Prepared for
Powerlink Queensland
ABN: 82 078 849 233

AECOM

Chapter 7

Hydrology

Otc-2021

Genex Kidston Connection Project - Ministerial Infrastructure Designation Assessment Report

7.0 Hydrology

7.1 Existing Environment

7.1.1 Surface water

The Project crosses the Gilbert River Basin before crossing into the Burdekin River Basin approximately 70 km along the Preferred Alignment from its western end. The Project involves 31 crossings of a third order (or higher) stream with only five of these in the Gilbert Basin and the remaining 26 crossings in the Burdekin River Basin. A full list of the major watercourse crossings of the Preferred Alignment are provided in Table 7-2 with an overview of the catchment areas above the transmission line provided in Figure 7-1. All watercourses crossed by the Project are ephemeral and generally cease to flow shortly after the cessation of rainfall. The Burdekin River represents the largest catchment area crossed by the Preferred Alignment and flows in the upper Burdekin can persist several months following the wet season. However flows generally cease in the dry season in this section of the river as well.

7.1.1.1 Environmental values

Environmental values (EVs) are the qualities that make water suitable for supporting aquatic ecosystems and human uses, and require protection from the effects of habitat alteration, waste releases, contaminated runoff and changed flows to ensure healthy aquatic ecosystems and waterways that are safe for community use. The EVs of waters are protected under the *Environmental Protection (Water) Policy 2009* (hereafter referred to as EPP Water). The policy sets water quality objectives (WQOs), which are physical and chemical measures of the water (i.e. pH, nutrients, salinity etc.) to achieve the EVs set for a particular waterway or water body. EVs define the suitable uses of the water (i.e. aquatic ecosystems, human consumption, industrial use etc.). Table 7-1 below lists the EVs that can be chosen for protection and provides definitions of each.

Table 7-1 Suite of environmental values that can be chosen for protection

Environmental Value	Definition
Aquatic ecosystem	A community of organisms living within or adjacent to water, including riparian or foreshore area (EPP Water, Schedule 2). The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes, lagoons, canals, natural and artificial channels and the bed and banks of waterways.
Irrigation	Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.
Farm water supply	Suitability of domestic water supply, other than drinking water. For example, water used for laundry and produce preparation.
Stock watering	Suitability of water supply for production of healthy livestock.
Aquaculture	Health of aquaculture species and humans consuming aquatic foods (such as fish, molluscs and crustaceans) from commercial ventures.
Human consumption of aquatic foods	Health of humans consuming aquatic foods, such as fish, crustaceans and shellfish from natural waterways.

Environmental Value	Definition
Primary recreation	Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, surfing, windsurfing, diving and water-skiing. Primary recreational use, of water, means full body contact with the water, including, for example, diving, swimming, surfing, water-skiing and windsurfing. (EPP Water, section 6).
Secondary recreation	Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing. Secondary recreational use, of water, means contact other than full body contact with the water, including, for example, boating and fishing. (EPP Water, section 6).
Visual recreation	Amenity of waterways for recreation which does not involve any contact with water - for example, walking and picnicking adjacent to a waterway. Visual recreational use, of water, means viewing the water without contact with it. (EPP Water, section 6).
Drinking water supply	Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection.
Industrial use	Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries. Industries usually treat water supplies to meet their needs.
Cultural and spiritual values	Indigenous and non-indigenous cultural heritage, for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities. • symbols, landmarks and icons (such as waterways, turtles and frogs). • lifestyles (such as agriculture and fishing). • cultural and spiritual values, of water, means its aesthetic, historical, scientific, social or other significance, to the present generation or past or future generations. (EPP Water, section 6).

Schedule 1 of the EPP Water lists rivers and catchments where EVs have been determined and issued by the regulatory authority. The Gilbert River Basin, does not fall within Schedule 1 of the EPP water and therefore no EVs have been designated. In this instance the EPP Water suggests that all EVs are applicable.

At time of report preparation Draft EVs are available for the Burdekin River Basin. These are provided in two documents, namely:

- *Community Draft Environmental Values for the waters of the Burdekin Dry Tropics region* (NQ Dry Tropics, 2013)
- *Draft Environmental Values and Water Quality Guidelines: Burdekin Basin Fresh and Estuarine Waters* (DSITI, 2017).

The surface water EVs for relevant sections of the Preferred Alignment are provided in Table 7-3. All waters crossed by the Project are considered to be “moderately disturbed”.

