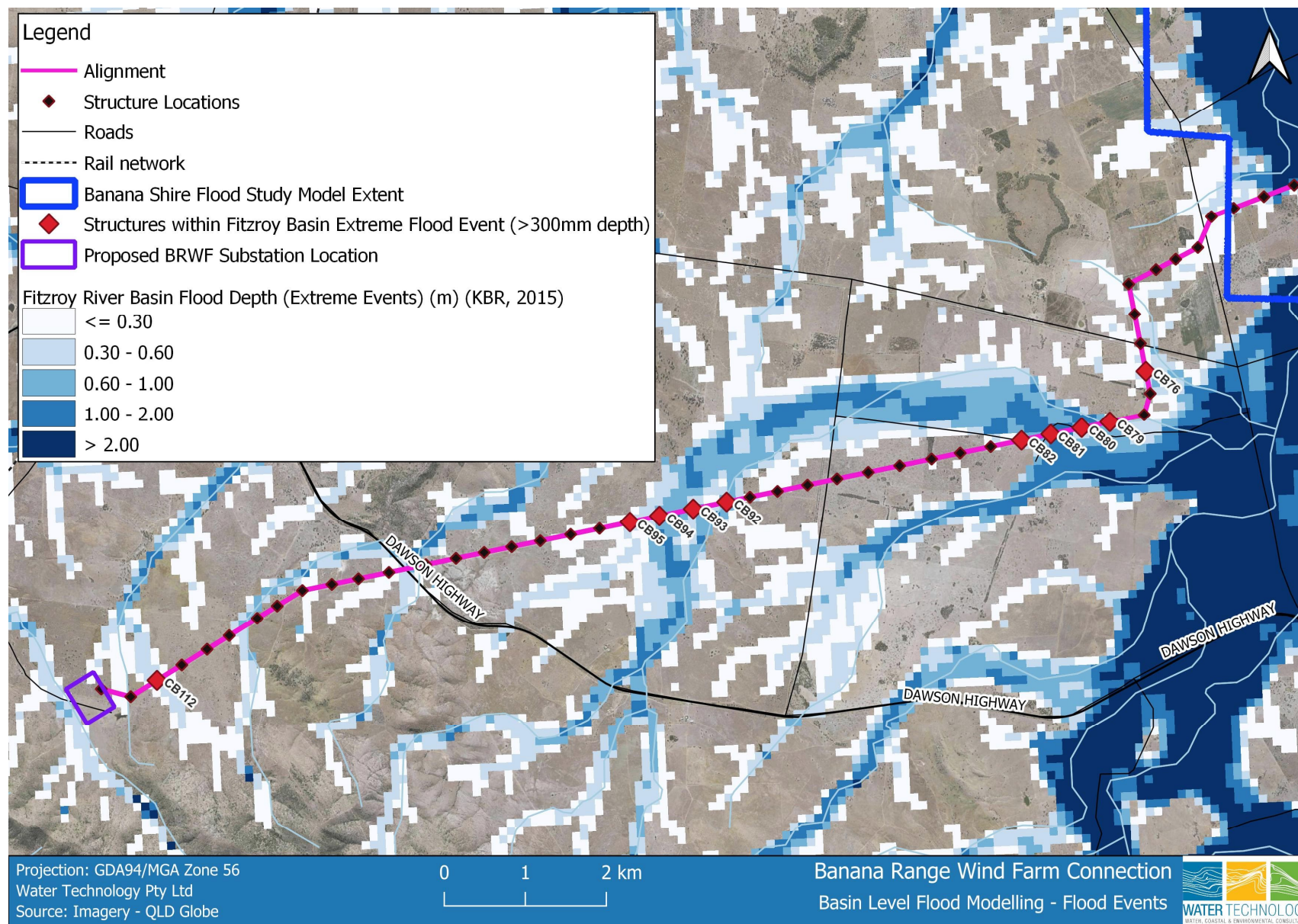


Figure 4-1 Basin Level Flood Modelling – Flood Extents





**Figure 4-2 Basin Level Flood Modelling – Flood Extents**



## 5 POTENTIAL IMPACTS

### 5.1 Impacts on Catchment Runoff and Flooding

The proposed Project may increase the volume of runoff generated from disturbed areas (including project infrastructure like the proposed sub-station) due to an increase in impervious area throughout the project area. However, the Project will result in a small change in catchment landuse in relation to the overall catchment size and is therefore unlikely to significantly increase the magnitude in peak discharges from the project area.

As the proposed infrastructure is spread throughout the project area, there will be large areas of undisturbed forest and grassland dispersed throughout the site. These undisturbed areas will reduce the impact of the proposed development by slowing runoff and allowing it infiltrate into soil downstream of impervious areas, particularly during smaller, more frequent runoff events. Management measures implemented as part of an Erosional and Sediment Control Plan (ESCP) will further mitigate any potential increase in runoff volume resulting from the project.

It is recommended that a flood assessment is undertaken for the sections of the alignment outside the Banana Shire Flood Study model extent to better define the local flood behaviour, confirm tower locations affected by flooding and provide flood information to inform the design. A flood impact assessment should be completed to demonstrate that the development will not increase risk to natural hazard.

### 5.2 Impacts on Water Quality

The proposed Project may impact on downstream water quality via two key mechanisms:

- Increased concentrations of suspended solids, nutrients and metals associated with the erosion of disturbed areas.
- Introduction of contaminants from chemicals and fuels used for the construction and maintenance of the proposed transmission line and substation.

Any disturbance that involves the clearing of vegetation or earthworks should be carefully considered to ensure the Project does not result in increased sediment loads and associated pollutants from entering the downstream receiving environment. Appropriate erosion and sediment control measures should be implemented.

The introduction of contaminants to the project area for the construction, maintenance, operation and decommissioning of the project infrastructure poses a risk of these contaminants ending up in the receiving environment. Local storage of chemicals and fuels within the project area will increase this risk along with concrete batching and associated materials. Therefore, relevant guidelines and standards governing the storage and use of hazardous materials and waste removal should be followed to reduce this risk.

### 5.3 Impacts on Waterways and Fish Passage

The Queensland *Fisheries Act 1994* is administered by Department of Agriculture and Fisheries (DAF) and governs the management of fisheries, declared fish habitat areas and marine plants. Works which may cause disturbance to 'waterways' as defined under the *Fisheries Act 1994* can be subject to assessable operational work for waterway barrier works, unless construction complies with the conditions under the 'Accepted development requirements for operational work that is constructing or raising waterway barrier works'.

The *Fisheries Act 1994* waterway classification does not indicate the relative importance of the fish habitat, rather it has been determined by several characteristics including stream order, stream slope and tidal influence.



