Genex Kidston Connection Project:
Draft Environmental Assessment Report
Powerlink Queensland

Chapter 3

Project Description

3.0 Project Description

3.1 Project Overview

Genex is seeking to establish the Kidston Renewable Energy Hub, a combination solar and pumped storage hydro power generation at the old Kidston mine. Powerlink Queensland has been engaged by Genex to connect this facility to its existing transmission network at Mount Fox, via a new 275 kV electricity transmission infrastructure project known as the Genex Kidston Connection Project (the Project).

The Project comprises the following components:

- a 275 kV substation proposed in the locality of Mount Fox, Queensland (the 'Mount Fox substation')
- a 275 kV substation proposed in the locality of Kidston, Queensland (the 'Copperfield River substation')
- an up to 195 kilometre (km) 275 kV double circuit or single circuit transmission line between Mount Fox substation, Copperfield River substation and Genex's Kidston Solar Farm Stage Two and Kidston Pumped Storage Hydro substations (the 'transmission line').

Depending on the Copperfield River substation requirements, Powerlink may realign the transmission line west of Copperfield River to run directly north-west into the Kidston Renewable Energy Hub. Both alignments are presented in this EAR and are shown on Figure 3-1.

An overview of the components of the Project is provided below. A detailed description is provided in Section 3.5 (transmission line) and Section 3.6 (substations). The Project will also require the temporary construction of camp accommodation and construction site offices (Section 3.7). Approvals for these facilities will not form part of the ID process.

3.1.1 Substation – Mount Fox

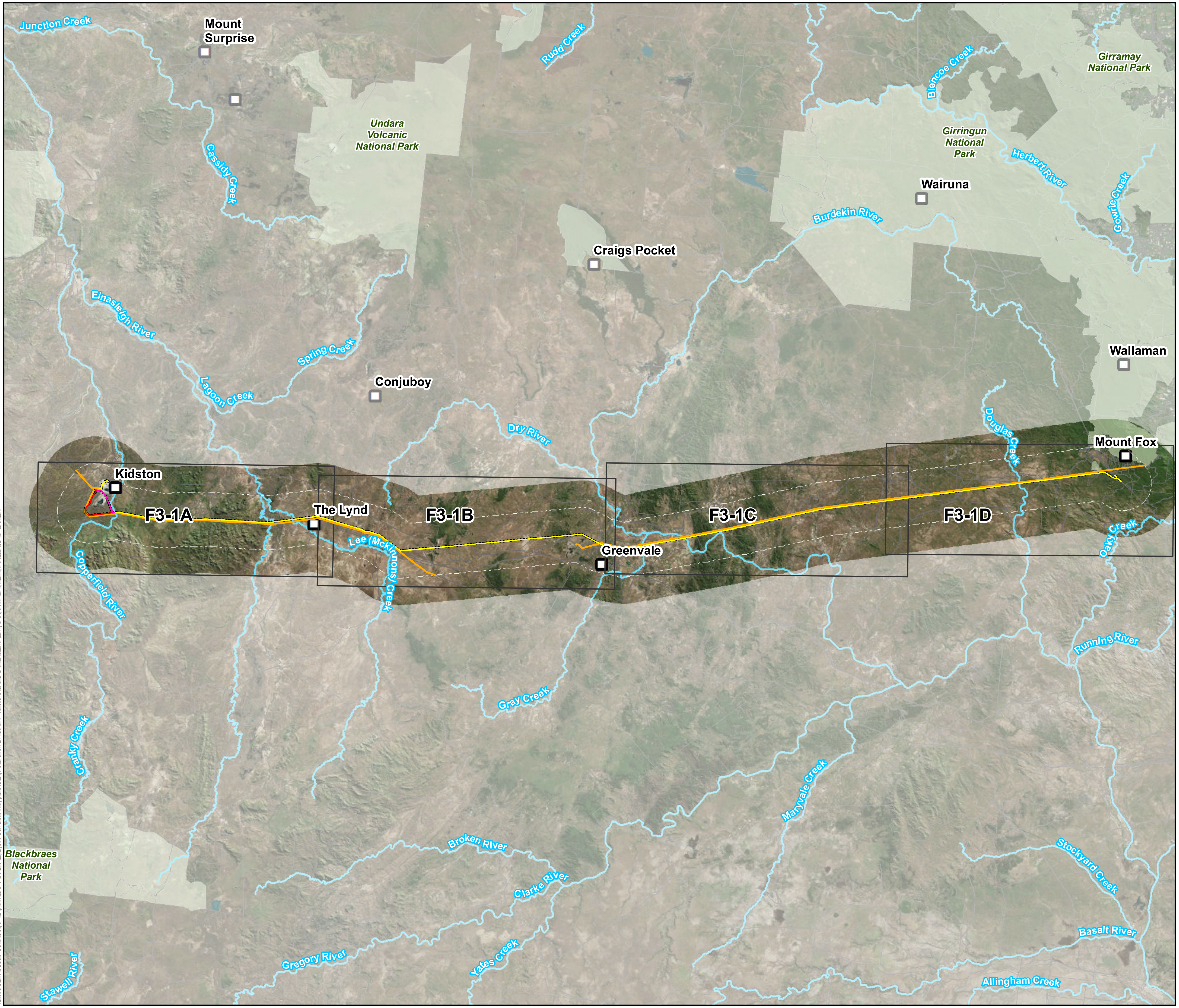
At the eastern extent of the Draft Alignment, the 275 kV transmission line will connect into a new substation at Mount Fox. A suitable location for the Mount Fox substation has been identified and land is being acquired off Knuckledown Road. The Mount Fox substation will connect into Powerlink Queensland's existing double circuit 275 kV Ross to Chalumbin transmission line. In addition to providing a physical connection point for the new line, the Mount Fox substation will provide critical power monitoring and control capabilities to safely and reliably operate the transmission network. The initial substation footprint will measure approximately 210 m long by 150 m wide, and be constructed within a larger area of land to provide a buffer to adjacent land uses, sufficient area to establish a flat platform and future expansion opportunities.