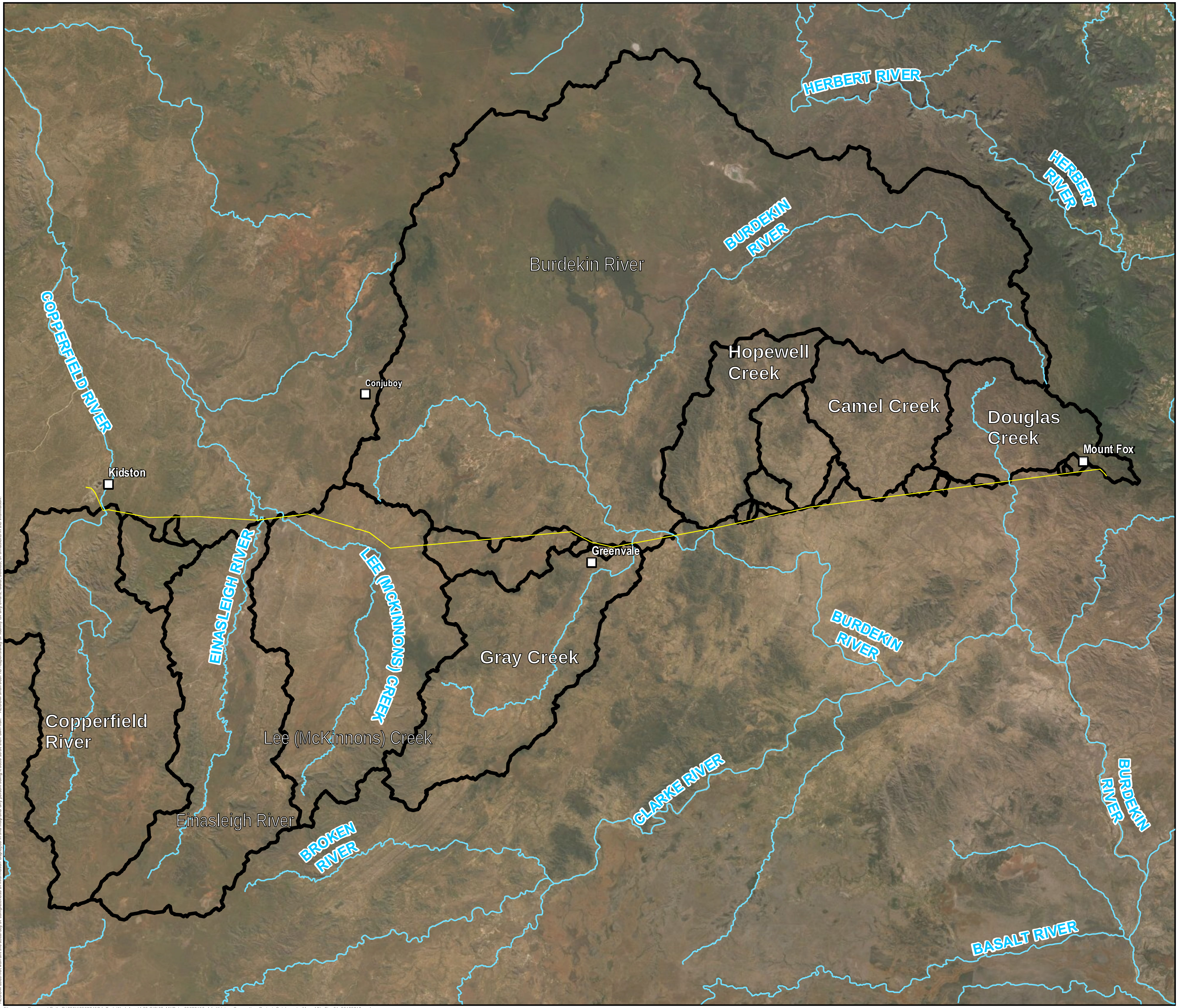
7.1.1.2 Water quality objectives

WQO are available for the Burdekin Basin (DSITI, 2017). The WQOs for each basin within the Preferred Alignment have been collated in Table 7-4. As the EVs for the Gilbert Basin are undefined, the lowest set of WQOs to protect all EVs is applicable. This is generally taken to be the values as outlined in Table 3.3.4 of the ANZECC (2000) guidelines for an upland river. Given that ANZECC (2000) does not specify a WQO for sulfate within aquatic ecosystems, a WQO of 250mg/L has been chosen based on aesthetic protection of drinking water (NHMRC, 2011).

Table 7-2 Watercourses and drainage lines crossed by the Preferred Alignment

Chainage (km)	Watercourse Name	Sub-Basin	Watercourse Width (m)	Stream Order	Easting (MGA Zone 55)	Northing (MGA Zone 55)	Catchment Area (km²)
11.08	Copperfield River	Gilbert	135	6	201653	7906233	1612
15.38	East Creek	Gilbert	70	4	205899	7905617	145
24.2	Walkers Creek	Gilbert	8	4	214646	7905062	11.43
39.05	Einasleigh River	Gilbert	45	6	229494	7904892	1294
42.58	Lee (McKinnon's) Creek	Gilbert	88	6	232971	7905397	1468
80.52	N/A	Dry River	16	4	269272	7901759	70.25
88.4	Paddy's Creek	Dry River	35	5	277139	7902621	96.86
88.7	Paddy's Creek	Dry River		4	277484	7902669	
96.35	N/A	Upper Burdekin	20	3	284869	7902752	12.59
98.82	N/A	Upper Burdekin	11	3	287036	7901585	7.36
102.38	N/A	Upper Burdekin	10	3	290479	7900706	5.60
106.35	Gray Creek	Gray Creek	60	6	294378	7901264	1044
114.1	Burdekin River	Upper Burdekin	155	7	301936	7902836	6235
120.35	Hopewell Creek / Burdekin River	Camel Creek	30	5	308085	7904116	517
126.46	N/A	Burdekin River (Blue Range)	15	3	314027	7905514	8.64

Chainage (km)	Watercourse Name	Sub-Basin	Watercourse Width (m)	Stream Order	Easting (MGA Zone 55)	Northing (MGA Zone 55)	Catchment Area (km^2)
127.95	N/A	Burdekin River (Blue Range)	15	3	315484	7905860	3.81
133.8	N/A	Camel Creek	10	3	321146	7907256	5.86
135.55	N/A	Camel Creek	10	3	322853	7907674	41.51
136.65	Perry Creek	Camel Creek	25	5	323918	7907934	202.43
139.7	N/A	Camel Creek	10	3	326893	7908539	21.97
149.8	Camel Creek	Camel Creek	42	6	336922	7909997	514.2
156.6	N/A	Camel Creek	40	3	343590	7910962	24.6
157.05	N/A	Camel Creek	30	3	344088	7911039	
161.42	N/A	Camel Creek	10	3	348393	7911665	6.2
171.38	N/A	Douglas Creek	8	4	364191	7913962	6.47
171.5	N/A	Douglas Creek	5	3	358357	7913099	2.45
173.62	Douglas Creek	Douglas Creek	80	6	360468	7913420	483
183.08	N/A	Douglas Creek	18	3	369822	7914780	2.45
184.52	N/A	Douglas Creek	10	3	371250	7914991	1.85
185.35	N/A	Douglas Creek	20	3	372062	7915107	9.12
185.55	N/A	Douglas Creek	20	3	372280	7915138	



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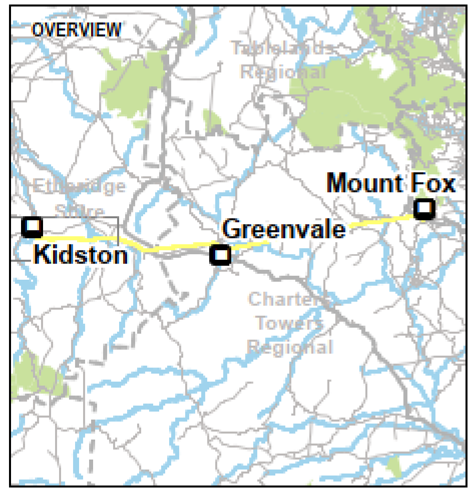
Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 8 16 24 32
Kilometers

1:650,000 (when printed at A3)

Legend
- Places
- Major Watercourses
- Preferred Alignment
- Catchments



Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2021
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Kidston Connection Project

Catchments

PROJECT ID:	60577456
CREATED BY:	CA
LAST MODIFIED:	CA - 28/09/2021
VERSION:	2

Figure 7-1

A3 size

Table 7-3 Surface water environmental values for the Preferred Alignment

Chainage (km)	Basin and Sub-Basin	Environmental Values											
		Aquatic Ecosystems	Irrigation	Farm Supply	Stock Watering	Aquaculture	Human Consumption	Primary Recreation	Secondary Recreation	Visual Recreation	Drinking Water	Industrial Use	Cultural
0 - 69	Gilbert Basin	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
69 - 93	Burdekin - Dry River	✔			✔					✔		✔	✔
96 – 105 108 - 118	Burdekin - Upper Burdekin	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
105 - 108	Burdekin - Gray Creek	✔			✔					✔			✔
118 - 122 130 - 164	Burdekin - Camel Creek	✔		✔	✔					✔			✔
122 - 130	Burdekin - Burdekin River (Blue Range)	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
164 - 186	Burdekin - Douglas Creek	✔			✔					✔			✔