- Waterways classified as 1 (low) (green) or 2 (medium) (amber) are typically in the upper reaches of a catchment where fish are typically smaller with stronger swimming abilities; and
- Waterways classified as 3 (high) (red), 4 (major) (purple), or 5 (tidal) (grey) typically are host to a wider range of fish sizes and swimming abilities.

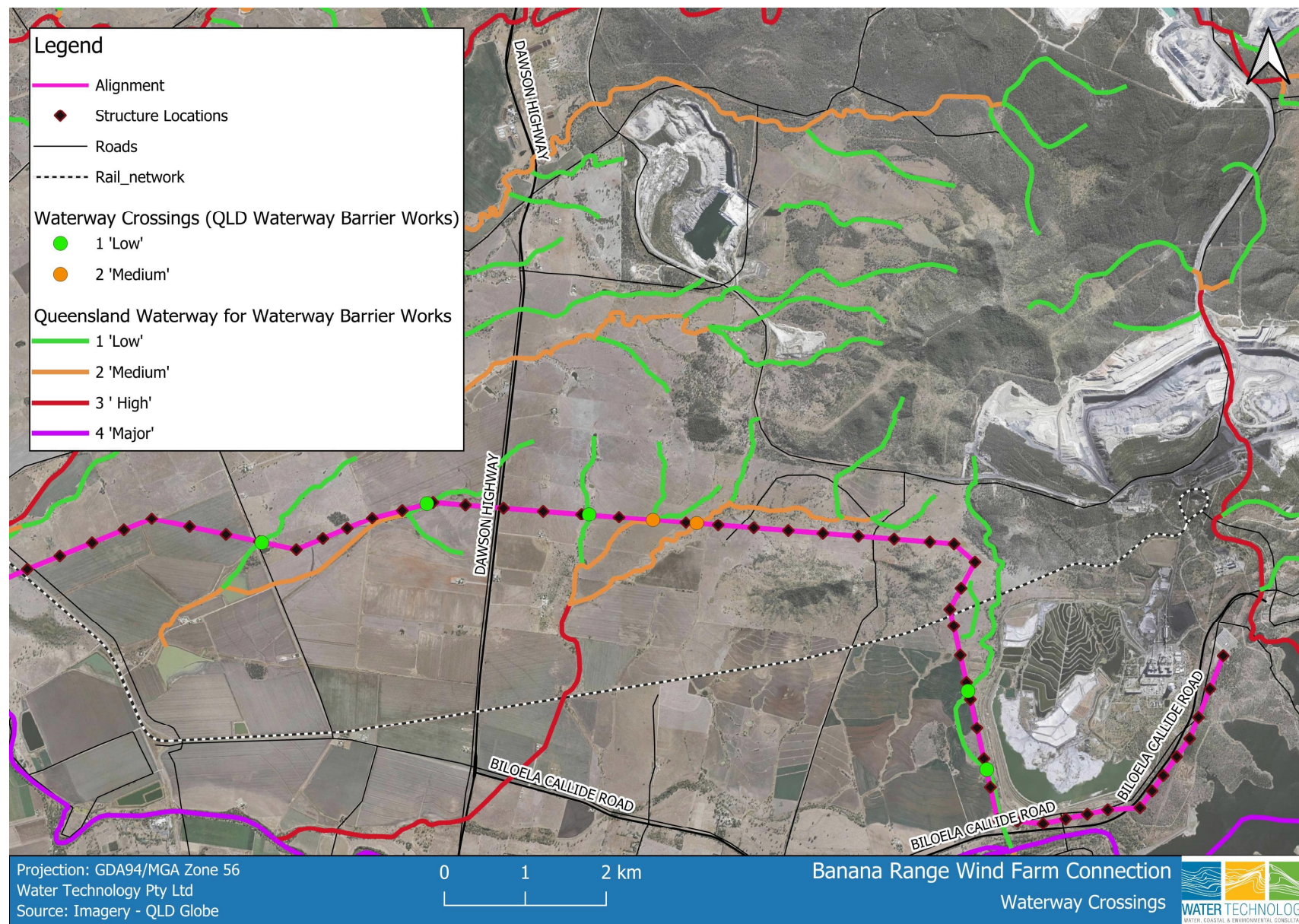
Figure 5-1, Figure 5-2 and Figure 5-3 illustrate the proposed alignment against the Department of Agriculture and Fisheries *Queensland waterways for waterway barrier works* spatial layer (DAF, 2023), including:

- 21 crossings classified as 'Low';
- 5 crossings classified as 'Medium';
- 2 crossings classified as 'High'; and
- 3 crossings classified as 'Major'.

This spatial layer classifies waterways defined by the *Fisheries Act 1994* to assist in determining whether proposed barrier works are assessable or accepted (DAF, 2023).

Construction of the transmission line or substation will not require works that disturb a waterway, however, construction of access/maintenance tracks may require crossings of waterways. Where existing approved crossings cannot be utilised, works will need to comply with the accepted development requirements. Should any works within a waterway not comply with the Accepted development requirements, a development permit is ordinarily required under the Planning Act. However, if the Project is granted an Infrastructure Designation, operational work for waterway barrier works will be considered accepted development and will not require a development permit. Regardless, any access/maintenance tracks requiring construction across a waterway should be designed with consideration of the accepted development requirements.