3.1.2 Transmission line

Detailed design and costings are currently underway to optimise the configuration of the proposed 275 kV transmission line to the expected generation output requirements. The line will be either double or single circuit configuration on self-supporting structures (steel lattice towers and/or poles) or guyed structures. The transmission line will be located within a 60 m wide easement.

3.1.3 Substation – Copperfield River and connection

At the western end of the Draft Alignment, the 275 kV transmission line will connect into a new substation at Kidston, known as the Copperfield River substation. The Copperfield River substation will be located adjacent to the Kidston Renewable Energy Hub. In addition to providing a physical connection point for the new line, the substation will provide critical power monitoring and control capabilities to safely and reliably operate the transmission network. The initial substation will measure approximately 210 m long by 150 m wide, and be constructed within a larger area of land to provide a buffer to adjacent land uses, sufficient area to establish a flat platform and future expansion opportunities.



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Kilometers

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Legend

- Indicative Structure Locations
- Places
- Watercourses
- Ergon Lines
- Protected Areas
- Project 10 km Buffer
- Project 5 km Buffer
- Draft Alignment
- Draft Alignment A
- Draft Alignment B

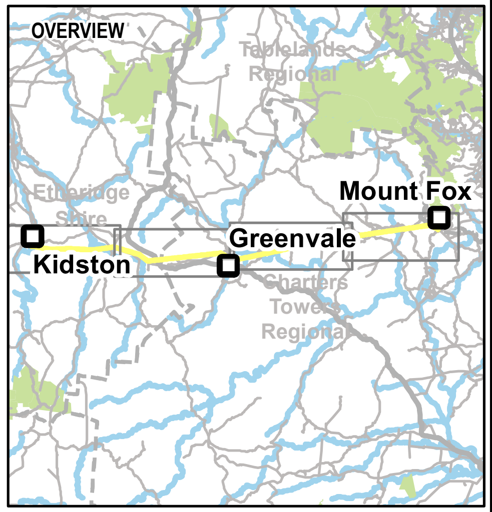

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Figure F3-1

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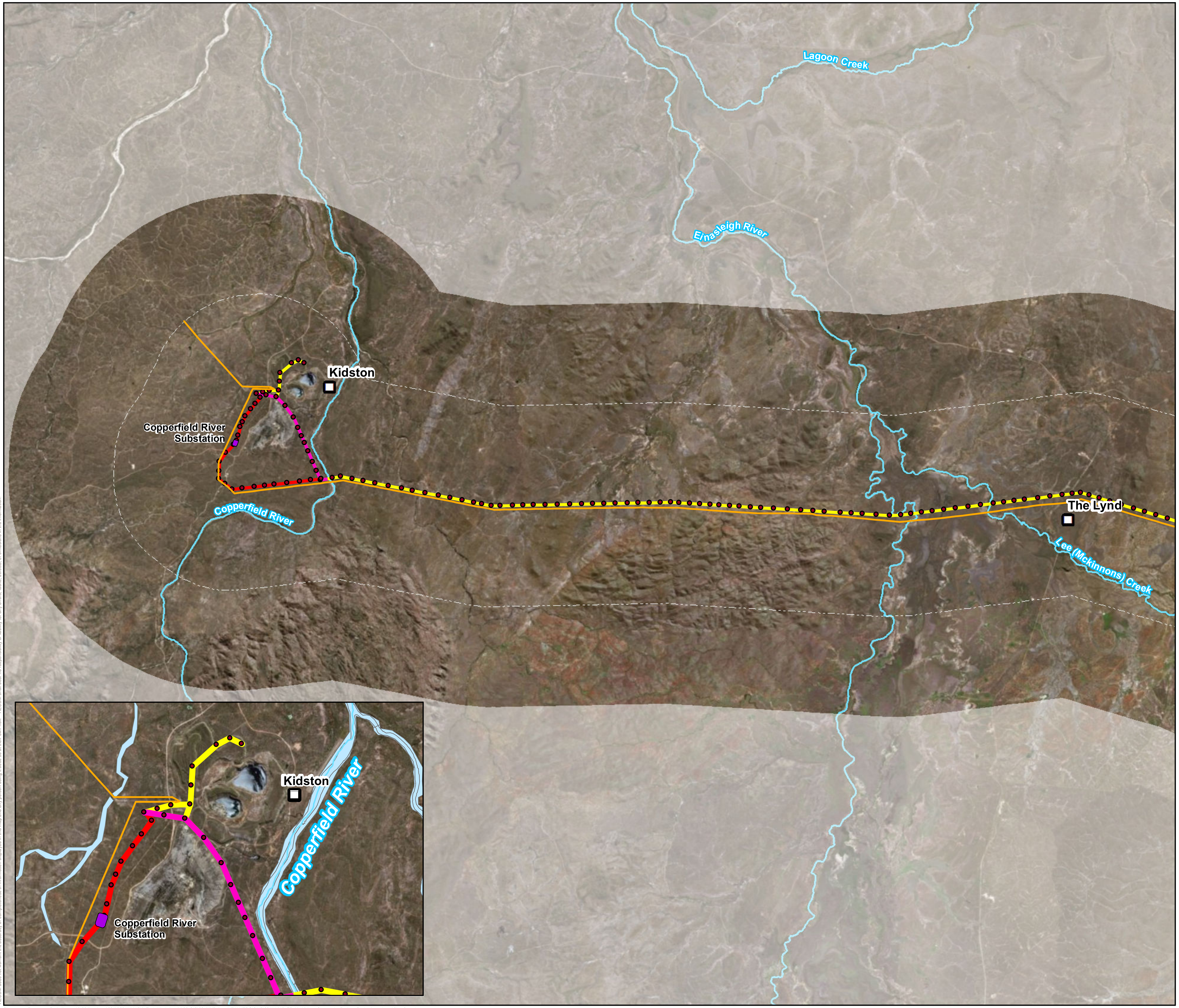

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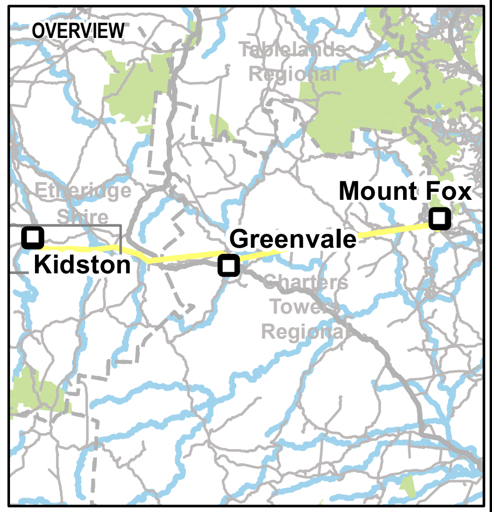

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Figure F3-1A

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Projection: Transverse Mercator