Table 7-4 Water quality objectives for the Preferred Alignment

Chainage (km)	Basin and Sub-Basin	Water Quality Indicators										
		pH	Electrical Conductivity (µS/cm)	Turbidity (NTU)	Suspended Solids (mg/L)	Dissolved Oxygen (% sat)	Total N (mg/L)	Ammonium N (mg/L)	Oxidised N (mg/L)	Filterable Reactive P (mg/L)	Total P (mg/L)	Sulfate (mg/L) (See Note 3)
0 - 69	Gilbert Basin	6.0-7.5	250	25		90-120	0.250	0.006	0.030	0.005	0.03	250
69 - 93	Burdekin - Dry River	6.5-8.5	230-310-385	5-10-30	5-10-30	85-110						1-2-3
96 – 105 108 - 118	Burdekin - Upper Burdekin	6.5-8.5	105-295-540	5-20-25	5-15-25	85-110	0.150-0.195-0.370				002-0.045-0.070	1-2-3
122 - 130	Burdekin - Burdekin River (Blue Range)	6.5-8.5	280-420-540	5-10-30	5-10-25	85-110	0.140-0.190-0.280	0.005-0.005-0.006	0.005-0.005-0.007		0.02-0.045-0.070	1-1-2
105 - 108 118 - 122 130 - 164	**Baseflow (<121m^3/s at Sellheim)** Burdekin - Gray Creek	6.5-8.5	130-320-550	5-10-25	5-10-20	85-110	0.160-0.250-0.365	5-5-15	5-5-35	5-10-30	0.020-0.035-0.065	1-2-3

Chainage (km)	Basin and Sub-Basin	Water Quality Indicators										
		pH	Electrical Conductivity (µS/cm)	Turbidity (NTU)	Suspended Solids (mg/L)	Dissolved Oxygen (% sat)	Total N (mg/L)	Ammonium N (mg/L)	Oxidised N (mg/L)	Filterable Reactive P (mg/L)	Total P (mg/L)	Sulfate (mg/L) (See Note 3)
164 - 186	Burdekin - Camel Creek Burdekin - Douglas Creek											
105 - 108	**Flood Flow ($>121m^3/s$ at Sellheim)**	6.5-8.5	70-100-150	30-140-250	50-180-620		0.530-0.755-1.22	5-5-10	20-40-85	20-25-35	0.120-0.190-0.390	1-2-3
118 - 122 130 - 164	Burdekin - Gray Creek Burdekin - Camel Creek											
164 - 186	Burdekin - Douglas Creek											

Note 1: Where a range of three values is provided (i.e. 70-100-150) the values correspond to the 20th-50th-80th percentile respectively. Comparison of the 50th percentile to this test data (50th percentile) is recommended with the 20th and 80th percentile provided as a guide only. It is preferable that the statistics provided are calculated from a minimum of five independent values (DSITI, 2017).

Note 2: Where two values are provided as a range (i.e. pH 6.5-8.5), the median (50th percentile) should fall within this range (DSITI, 2017).

Note 3: Value adopted for Gilbert Basin as outlined in Section 7.1.1.2. Values within Burdekin Basin are identified in draft within Schedule 1 of EPP Water

7.1.1.3 Water quality

The Project lies within the dry tropics of Queensland. Water quality throughout this region is dependent on the flow regime and position in the hydrograph. Ephemeral flows in the watercourses and drainage lines of the region are dominated by flows with elevated concentrations of total suspended sediments, appearing brown in colour. The majority of sediments are washed from the land surface at the onset of a major flood. Once a major flood has passed, water quality generally improves with lower suspended sediment concentrations experienced on the falling limb of the hydrograph.

Water quality data throughout the region is limited. There is only one Queensland Government water quality gauge that is directly relevant to the Project. This is the Burdekin River at Mount Fullstop (gauge ID 120110A) approximately 50 km downstream from the Project. However water samples of the Copperfield River have been taken as part of the historic mining operations at the Kidston site. There are 180 samples available from this record taken at the site specific monitoring point "WB", upstream of the mining activities and 1 km downstream from the proposed transmission line crossing of the Copperfield River. These water samples indicate that the concentrations of the following parameters are elevated[1] above the default WQOs[2] for metals:

- dissolved and total aluminium
- dissolved and total copper
- total zinc.

Elevated values above the ANZECC default WQOs were also recorded from the historic Queensland Government gauges 917115A (Copperfield River at Spanner Waterhole) and 917116A (Copperfield River at Kidston Dam Headwater). This provides an indication that the sources of elevated aluminium, copper and zinc are from above the catchment above the Copperfield Dam.

Hillslope erosion is the main source of sediment and nutrients affecting water quality in the Upper Burdekin Basin (Kinsey-Henderson, Sherman, & Bartley, 2007). The Upper Burdekin Basin (to the Burdekin Dam) has been modelled as having an average annual soil loss of 575kg/ha/yr. which is moderate compared to other catchments in the Burdekin (Kinsey-Henderson, Sherman, & Bartley, 2007).

7.1.1.4 Wetlands

Wetland Data (version 4.0) was acquired from the Queensland Government. Available data suggests that there are no wetlands crossed by the Preferred Alignment for the transmission line. The closest wetlands to the Project are outlined in Table 7-5. Activities occurring as a result of construction or operation of the transmission line are not expected to have any impact on these wetlands.

Table 7-5 Wetlands in close proximity to the Preferred Alignment

QLD Wetlands Mapping ID	Type of Wetland	Distance from the Preferred Alignment
92992	Palustrine	3.8 km to the north-east of the Mount Fox switching station.
93193	Palustrine	3.3 km north of the Preferred Alignment from chainage 89 km
N/A	MSES Vegetation 100m buffer from a wetland	215 m to the north and 900 m to the south of the Preferred Alignment at 40.1 km chainage

[1] Elevated in this context means that the 95th percentile of the WB dataset is above the default WQO in accordance with ANZECC (2000) guidelines.
[2] As outlined in Table 3.4.1 of the ANZECC (2000) guidelines for a 95% species protection level for aquatic ecosystems

7.1.1.5 Historic flood events

7.1.1.5.1 Gilbert Basin

The Copperfield Dam is situated approximately 22 km upstream from the Preferred Alignment for the transmission line. The Copperfield Dam has the potential to affect flooding processes in the reach downstream by withholding water and flattening out the hydrograph. There are four gauges which monitor water level and discharge on the Copperfield River situated upstream of the Preferred Alignment (Table 7-6).

Table 7-6 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

A flood-frequency analysis (FFA) was undertaken on the dataset from the Copperfield Dam tailwater (gauge 917118A) to determine the average recurrence interval (ARI) and annual exceedance probability (AEP) of the flood events recorded upstream of the dam. The results of this FFA are presented in Table 7-7.

Table 7-7 Flood frequency analysis of historical floods from the Copperfield River at Spanner Waterhole/Middle Creek Gap

Rank	Discharge (m3/s)	Year	ARI	AEP
1	2077	1974	84	1.2%
2	1428	1972	31	3.2%
3	1350	1976	19	5.3%
4	1089	1981	14	7.1%
5	923	2002	11	9%
6	837	2009	9	11%
7	825	1975	8	12.5%
8	822	2005	7	14.3%
9	816	2001	6	16.6%
10	765	1980	5	20.0%

Severe flooding occurred throughout the upper Gilbert Basin in March 1956 (Greencross Australia, n.d.). However the available river height and discharge monitoring data does not extend back to this date so the magnitude of the flooding cannot be compared to more recent floods. The highest recorded flood throughout the catchment occurred in January 1974.