**Figure 5-1 Waterway Crossings**



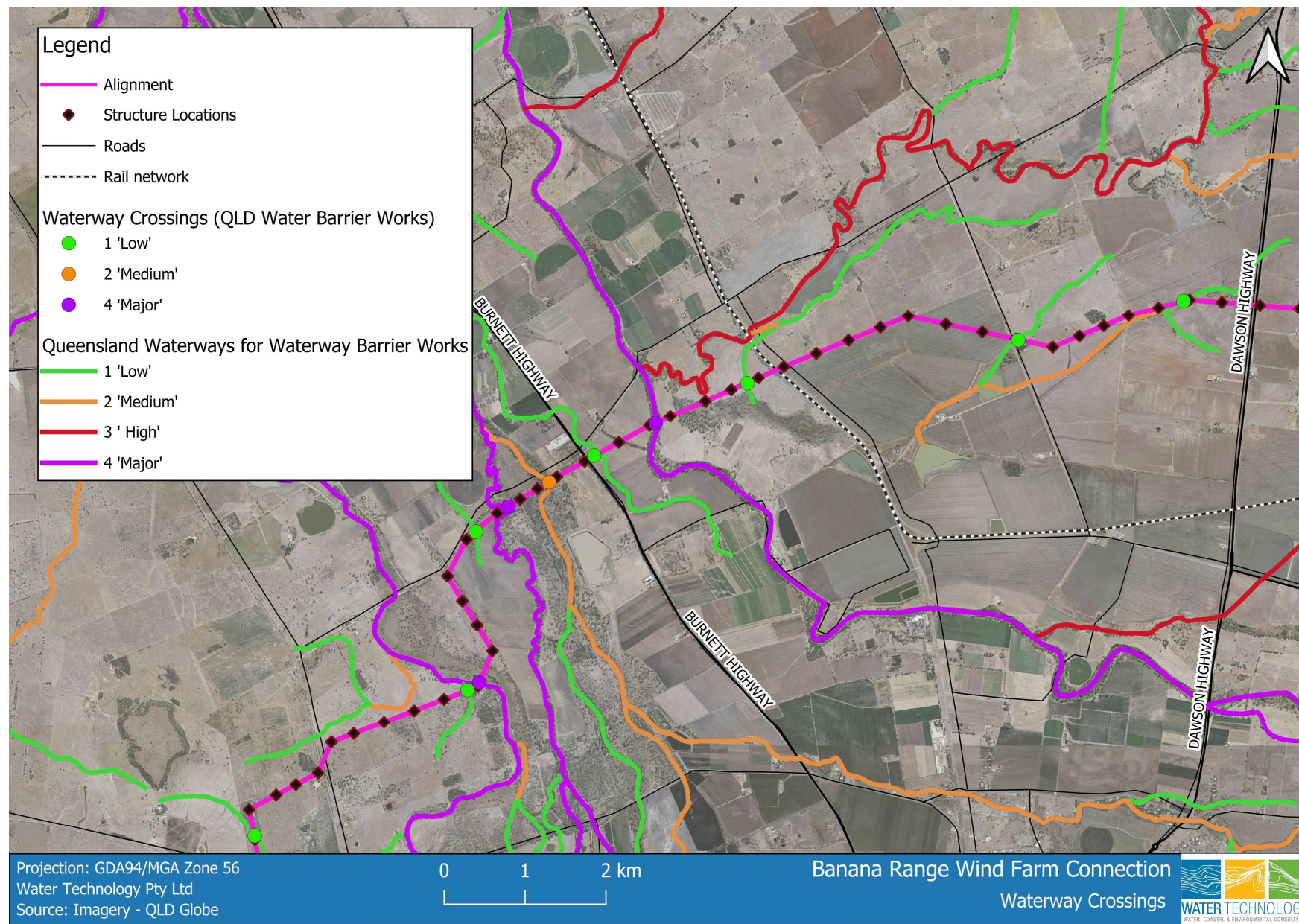


Figure 5-2 Waterway crossings



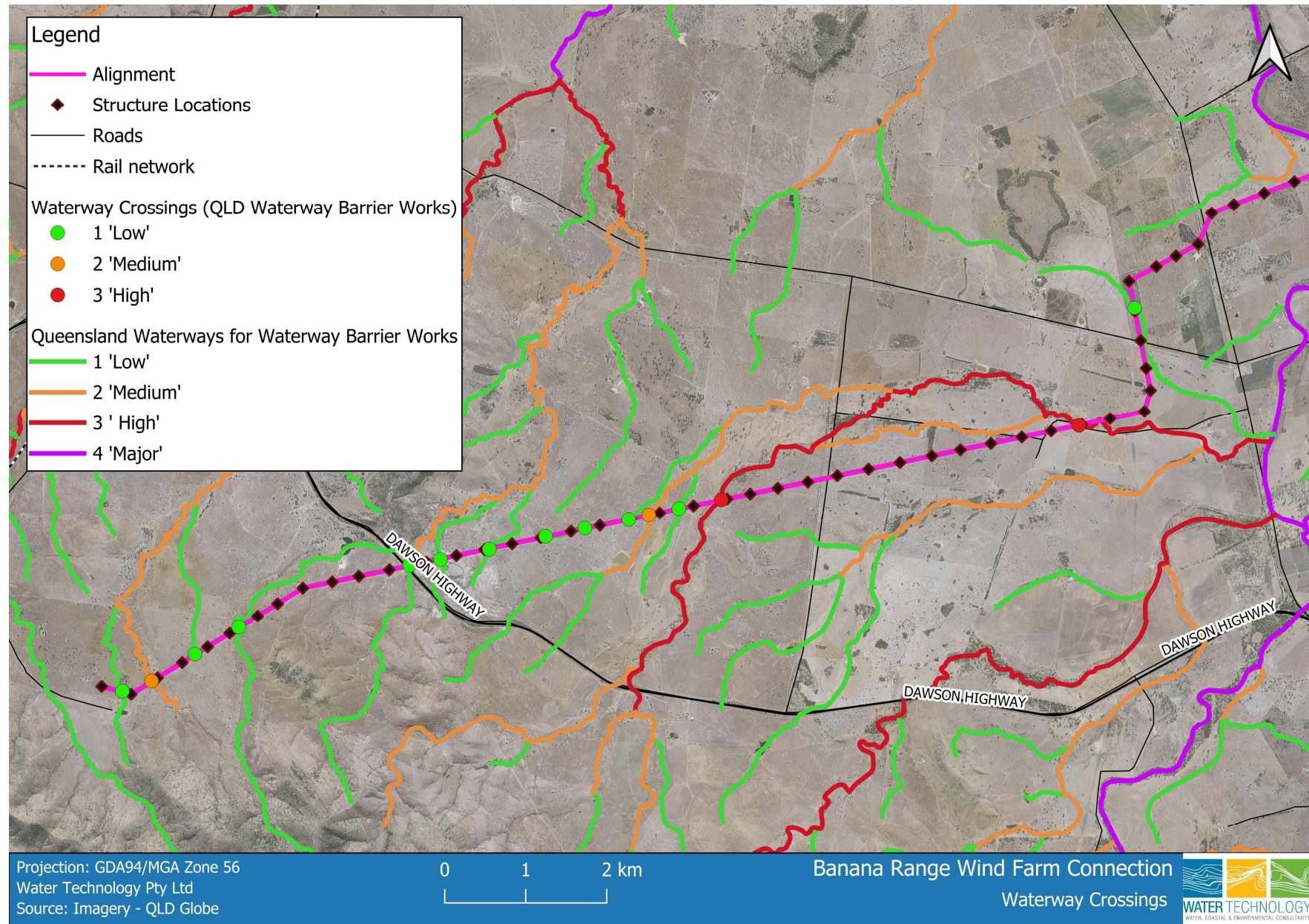


Figure 5-3 Waterway crossings





## 6 SUMMARY

This desktop hydrology assessment of the proposed BRWF Connection Project has identified:

- The proposed alignment crossed the Callide Creek/Kroombit Creek floodplain which spans approximately 6km.
- Tower structures CB50 to CB67 are located within the Callide Creek/Kroombit Creek floodplain based on review of the Banana Shire Flood Study (KBR, 2017) hydraulic modelling results. Flood depths and velocities have been extracted at these towers to inform the design.
  - Towers would need to be designed to withstand the modelled flood depths and velocities, with particular consideration for towers located within hazard categories H5 and H6 as these categories indicate areas where structures may be vulnerable to damage or failure (AIDR, 2017). One tower 'CB59' is located in hazard category H6 in the 0.2% AEP event where "All building types considered vulnerable to failure.". As such, further consideration of the location of this tower should be undertaken to reduce its hazard and vulnerability to failure.
  - Consideration will also be required for the design to limit potential scour of the waterway surrounding the tower or include the design of appropriate scour protection.
- The alignment crosses several minor watercourses outside the floodplain extent and several tower locations have been identified as having potential to be affected by local catchment flooding as described in Section 4. As the resolution of the available flood mapping for these areas is very coarse, it is recommended that a flood assessment is undertaken to confirm the local flood behaviour.
- The Proposed BRWF Substation is located outside the extreme flood extents based on available basin scale flood mapping.
- The proposed project will result in a small change in catchment landuse in relation to the overall catchment size and is therefore unlikely to significantly increase the magnitude in peak discharges from the project area.
- Any disturbance that involves the clearing of vegetation or earthworks should be carefully considered to ensure the project does not result in increased sediment loads and associated pollutants from entering the downstream receiving environment. Appropriate erosion and sediment control measures should be implemented.

It is recommended that:

- A flood assessment is undertaken for the sections of the alignment outside the Banana Shire Flood Study model extent to confirm tower locations affected by flooding and provide flood information to inform the design.
- A flood impact assessment is completed to demonstrate that the development will not increase risk to natural hazard.



## 7 REFERENCES

- AIDR (2017) Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia. Flood Hazard Guideline 7.3
- DAF (2023) State of Queensland, prepared by Department of Agriculture and Fisheries, Queensland waterways for waterway barrier works spatial data layer. Guide to determining waterways, 2 December 2023
- DES (2013) <https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/basin-fitzroy/>
- DOR (2023) Department of Resources FloodCheck Application.  
<https://floodcheck.information.qld.gov.au/>
- JBS&G (2023) Alignment and structure locations. "CP.02942 - BRange Wind Farm - Current Alignment Option\_2023-10-16.kmz".
- JBS&G (2023) Substation locations.  
"UTL\_Powerlink\_BRWFSubstationArea\_500x400\_GDA20z56.kmz" provided by JBS&G.
- KBR (2015) Flood Mapping for the Fitzroy River Basin.
- KBR (2017) Banana Shire Flood Study Stage 2- Floodplain Management Plan. Prepared for Banana Shire Council.



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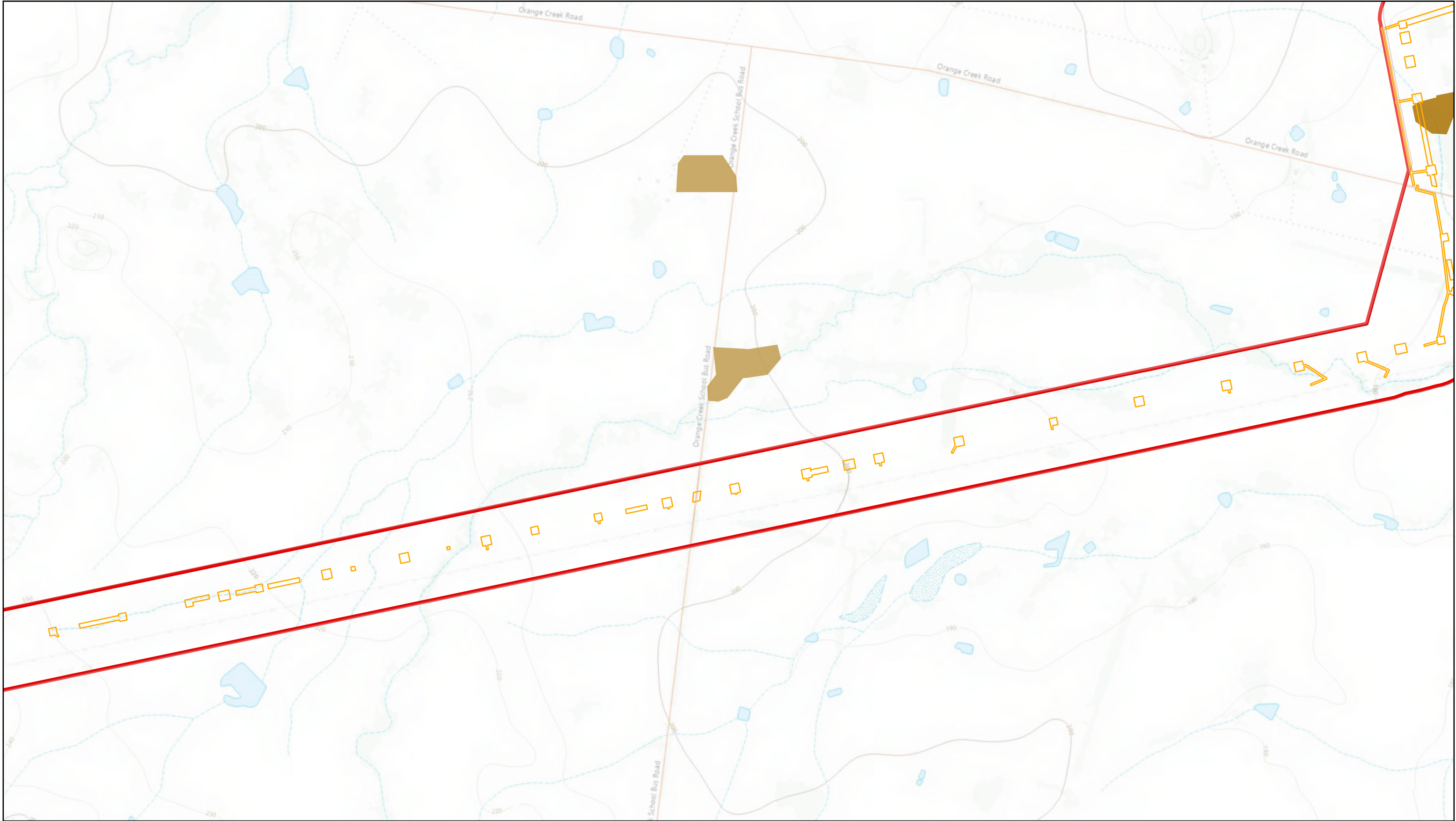
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Stawell VIC 3380  
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**Legend**