0 2 4 6 8
Kilometers

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Legend

- Places
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- Watercourses
- Ergon Lines
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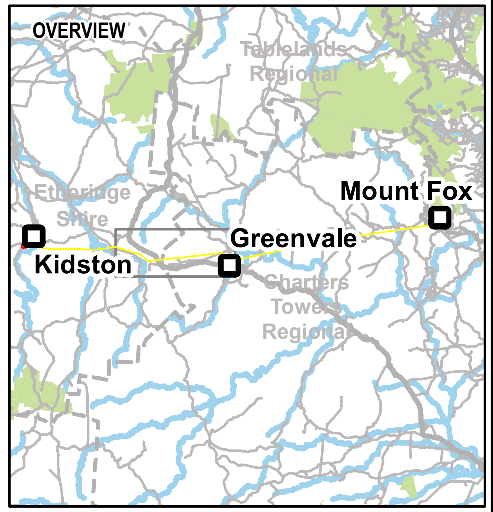
- Project 5 km Buffer
- Draft Alignment



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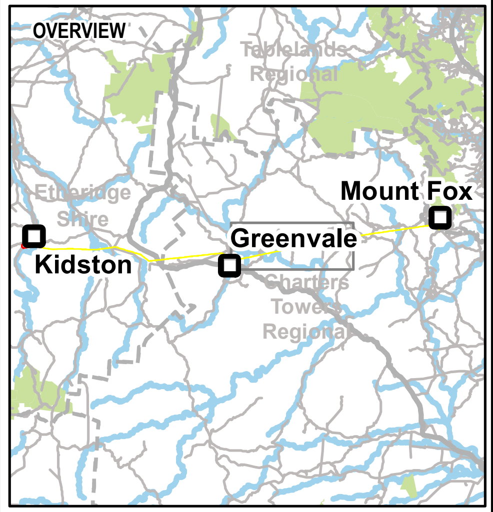

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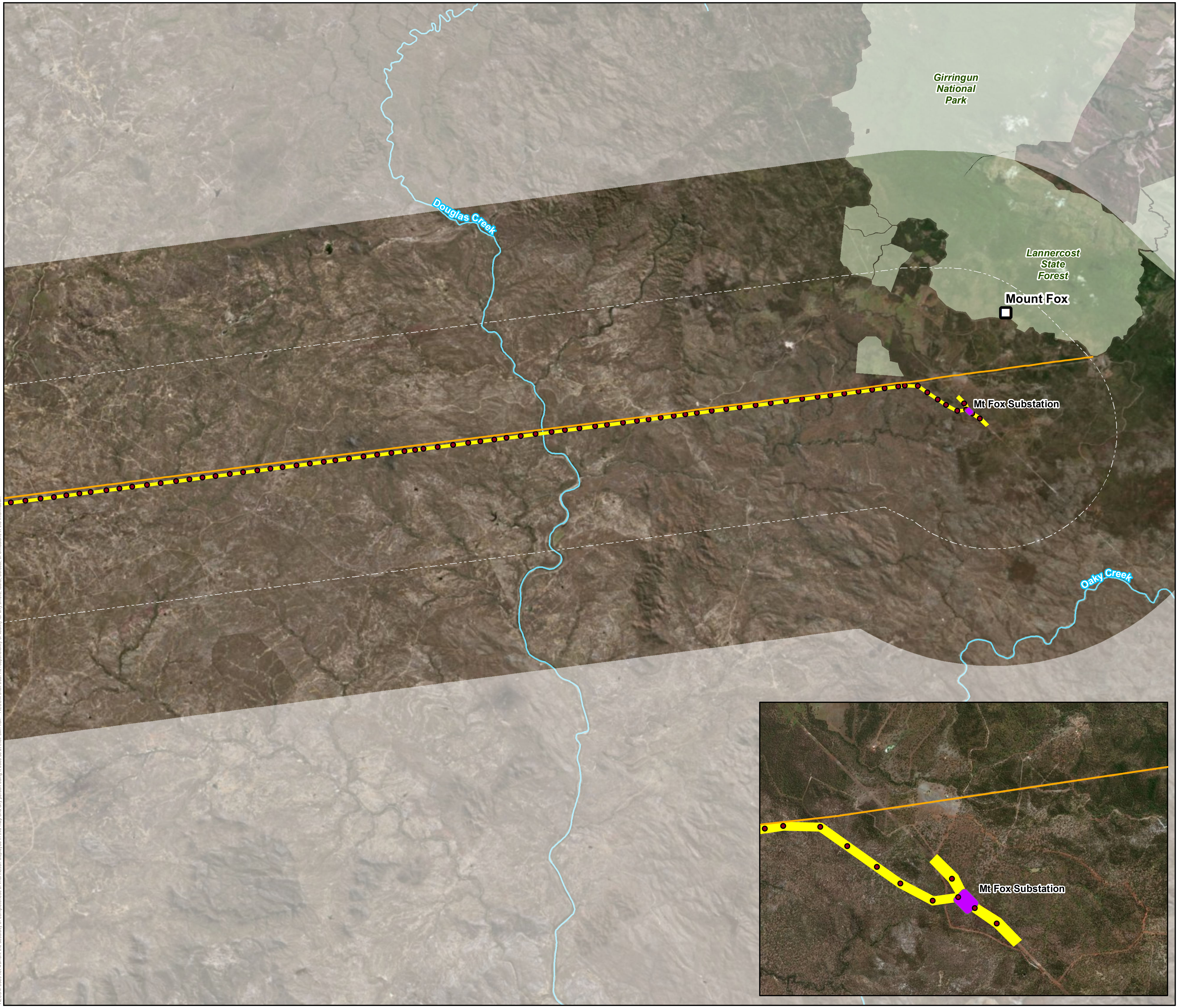