7.1.1.5.2 Burdekin Basin

A FFA was also undertaken on a combined record from two Queensland Government monitoring stations on the Burdekin River 33 km downstream from the Project (Appendix C Hydrology Technical Report). 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 (Appendix C Hydrology Technical Report). The ten largest floods during this time are provided in Table 7-8 below.

Table 7-8 Flood Frequency Analysis of historical floods from the Burdekin River at Blue Range

Rank	Peak Discharge (m3/s)	Year	ARI	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	5948	2021	16	6.3%
6	5772	1981	14	7.1%
7	5488	1974	12	8.3%
5	5290	1997	10	10.%
9	5159	1979	9	11.1%
10	4742	1998	8	12.5%

The largest flood since 1952 occurred in 1991. This flood was the result of a monsoonal trough which was prolonged over the whole of North Queensland (Fleming & Loofs, 1991). As a consequence of the prolonged monsoonal trough soils were not permitted to dry out and soil moisture was maintained at high rates causing relatively high runoff rates (Fleming & Loofs, 1991). There was no one particular weather system that was responsible for flooding in the Upper Burdekin during this time (Fleming & Loofs, 1991).

State-wide rainfall in February 1956 saturated the upper Burdekin Catchment. Subsequent cyclones in March 1956 saw waters rise rapidly to record levels. The Burdekin River at Greenvale experienced a sharp flood peak rising from 3.3 m, corresponding to a discharge of 90 m^3/s on 5 March to 16.6 m, corresponding to a discharge over 10,000 m^3/s on 7 March.

Floods in 2009 were the result of ex-tropical cyclone Ellie which passed over the upper catchment. Earlier rainfall in February had saturated the catchment so that intense rainfall associated with ex-tropical cyclone Ellie caused significant flooding throughout the region.

7.1.1.6 Flood immunity

The 1% AEP flood extent was determined for all third-order or higher watercourse crossings along the Preferred Alignment (Appendix C Hydrology Technical Report). The Gilbert Basin FFA was utilised on suitable gauges as outlined above, and the 1% AEP was scaled based on catchment area and shape factor to estimate flows near the transmission line alignment (Appendix C Hydrology Technical Report). Data from the Queensland Government's Flood Mapping Program was utilised in the Burdekin Basin to provide an indication of flood extents. The Flood Mapping Program for the Burdekin Basin utilises a coarse hydraulic model employing rain-on-grid techniques to determine the 1% AEP flood. These flood extents are approximate and are only provided as an indicator. The 1% AEP flood extents generated as part of this study will be used to ensure that relevant infrastructure is either located outside of the flood envelope or flagged for a design response to the flood hazard.

Flood immunity was calculated to a higher level of detail for the proposed Mount Fox switching station site. Switching stations are required to operate with a 0.5% AEP flood immunity (i.e. the 200 year flood) as outlined in the Queensland Reconstruction Authority's *Planning for stronger, more resilient electrical infrastructure* document (QRA, n.d).

The location of the Mount Fox switching station has been compared to the flood mapping undertaken for the entire Burdekin Basin completed by the Queensland Reconstruction Authority. Further details are provided in Appendix C Hydrology Technical Report. Appendix C shows that the Mount Fox switching station is situated outside of and above the probable maximum flood (PMF) level. Therefore, the Mount Fox switching station would likely be provided with flood immunity greater than the 0.5% AEP.

7.1.2 Groundwater

7.1.2.1 Bores

The entire area traversed by the Preferred Alignment has a low density of registered groundwater bores as outlined in the Queensland Registered Bore database. There are 76 registered groundwater bores within 10 km of the Preferred Alignment. The majority (60) of these bores are installed to less than 50 m depth below ground level. There are no registered bores within 10 km of the Preferred Alignment between chainage 120 km and 170 km.

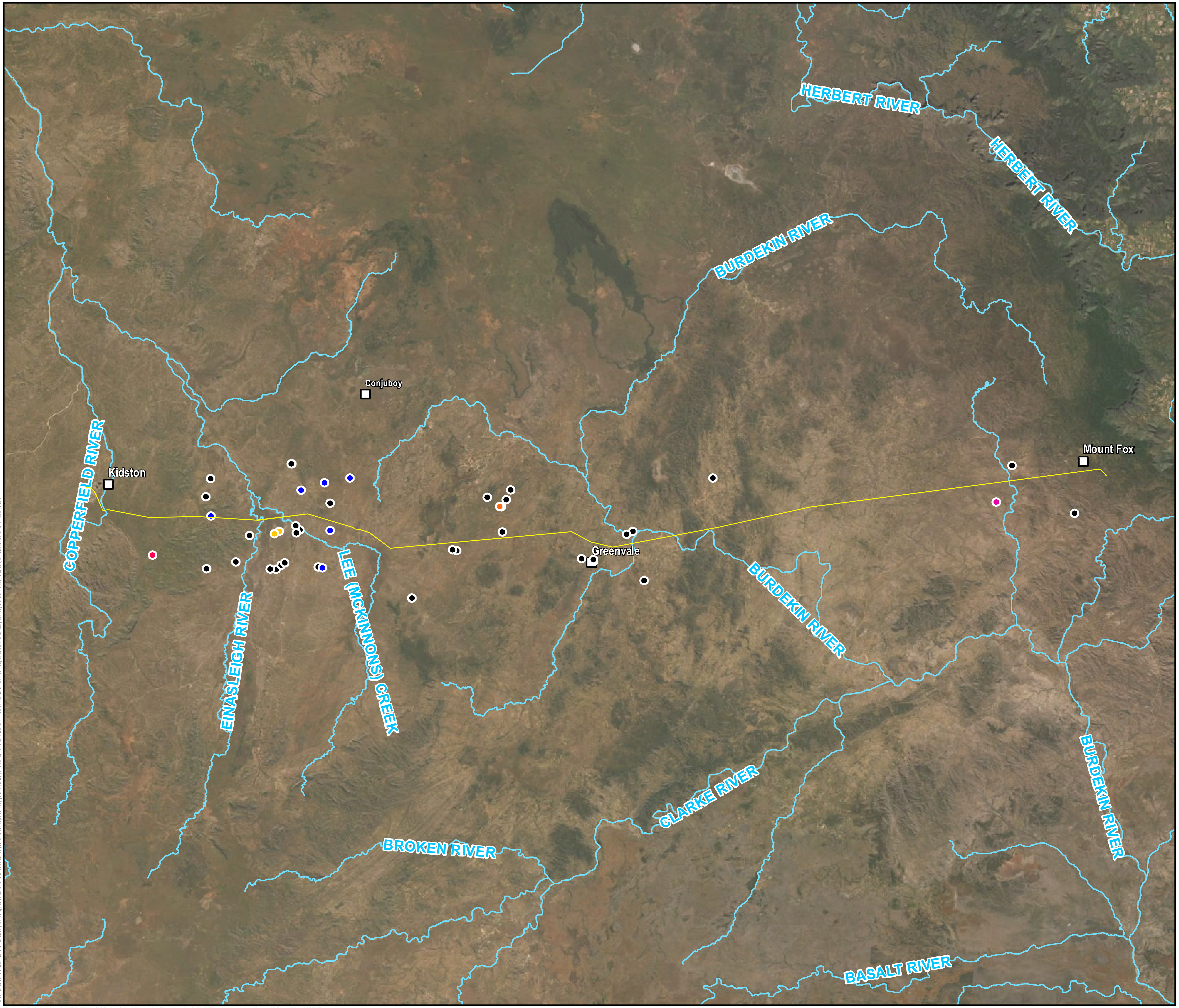
The main formations that are intercepted by bores within 10 km of the Preferred Alignment include:

- McKinnon's Creek Granite (6 of 76) between 3 to 25 m below ground level
- Dido Granodiorite (2 of 76) at 16 and 32 m below ground level
- Bulgeri Formation (2 of 76) at greater than 30 m depth
- Forsayth Granite (1 of 76) at 17 to 31 m below ground level
- Kangaroo Hills Formation (1 of 76) at 1.5 to 3 m below ground level.

The remainder (55) of registered bores within 10 km of the Preferred Alignment do not have a registered aquifer formation in the Queensland Registered Bore Database. The formations intercepted by the available bore data suggest that the majority of groundwater that is present is within fractured rock aquifers where water exists within the fractures and joints of rock masses. Yields are typically low but can be highly site specific depending on whether the bore intercepts significant fractures. Bulgeri Formation and the Kangaroo Hills formation relate to sedimentary sequences (sandstones and mudstones) which are not fractured rock aquifers. Water yield within these kinds of aquifers is often higher than fractured rock aquifers as water is stored within available pore space in addition to fractures and joints within the formations.

Standing water level information is provided for 23 of 76 bores along the Preferred Alignment. The average standing water level of all 23 bores within 10 km of the Preferred Alignment is approximately 11 m below the top of the bore. The maximum standing water level is approximately 28 m below the top of the bore (Bulgeri Formation) and the smallest standing water level is approximately 4 m below the top of the bore (McKinnon's Creek Formation).

There are also 23 bores with water yield information. The average water yield of these bores is approximately 2.5 L/s. The maximum yield encountered is 11.96 L/s from a bore installed in the McKinnon's Creek Granite within 280m of the Preferred Alignment near chainage 29 km. The lowest yield is 0.14 L/s. Generally, most bores have a yield between 1 and 2 L/s.



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Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 8 16 24 32
Kilometers

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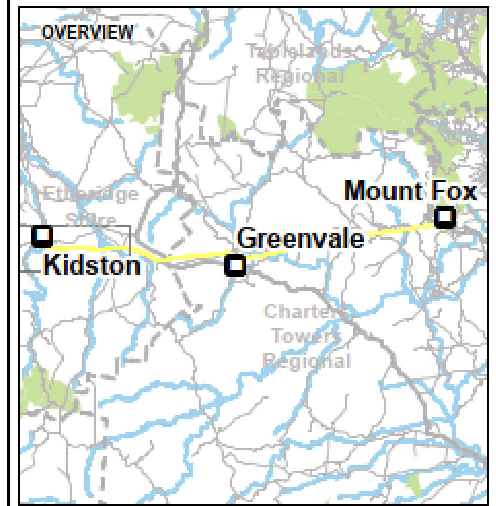
Legend

- Point Of Interest
- Major Watercourses
- Preferred Alignment

Groundwater Bores

- No Formation Provided
- Bulgeri Formation
- Dido Granodiorite
- Forsayth Granite
- Kangaroo Hills Formation
- Mckinnons Creek Granite



Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2021
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Kidston Connection Project

Groundwater Bores

PROJECT ID: 60577456
CREATED BY: CA
LAST MODIFIED: CA - 28/09/2021
VERSION: 2

Figure 7-2

A3 size

7.1.2.2 Environmental values

Draft EVs have been prepared for the Burdekin Basin and are sourced from the following document:

- *Environmental Values and Water Quality Objectives for Groundwaters of the Burdekin, Don and Haughton River Basins – Draft for Consultation* (DEHP, 2017).

Groundwater EVs for the Burdekin Basin are provided for different aquifers which are based on lithology as outlined in the above document. Aquifers/lithology which are crossed by the Preferred Alignment where there are prescribed EVs include:

- Alluvium
- fractured rock
- Cainozoic deposits.

The depth of water encountered in bores and the stratigraphy of each bore will determine which of the above aquifers is applicable. Relevant groundwater EVs are provided for the Project below in Table 7-9. Each of the three aquifer units relevant in the Burdekin Basin have the same EVs, namely:

- aquatic ecosystems
- visual recreation
- cultural and spiritual values.

Like surface water EVs, groundwater EVs have not been defined for the Gilbert Basin. As a consequence the precautionary approach outlined in the EPP Water requires that all EVs apply in a similar manner to surface water. Groundwater from the Gilbert Basin is likely to be used for the following uses associated with an EV:

- aquatic ecosystems
- farm supply
- stock watering
- drinking water
- cultural and spiritual values.

Other uses of groundwater in the Gilbert Basin in areas crossed by the Preferred Alignment which are suggested by the application of default EVs (such as aquaculture, primary recreation and secondary recreation) are highly unlikely to be applicable. As a result it is not recommended that these EVs are adopted for use by the Project.

Table 7-9 Ground water environmental values for the Project

Lithology and Unit	Environmental Values											
	Aquatic Ecosystems	Irrigation	Farm Supply	Stock Watering	Aquaculture	Human Consumption	Primary Recreation	Secondary Recreation	Visual Recreation	Drinking Water	Industrial Use	Cultural and Spiritual
Gilbert – All	✔	✔	✔	✔		✔			✔	✔	✔	✔
Alluvium Zones – Upper Burdekin	✔								✔			✔
Fractured Rock Zones – Greenvale Craton	✔								✔			✔
Cainozoic Deposits – Scattered Remnants Northern Burdekin Headwaters	✔								✔			✔