Disturbance Footprint

Project area

**Brigalow Belt Biodiversity Planning Assessment**

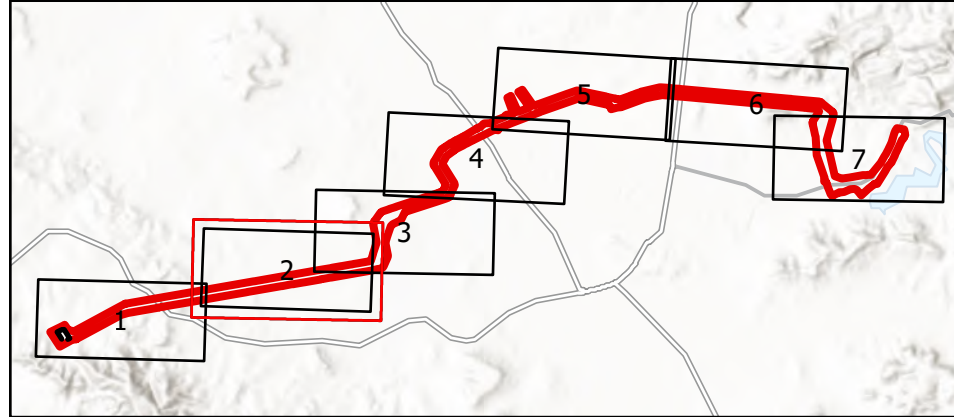
Biodiversity Significance

Local or Other Values

Statewide Corridors

Regional

State



**BANANA RANGE WIND FARM CONNECTION PROJECT**

**Map 11 - Corridors and Connectivity - Biodiversity Planning Assessment**

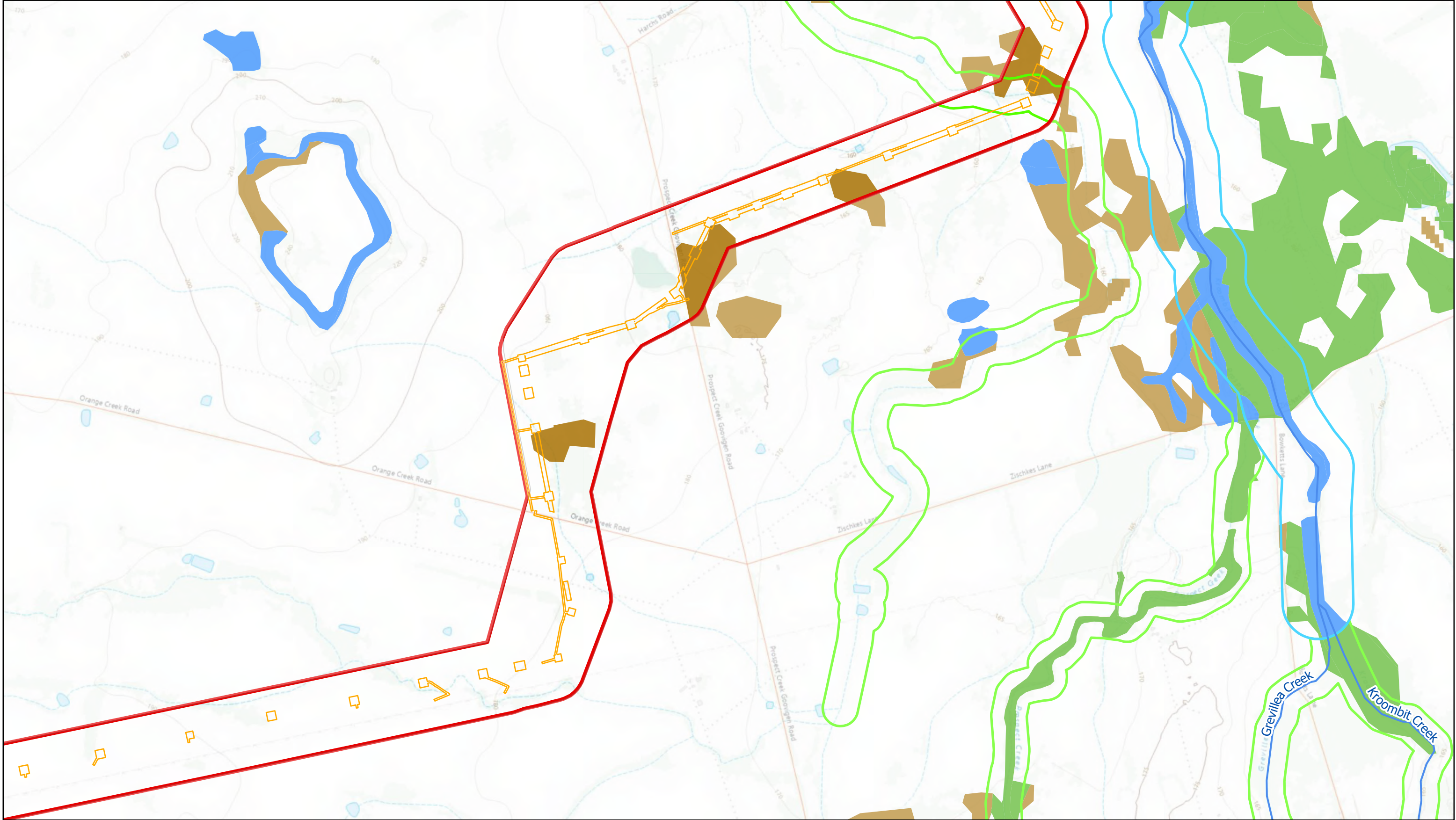
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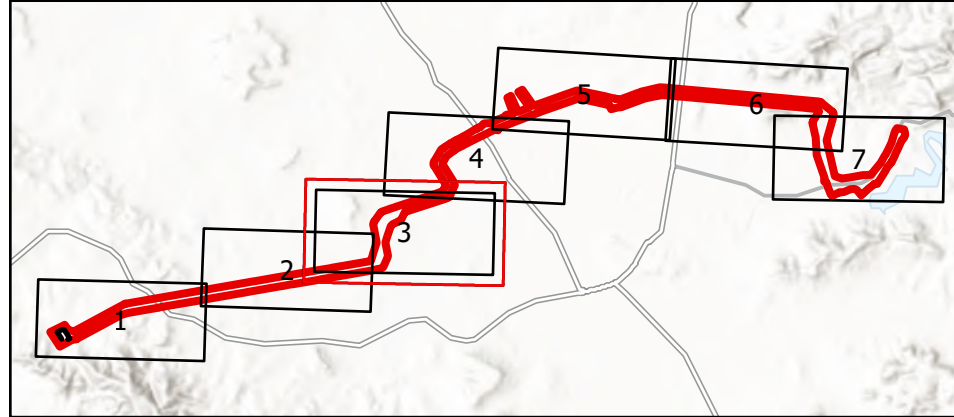
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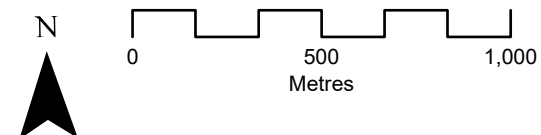
## Legend