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Coordinate System: GDA 94 MGA Zone 55
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Kilometers

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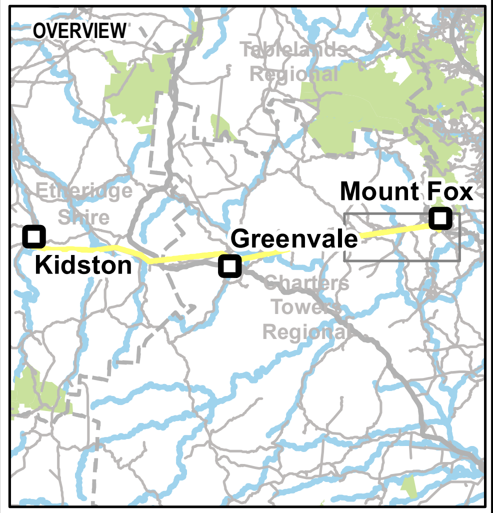
- Places
- Watercourses
- Ergon Lines
- Project 10 km Buffer
- Project 5 km Buffer
- Protected Areas
- Substation
- Draft Alignment



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3.2 Project Timeline

The construction period is proposed to be approximately 18 months, commencing in July 2019. Works on the substations and transmission line will be undertaken concurrently. Construction is anticipated to occur Monday to Saturday, between 6:30am and 6:30pm, however Contractors may adopt working rosters to manage efficiency and fatigue. These rosters are expected to be 10 days on, 4 days off (10/4 roster).

3.3 Site Description Summary

The Draft Alignment commences near Mount Fox, approximately 100 km north-west of Townsville and extends in a westerly direction for approximately 195 km to the township of Kidston. The Draft Alignment intersects three individual Local Government Areas (LGA) – Hinchinbrook Shire Council, Charters Towers Regional Council and Etheridge Shire Council (Figure 3-2).

The proposed substation at Mount Fox is located within the Hinchinbrook Shire Council LGA. The nearest locality to the substation is Mount Fox and the nearest population centre is Ingham (approximately 40 km north-east of Mount Fox). The proposed Copperfield River substation will be located within Etheridge Shire Council LGA with the nearest population centre being Einasleigh (approximately 40 km north of Kidston). Approximately 115 km of the proposed transmission line will be located within Charters Towers Regional Council with the nearest population centre being Greenvale.

The Draft Alignment currently traverses 21 properties and numerous untitled roads and watercourses. Table 3-1 provides a list of property titles, tenure and local government areas subject of the Draft Alignment. Land tenure traversed by the Draft Alignment is predominantly leasehold which is held by the State of Queensland and leased for specific purposes (grazing, agriculture, telecommunications etc.) for a specified period. There are also scattered freehold lots throughout the Draft Alignment. The dominant land use is agricultural, predominantly grazing.

Table 3-1 Draft Alignment lot on plan details

Lot	Registered Plan	Tenure	Local Government Area
59	SP237064	Freehold	Hinchinbrook Shire Council
3198	PH2177	Leasehold	Charters Towers Regional Council
3	WU48	Leasehold	Charters Towers Regional Council
6	WU50	Leasehold	Charters Towers Regional Council
1	OC64	Leasehold	Charters Towers Regional Council
5234	SP275834	Leasehold	Charters Towers Regional Council
1	CLK23	Leasehold	Charters Towers Regional Council
5	CLK23	Leasehold	Charters Towers Regional Council
11	CLK26	Leasehold	Charters Towers Regional Council
501	SP232789	Leasehold	Charters Towers Regional Council
547	SP242570	Leasehold	Charters Towers Regional Council
3	CLK34	Leasehold	Charters Towers Regional Council
4	CD35	Leasehold	Etheridge Shire Council
1	CD25	Freehold	Etheridge Shire Council
3	CD12	Leasehold	Etheridge Shire Council