7.1.2.3 Groundwater Dependent Ecosystems

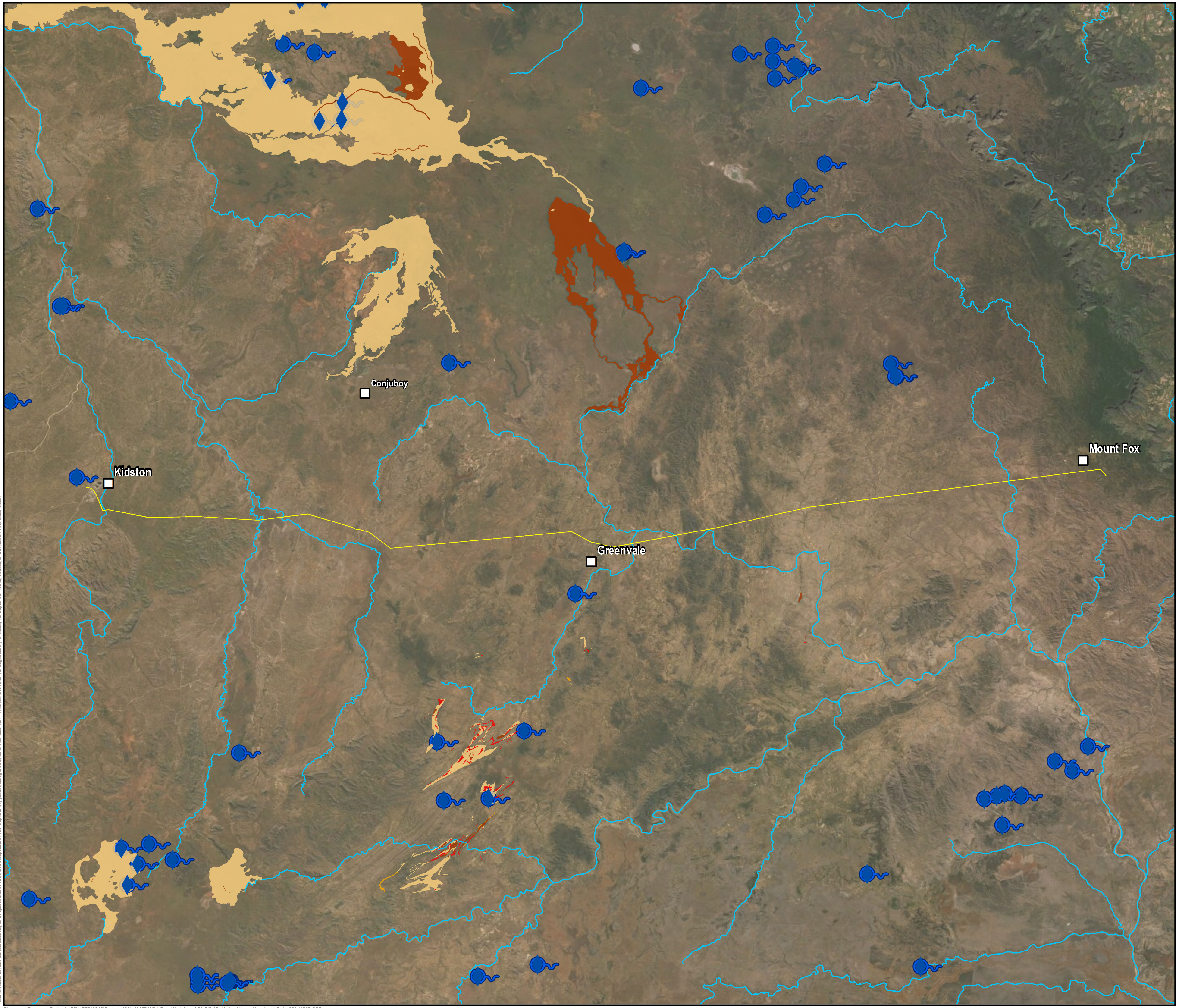
A review of the Queensland Spatial data layers for Groundwater Dependent Ecosystems (GDEs) was undertaken. The dataset outlines the following GDEs:

- surface expressions of GDEs
- terrestrial GDE areas
- subterranean GDE areas.

The dataset also shows potential GDEs on the following basis:

- unconsolidated sedimentary aquifers
- consolidated sedimentary aquifers
- igneous rock aquifers
- metamorphic aquifers
- a mixture of the above.

There are no GDEs or potential GDEs crossed by, or in close proximity (i.e. 20 km) of the Preferred Alignment.



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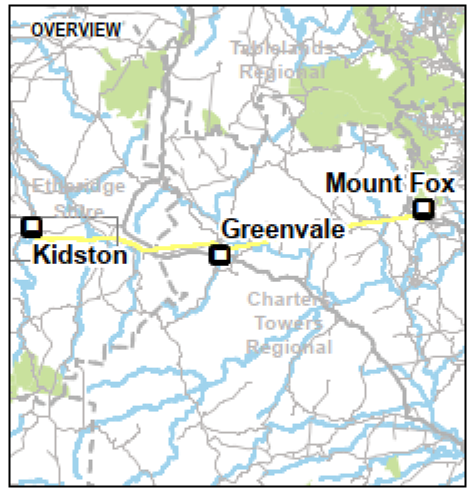
Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator

0 8 16 24 32
Kilometers

1:650,000 (when printed at A3)

Legend

- Places
- Major Watercourses
- Preferred Alignment
- Known GDE
- Known GDE
- Derived GDE - high confidence
- Derived GDE - moderate confidence
- Derived GDE - low confidence
- Derived GDE - unknown confidence
- Permanently active spring



Data sources:
DCDB, Roads, Watercourses - DNRM 2017
Site Features and Layout - AECOM 2021
© SISP Imagery 2017

Kidston Connection Project

Groundwater Dependent Ecosystems

PROJECT ID: 60577456
CREATED BY: CA
LAST MODIFIED: CA - 29/09/2021
VERSION: 3

Figure 7-3

A3 size

7.1.3 Water resource planning and use

The Project crosses the Gulf and Burdekin Water Resource Plans (WRP). The boundaries of these plans are coincident with the boundary between the Burdekin Basin and the Gilbert Basin. Under the *Water Act 2000* a water licence is required to take or interfere with water. WRPs govern the allocation of water throughout each respective basin.

A search of the water entitlements database held Queensland Government showed that there are water licences assigned to allotments crossed by the Project. These water licences and relevant details are provided below in Table 7-10. Only one of these water licences is located in the Gulf WRP/Gilbert Basin. The remainder are in the Burdekin WRP/Burdekin Basin area.

Table 7-10 Water licences on applicable land parcels from the entitlements database

Water Licence	Lot on Plan	Capacity	Water Source	Type
33700K	14 on LH8	240 ML/year at a max rate of 5.6 ML/day	Gilbert Unzoned Area – Unnamed tributary of Bundock Creek	Unsupplemented water
49004A	3198 on PH 2177	200 ML	Tributary of Douglas Creek	Licence to impound water
41489A	3 on CLK 34	768 ML/year at a max rate of 5.6 ML/day	Dry River	Unsupplemented water
54962AA	3 on CLK 34	5 ML	Dry River	Licence to impound water
19328A	5 on CLK23 1 on CLK23	480 ML/year at a max rate of 4.32 ML/day	Burdekin River	Unsupplemented water
57273A	5 on CLK23	240 ML/year at a max rate of 4.32 ML/day	Burdekin River	Unsupplemented water
188511	11 on CLK26	460 ML/year at a max rate of 1.46 ML/day	Burdekin River	Unsupplemented water
54948WA	3 on WU48	30 ML	Unnamed tributary of Dead Horse Creek	Licence to impound water

The Project is not near the site of the potential Hell's Gate Dam. The Hell's Gate Dam is situated downstream of the confluence of the Clarke River and the Burdekin River, 28 km to the south of the nearest point of the Preferred Alignment. The Mount Fullstop Dam has historically been proposed as an alternative to the Hells Gate Dam and is 43 km to the south of the nearest point of the Preferred Alignment.