- Disturbance Footprint
- Project area
- Brigalow Belt Biodiversity Planning Assessment**
- Biodiversity Significance**
- State
- Regional
- Local or Other Values
- Statewide Corridors**
- Regional
- State



## BANANA RANGE WIND FARM CONNECTION PROJECT

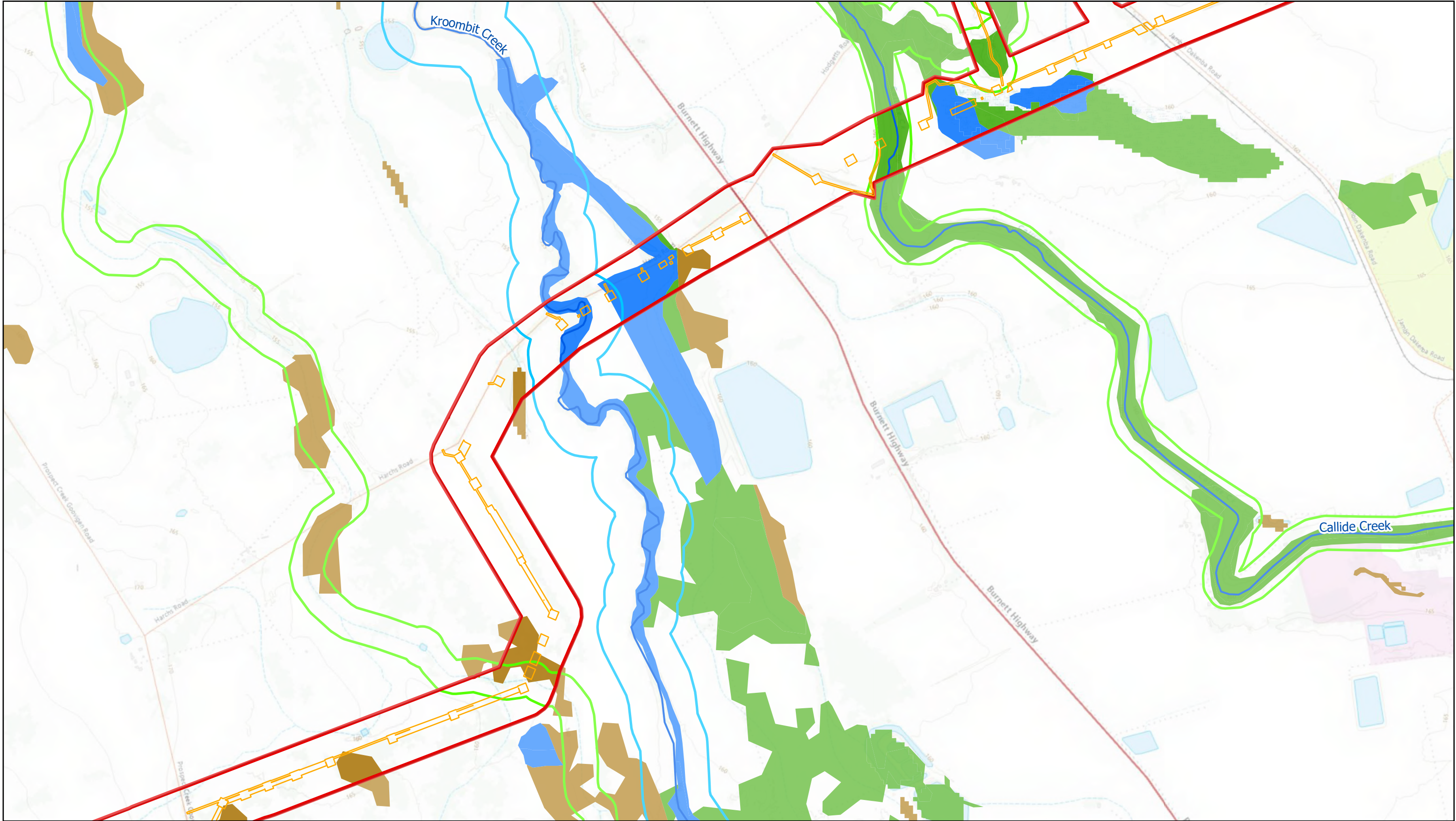
### Map 11 - Corridors and Connectivity - Biodiversity Planning Assessment



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**Legend**

- Disturbance Footprint

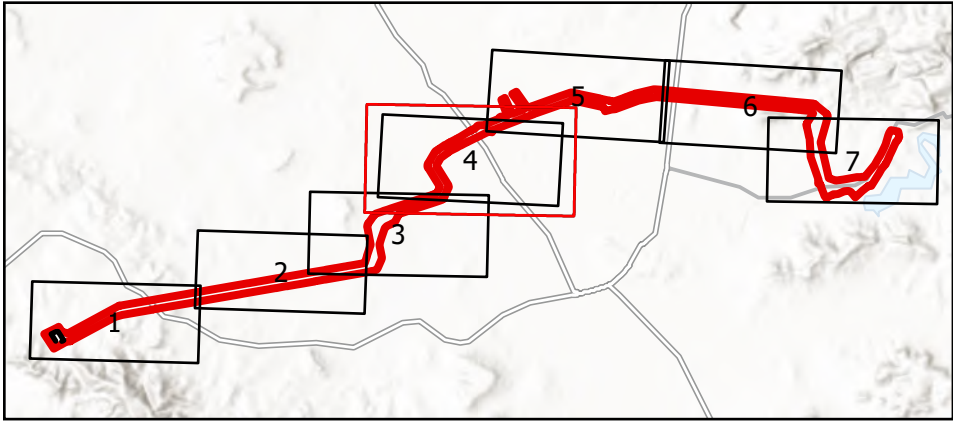
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- Regional