Lot	Registered Plan	Tenure	Local Government Area
14	LH8	Leasehold	Etheridge Shire Council
182	PH995	Leasehold	Etheridge Shire Council
66	SP287774	Leasehold	Etheridge Shire Council
44	USL33	Unallocated State Land	Etheridge Shire Council
2	SP289310	Freehold	Etheridge Shire Council
1	SP289310	Freehold	Etheridge Shire Council

Sensitive receptors in proximity of the Draft Alignment are shown on Figure 3-2. Sensitive receptors have been defined through a combination of sensitive receptors under the *Environmental Protection Act 1994* and sensitive land uses under the *Planning Act 2016*.

The closest sensitive receptor is within 500 m of the Draft Alignment. This has been identified as an old tin mine immediately on the northside of the Ergon 66kV line within 'Kilclooney' station (Lot 319 PH2177), which is used as a private campsite. The Draft Alignment is located on the southern side of the 66 kV line and is approximately 100 m from the camp site.

Existing electricity infrastructure within the area includes an Ergon 66 kV transmission line that runs 90 km west from Mount Fox to Greenvale and Ergon 132 kV transmission line that runs from Ross to Kidston. Co-location with this existing infrastructure is achieved between Mount Fox and Greenvale, and from the vicinity of Conjuboy to Kidston.

The Draft Alignment crosses, and is located in the vicinity of, a number of key pieces of transportation infrastructure within both State and local jurisdiction. The Draft Alignment crosses the Gregory Developmental Road within the vicinity of Conjuboy. This road is controlled by the Department of Transport and Main Roads under the *Transport Infrastructure Act 1994*.

The Draft Alignment crosses a mapped stock route, which is identified as 'minor and unused' in the vicinity of Conjuboy. Another 'minor and unused' stock route travels from Greenvale to the Valley of Lagoons and onto Mount Fox. The Draft Alignment traverses this route six times during its length.

There is no operational rail infrastructure corridor traversed by the Draft Alignment. Where the Draft Alignment passes through Greenvale, a decommissioned railway exists to the south of the alignment. The railway was decommissioned in 1993, and the tracks were removed in the mid-2000s, however the lease and some infrastructure still exists.

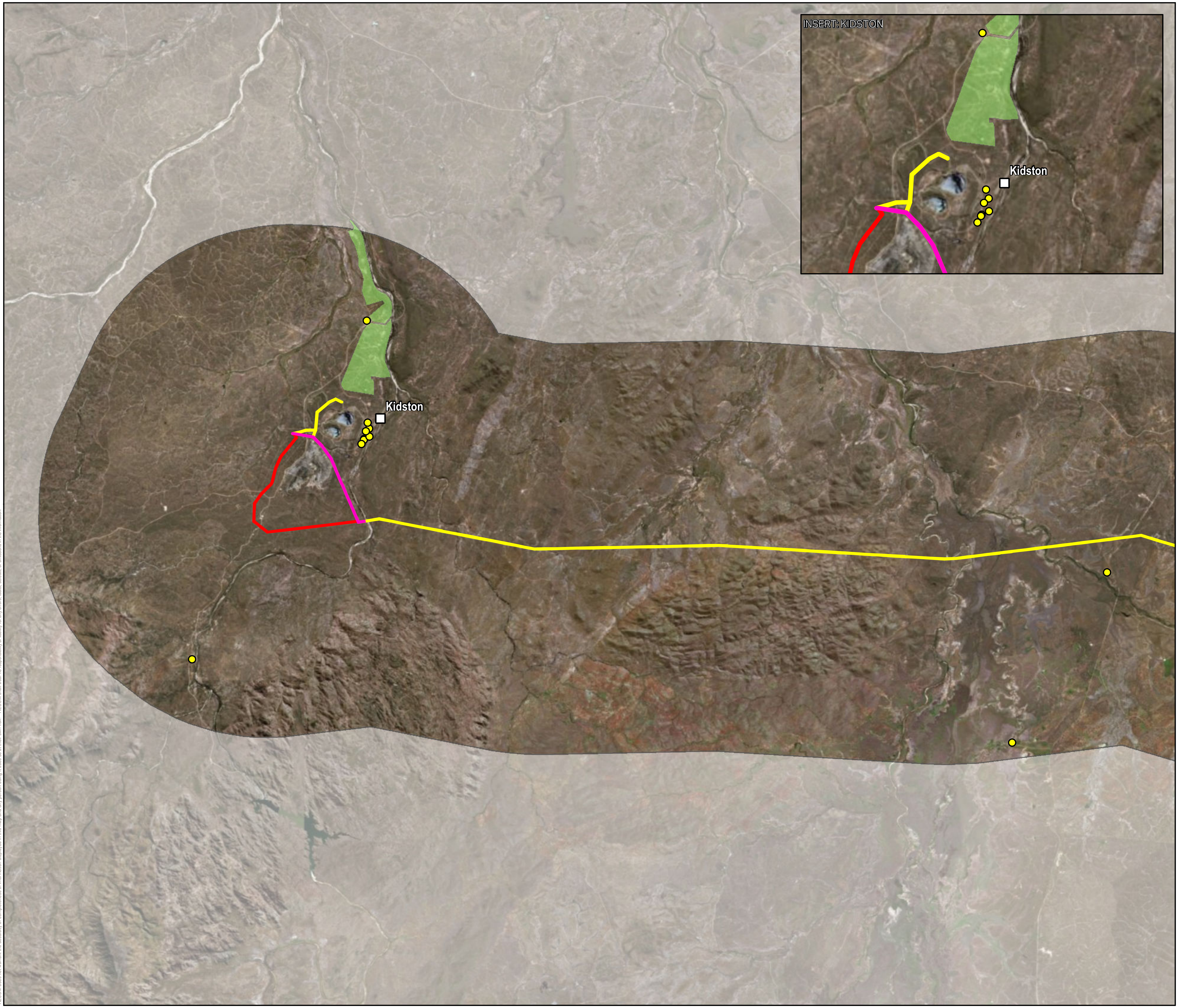
The Draft Alignment is well removed from any known air transport infrastructure. Aerodromes exist at Greenvale and Kidston, and a number of small private airstrips are located within the vicinity of the Draft Alignment. A risk assessment undertaken by Powerlink of the impact of the proposed transmission line located south of Kidston airfield found it will not pose an operational problem.