The Project will have minimal impact on the hydrology of natural waterways. Therefore, there will not be any changes to stream flows downstream of the Preferred Alignment, thus having negligible impact on any water licence holders.

7.2 Potential Impacts

7.2.1 Transmission Line

7.2.1.1 Surface water

Where practicable, transmission line structures are typically placed on high points in the landscape to maximise span distances. This ensures that transmission lines typically avoid drainage lines and depressions in the landscape, minimising their impact on surface water resources.

Construction activities have the potential to cause impact to riparian zones, surface water quality and flow through the clearing of access tracks, transmission line sites and general ground disturbance. As a result impacts to surface water quality are primarily limited to increases in suspended sediment as a result of runoff from disturbed areas during construction.

7.2.1.2 Groundwater

Excavation of footings for the transmission line structures poses a minor risk to water resources. Available information suggests that groundwater occurrence along the Preferred Alignment is minimal with the majority of water bearing aquifers consisting of fractured rock aquifers. Maximum footing depth is expected to be in the order of 10 m. It is noted that only bores within McKinnon's Creek Granite and Kangaroo Hills Formation showed groundwater shallower than 10 m.

Targeted geotechnical investigations along the Preferred Alignment will occur as part of the foundation design process. Any groundwater intercepted will be recorded as part of these investigations. If water is present it may need to be dewatered within the excavated area until the construction of footings is completed. This is expected to generate only a minimal impact on groundwater resources from the dewatering.

Any groundwater that enters footing sumps may be exposed to a number of pollutants associated with construction. This may include small amounts of hydrocarbons associated with construction machinery, excess sediment, concrete slurry or fine particles. These waters would not be actively dewatered and will be treated or removed. The contractor must submit a Dewatering Management Plan as part of the Environmental Management Plan for the Project. The objective of the Dewatering Management Plan is to prevent contamination of land, surface waters or groundwater's by establishing suitable protocols to treat or remove water from the site.

7.2.2 Switching Station

7.2.2.1 Flood immunity

The flood immunity of the Mount Fox switching station is described Section 7.1.1.6 is potentially outside of the PMF extent. Except for local drainage, the switching station is unlikely to any wholesale impacts on flooding in the Burdekin Basin.

7.2.2.2 Surface water quality

Surface water quality impacts will be mostly limited to the construction phase, with minimal impacts during maintenance. Without suitable controls or scheduled maintenance and repair of access tracks, there is the potential for additional sediment and potential pollutants associated with construction activities to be washed into drainage lines as a result of runoff.

7.2.2.3 Stormwater drainage and management

Stormwater and drainage management principles for the Mount Fox switching station will be limited to the local catchment immediately surrounding the earth fill pads. A stormwater drainage system will be incorporated into the facility to manage the stormwater runoff generated from structures and hardstand areas. There is a potential of hazardous chemicals spilling into the stormwater drainage system. Mitigation measures used to minimise risks to the environment and safety resulting from spills are provided in Section 7.3.3.

7.2.3 Access tracks

Access tracks will be required for the construction phase to move equipment and personnel along the Preferred Alignment to each tower construction site and to undertake vegetation clearing. During the operational phase the access tracks will be used for regular inspection and maintenance activities, including vegetation maintenance along the Preferred Alignment. Construction of access tracks has the potential for the following impacts if unmitigated.

- Increased erosion as a result of cut and fill activities in a watercourse or drainage line.
- Increased sediment movement into downstream areas.
- Affect riparian vegetation through clearing activities.

Where the proposed transmission line is co-located with existing Ergon Energy lines, it is intended to upgrade the existing access tracks where necessary. Off easement access may also be required back to the nearest public road and wherever possible, existing property tracks maybe used with landholder approval. Several new tracks will be required and will only be constructed following agreement with each landholder. Where additional watercourse crossings are required they will be designed and constructed to comply with Department of Agriculture and Fisheries '*Accepted Development Requirements for operational work that is constructing or raising waterway barrier works'*. Specifically, bed-level crossings will comply with the accepted development requirements for new or replacement bed level crossings relative to the impact level of the watercourse. The requirements cover:

- duration of construction
- bed level crossing dimensions and design
- bed level crossing configurations
- stream bed scour protection.

Access to the Mount Fox switching station will be provided via Knuckledown Road. This road is formed down to Michael Creek and it will be necessary to construct the road from Michael Creek to the switching station along the cleared road reserve a distance of approximately 1.4 km.

Activities associated with access tracks are not expected to have any impacts on groundwater resources or groundwater quality.

7.2.4 Groundwater

Groundwater occurrence along the Preferred Alignment and activities expected to have an impact on groundwater are minimal. Impacts to groundwater will be largest from extraction points to supply construction water (for dust suppression, access track compaction etc.). Water sources for the Project will be determined at the detailed design phase and will include consultation with local landholders. Surface water and impounded sources of water will be preferential to groundwater resources. The impacts to groundwater from the Project are therefore expected to remain minimal.

7.2.5 Wetlands

There are no known wetlands within close proximity to the Preferred Alignment. Construction and operation activities are not likely to impact on any wetlands. If wetland areas are encountered during the detailed design phase, transmission line design will be adjusted to ensure that direct disturbance to these areas are minimal. Construction activities and access tracks will be designed to avoid these areas (if encountered) to ensure minimal disturbance occurs as a result of the Project. Erosion and sediment control measures will be implemented to assure that there are no impacts to areas downstream of the Preferred Alignment or access tracks.

7.2.6 Water use and sourcing

Detailed water use by the Project is still currently unknown. Preliminary estimates for water use during the construction phase will include the following.

- Dust suppression and watering of access tracks (approximately 4 x 30 kL tankers refilling 4-5 times a day).
- Compaction of access tracks.
- Vehicle/ Machinery wash-down bays.
- Accommodation camps.
- Concrete production.

A riverine protection permit is required under the *Water Act 2000* from the Department of Resources to excavate or place fill in a watercourse or destroy vegetation in a watercourse. Exemptions for riverine protection permits exist, if authorised entities can comply with the '*riverine protection permit* *exemption requirements*' (RPP Exemption Requirements). Powerlink is an authorised entity under the RPP Exemption Requirements, and therefore does not require a riverine protection permit to carry out these activities in a watercourse, lake or spring if compliance can be achieved with the minimum requirements stipulated.

The Preferred Alignment may require disturbance to native vegetation on the bed and banks of the watercourse, primarily where the access track crosses a watercourse where reasonable alternative access cannot be sourced. A number of watercourse crossings may involve excavation or placing fill (typically rock aggregate filled with the extracted bed material) in the watercourse to create bed level crossings.

Where possible Powerlink will seek to achieve compliance with the RPP Exemption Requirements. Where compliance cannot be achieved, Powerlink will seek a Riverine Protection Permit from the Department of Resources.

Extraction of material from a watercourse is not expected to be required under this Project. Where fill is required for the construction of access tracks or transmission tower pads it will be sourced from other locations such as registered quarries and approved borrow pits within the local area.

7.3 Mitigation and Management Measures

7.3.1 Detailed design

The detailed design phase of the Project has not yet been finalised. A number of key items will need to be determined during the detailed design phase. The Project will incorporate the following elements during the detailed design and pre-construction phase.