Local or Other Values
- Statewide Corridors

Regional

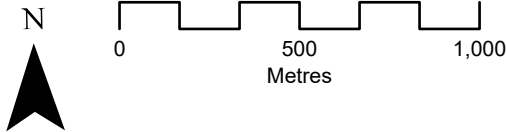
State
- Biodiversity Significance

State



**BANANA RANGE WIND FARM  
CONNECTION PROJECT**

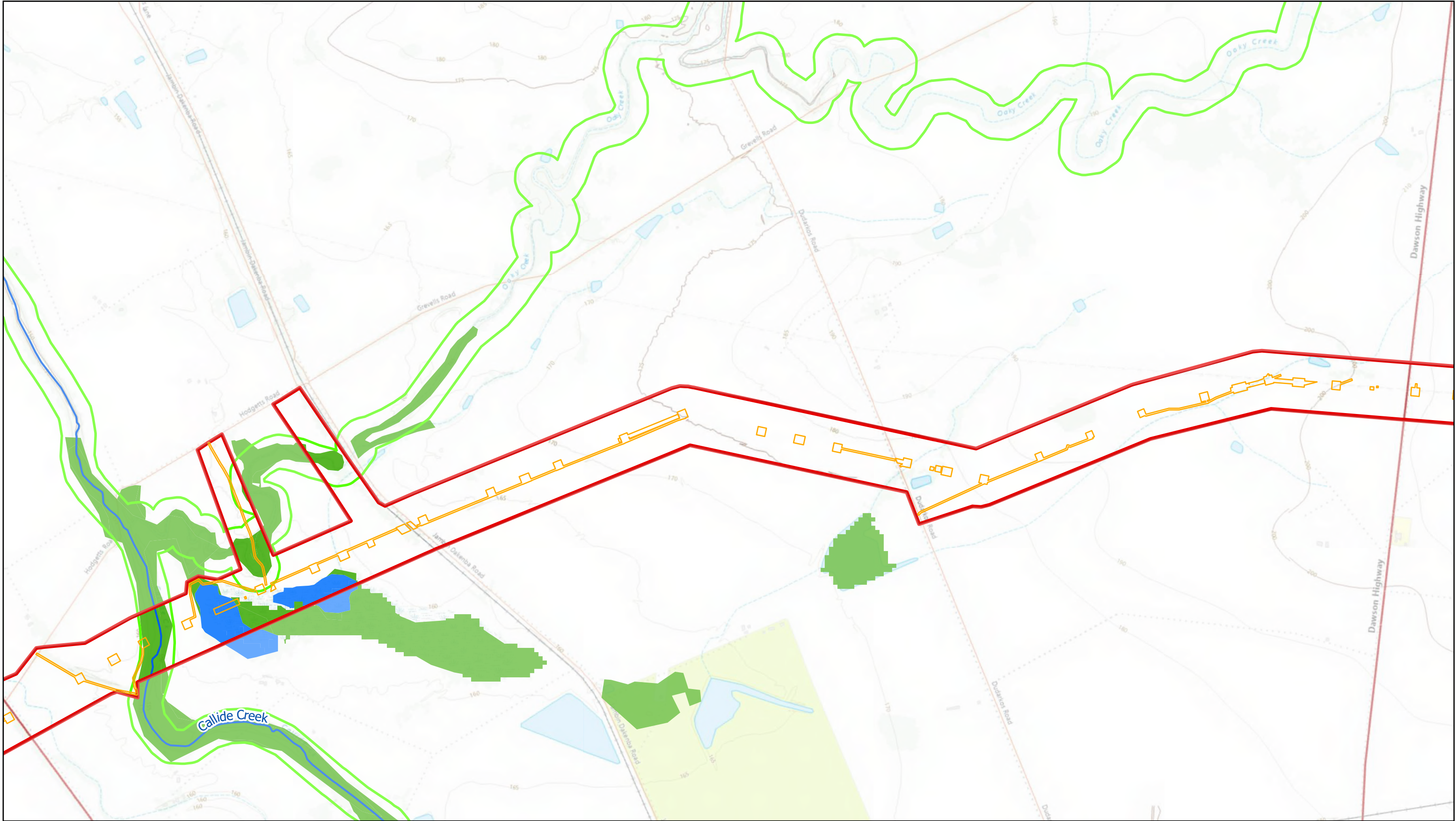
**Map 11 - Corridors and Connectivity -  
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**Legend**