No interests under the *Petroleum and Gas (Production and Safety) Act 2004* have been identified within the Draft Alignment. Several resource interests governed by the *Mineral Resources Act 1989* have been identified, with the predominant resource interests identified for exploration purposes. Any required consents from resource interest holders are not linked to the ID processes and will be sought once detailed design is completed and prior to construction activities commencing.

Topography along the Draft Alignment ranges from flat, low-lying land to steep crossings of multiple ranges, including part of the Pelican Range (70 km west of Mount Fox) and the Great Dividing Range (100 km west of Mount Fox). Elevation throughout the Draft Alignment generally ranges from 400-800 m AHD.

Due to landholder access restrictions, Lot 5234 SP275834 and Lot 1 OC64 have only been surveyed where public roads cross the Draft Alignment. Powerlink Queensland is currently undertaking an independent assessment process with the landholder of these lots which involves the use of experts nominated by Powerlink Queensland and the landholder to undertake a site inspection to assess the potential impact of the proposed transmission line and to document the findings in a joint expert report.

Should the agreed findings propose a change in alignment for the proposed transmission line on the subject properties, Powerlink Queensland will undertake further environmental, social, technical and economic assessments to determine the suitability of any realignment in accordance with planning approval requirements. These further assessments if necessary will be incorporated into the Final EAR.



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Kilometers

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Legend

- Commercial and Retail Activity
- Dwellings and Accommodation
- Educational facility
- Outdoor Recreational Area
- Places
- Protected Area
- Draft Alignment
- Draft Alignment A
- Draft Alignment B

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SENSITIVE RECEPTORS

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Figure
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Legend

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Sensitive Receptors
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Sensitive Receptors