- Transmission towers will be set-back from riparian vegetation and the high-bank of a watercourse or drainage line a minimum of 50 m, where possible.
- Minimise runoff and stormwater concentration.
- Utilise existing watercourse crossings and access tracks wherever possible.
- Minimise clearing of vegetation by trimming or lopping in riparian areas where possible.
- Where clearing of vegetation in a watercourse is required, hand clearing methods are to be utilised.
- Necessary vegetation clearing along the Preferred Alignment is to occur in a manner to minimise soil disturbance.
- Clean water diversions around local stockpiles and exposed areas to be implemented.
- Spill kits are to be kept at each work area. Ensure that all personnel are trained in the location and use of spill kits.

Further details regarding specific aspects of the Project that need to be considered during the detailed design phase are provided below.

7.3.1.1 Transmission line

Powerlink transmission line structures are designed to span watercourses. Transmission lines will be set back from the bank of watercourses and drainage lines crossed by the Preferred Alignment. Flood extents for the Burdekin River for the 1% AEP are extensive and transmission lines will not be able to span this entire extent. Therefore, transmission lines will be required to be installed in the Burdekin River floodplain. The structures will aim to be sited outside of overland flow channels. Foundations are generally designed in accordance with AS7000:2010 (Overhead Line Design) and AS2159:2009 (Piling – design and installation).

7.3.1.2 Switching Station

Switching stations are required to be installed above the 0.5% AEP water level in accordance with the *Planning for stronger, more resilient electrical infrastructure* guidelines. Flood assessment outlined in Appendix C Hydrology Technical Report show that the Mount Fox switching station would likely be above the above the 0.5% AEP flood envelope. Therefore, further flood mitigation measures to minimise impacts are not applicable.

7.3.1.3 Stormwater drainage and management

A stormwater drainage system is provided in all Powerlink switching station to capture and manage stormwater runoff. Fixed plant that contain large volumes of hydrocarbons are typically bunded. Bund design criteria are generally in accordance with AS1940:2004 (The Storage and Handling of Flammable and Combustible Liquids) and consist of the following.

- Sized to contain at least 110% of the oil volume from the items enclosed.
- 1m separation to be maintained with the bund and all oil containing parts.
- Floor and walls of the bund are to be impermeable to oil and water.
- Oil and water leaks are to be prevented by appropriately sealing cable and pipe entries to the bunded area.

A Switching Station Stormwater Drainage Management Plan will be developed as part of the detailed design phase. The plan will provide the stormwater drainage strategy, drainage system and any pre-treatment proposed prior to discharge of surface water runoff.

7.3.1.4 Groundwater

Management measures for groundwater impacts will only be required if water is sourced from bores for construction. This will be determined at the detailed design phase and will include consultation with landholders.

7.3.1.5 Water use and sourcing

The volumes of water required for the Project and their locations will be determined at the detailed design phase. As part of detailed design, consultation with landholders for the location of access tracks and land access will also include negotiations for access to water. It is not expected that water would need to be sourced from local watercourses. If water is to be sourced from a watercourse, Powerlink will extract water in accordance with the '*Exemption requirements for constructing activities for the take of water without a water entitlement (OSW/2020/5467 Version 4.01 updated 05/02/2021* or any later revision). If Powerlink cannot meet the exemption requirements of the above document, a water licence application will be submitted with the Queensland Government.

7.3.2 Construction activities

7.3.2.1 Erosion and sediment control

All construction activities have the potential to cause erosion and sedimentation through clearing and disturbance of soil. Powerlink's standard environmental controls relating to soil erosion and sediment control will minimise impacts on the receiving environment. These Standard Controls will be implemented throughout the entire Project. In summary the controls include the following.

- Manage disturbance in accordance with the IECA Best Practice Guidelines.
- Assessment of upslope and downslope receiving environment, time of year, expected soil type and rainfall.
- Diversion of up-slope stormwater runoff to minimise erosion.
- Minimise ground disturbance and retain ground cover to reduce the surface area potentially subject to erosion.
- Develop and implement an Erosion and Sediment Control plan for switching station sites and transmission line structure sites, prior to ground disturbance.
- Undertake progressive rehabilitation of disturbed areas as soon as practicable to establish ground cover.
- Rehabilitation is to achieve 70% ground cover requirements to disturbed areas.
- Identify environmental values and water quality objectives of the receiving waters. Utilise regional water quality objectives where available (refer to Table 7-4). Where no regional water quality objectives have been established, baseline data (pH and turbidity as NTU) to be collected from receiving waters upstream and downstream of works. Where baseline data cannot be collected the following standards shall apply:

  - Turbidity less than 75 NTU
  - pH 6.5-8.5
  - Dissolved oxygen >6.5mg/L
  - No visible debris or hydrocarbons.
- Undertake visual assessments for the effectiveness of erosion and sediment control structure. This should be 24 hours proceeding of expected significant rainfall events and weekly inspections when no significant rainfall is expected. Records of this monitoring are to be kept, maintained and made available for inspection.

The above controls will be applied to all site disturbances during the construction and operation phases.

7.3.2.2 Surface water quality

Construction works have the highest probability of having an impact to surface water quality through the mobilisation of additional sediment as a result of ground disturbance activities. Principles of runoff management will include the following.

- Divert clean, non-impacted storm water runoff around any activities that have the potential to add contaminants.
- Diversion drains/bunds and associated infrastructure are to be designed in accordance to the IECA Best Practice Erosion and Sediment Control Guidelines (2009).
- All hazardous and flammable materials are to be stored in accordance with AS1940:2004.

Suitable erosion and sediment controls will be implemented as outlined in Section 7.3.1 of this document.

7.3.2.3 Access Tracks

Erosion and sediment controls outlined in Powerlink's Standard Environmental Controls will be implemented for the construction of any access tracks or additional watercourse crossings that may be required. Measures from Powerlink's LMC-003.6 Access Tracks and Drainage will also be employed during the design, construction, operation and rehabilitation of access tracks.

There are no defined flood immunity requirements for access tracks and any additional watercourse crossings that may need to be added as part of the Project.

7.3.3 Operational phase

Risks to water resources will decrease during the operational phase of the Project. This phase requires less ground disturbance and areas that have been disturbed during the construction phase have been rehabilitated. Measures to be implemented in the operational phase of the Project to protect water resources include the following.

- Ongoing implementation of erosion and sediment controls for areas where required.
- All vehicles and equipment is to be maintained.
- Spills are to be cleaned up immediately.
- Routine maintenance of vehicles is to occur in designated areas with appropriate infrastructure. Routine maintenance of vehicles, including refuelling is not to occur within 100 m of the high bank of a watercourse or drainage line.
- Scour protection, beds and banks at watercourse crossings to be regularly inspected and maintained.
- The hydraulic capacity of any cross-drainage infrastructure is to be regularly inspected for blockage, sediment, vegetation etc. Where flows are being inhibited by such processes, remedial actions are to occur.
- Liaise with regulatory authorities where required prior to disturbing the bed and banks of any watercourse, including for remedial works.