- Disturbance Footprint

Project area

**Brigalow Belt Biodiversity Planning Assessment**

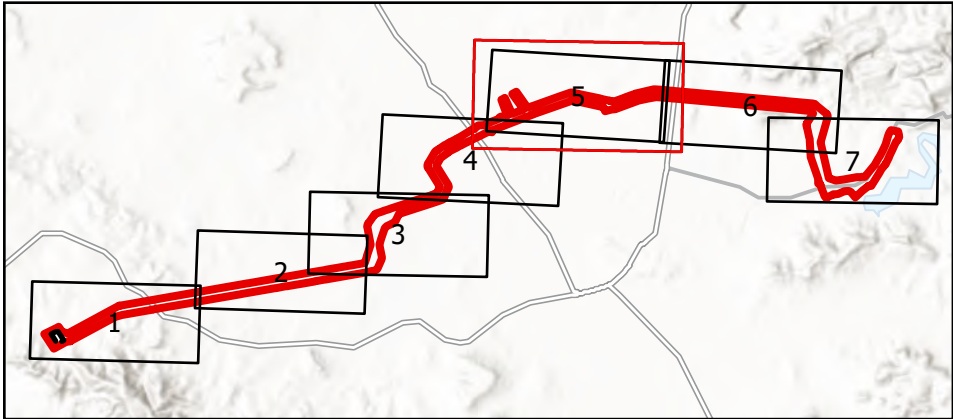
Biodiversity Significance

State
- Regional

Statewide Corridors

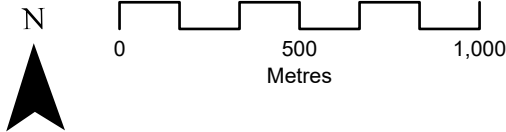
Regional

State



**BANANA RANGE WIND FARM  
CONNECTION PROJECT**

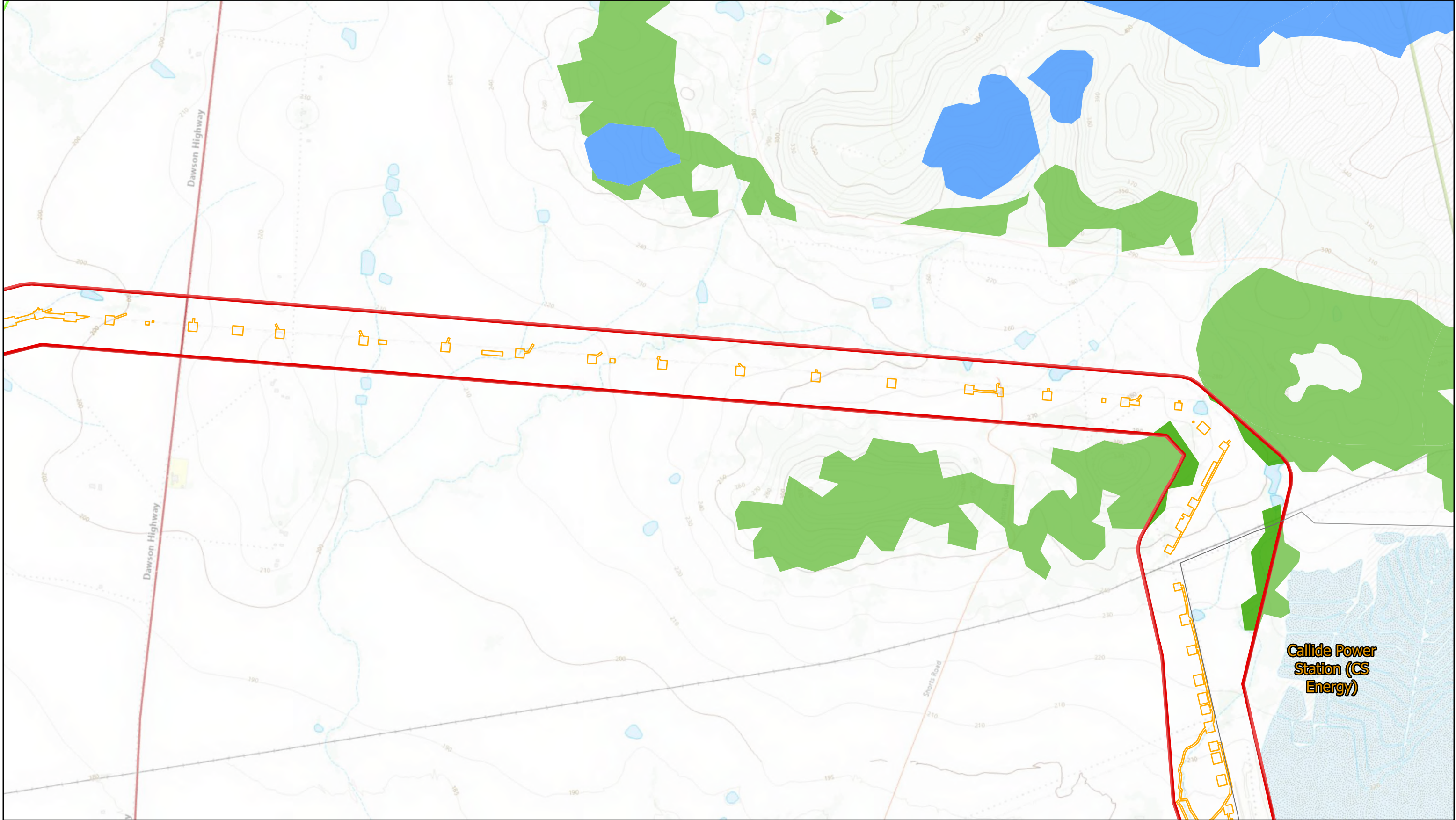
**Map 11 - Corridors and Connectivity -  
Biodiversity Planning Assessment**



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**Legend**

Disturbance Footprint

Project area

**Brigalow Belt Biodiversity Planning Assessment**

Biodiversity Significance

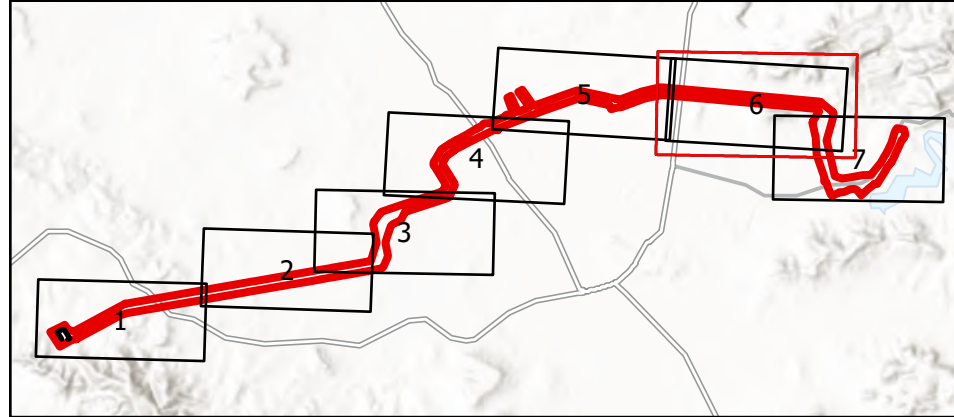
State

Regional

Statewide Corridors

Regional

State



**BANANA RANGE WIND FARM CONNECTION PROJECT**

**Map 11 - Corridors and Connectivity - Biodiversity Planning Assessment**

0 500 1,000  
Metres

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**Legend**

- Disturbance Footprint

Project area

Helipad Area

Callide substation Expansion

Lake Callide
- Brigalow Belt Biodiversity Planning Assessment**

State Habitat for EVNT taxa

**Biodiversity Significance**

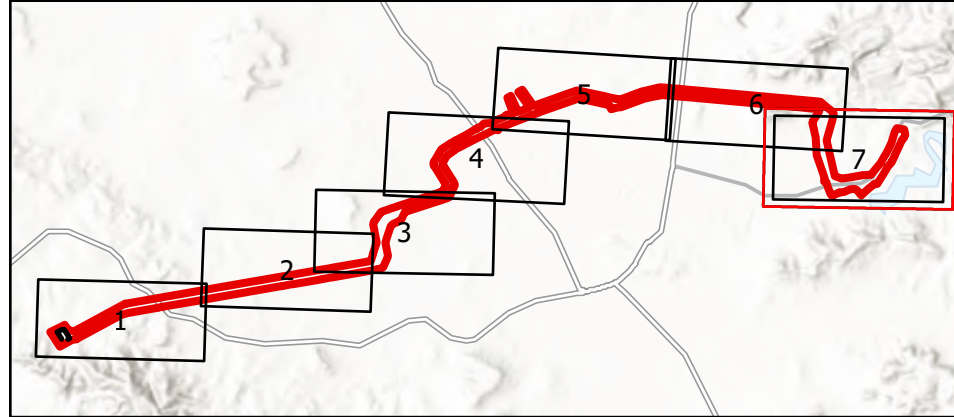
State

Regional

Local or Other Values

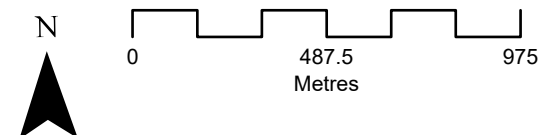
Statewide Corridors Regional

State



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**Map 11 - Corridors and Connectivity - Biodiversity Planning Assessment**



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