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SENSITIVE RECEPTORS

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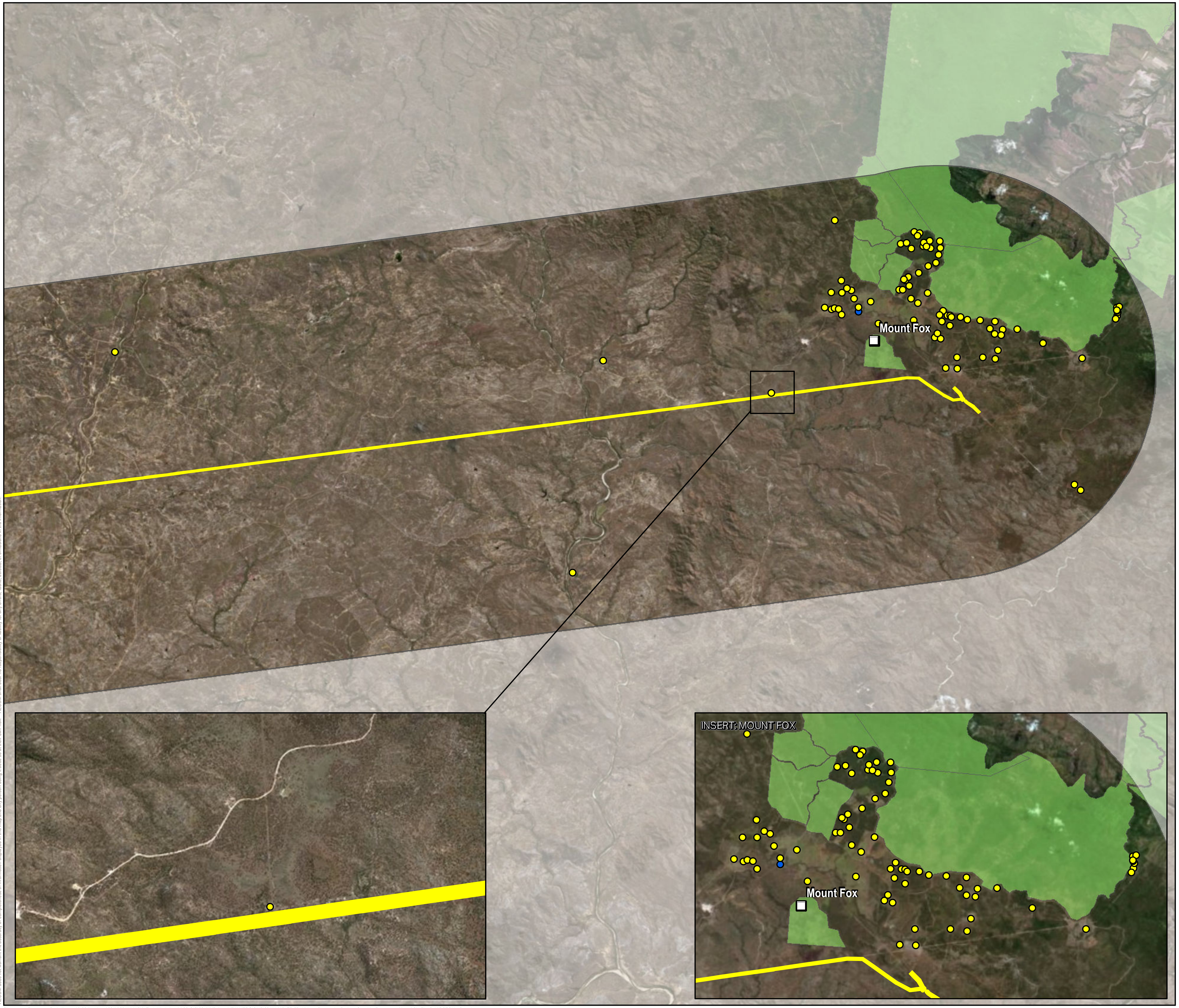

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3.4 Relationship to Other Projects

Existing Powerlink Queensland infrastructure in the Project area includes the 275 kV Ross to Chalumbin Transmission Line and the Mount Fox Communications Site. The Kidston Renewable Energy Hub is currently under development, with the following key projects either completed or proposed.

- The 50 MW Kidston Solar Project (Stage One) has completed construction and is generating electricity into the National Electricity Market through a connection to Ergon Energy's existing 132kV Ross-Kidston transmission line. This line does not have sufficient spare capacity for the following projects.
- The 250 MW Kidston Pumped Storage Hydro Project (Stage Two) is seeking development approval from Etheridge Shire Council and State Government and is securing an Engineering, Procurement and Construction contract for the development.
- The 270 MW Kidston Solar Project (Stage Two) has received development approval from Etheridge Shire Council and State Government and is proceeding to construction in 2019.

Although not related to this Project, it is noted that a detailed feasibility study is currently underway for the proposed Hells Gate Dam on the Upper Burdekin River. The proposed dam is located approximately 27 km south of the proposed transmission line. The dam's objective is to provide opportunities to significantly increase the agricultural production of the North, establishing up to 100,000 hectares (ha) of irrigated agricultural land.

3.5 Transmission Line

3.5.1 Physical details of the transmission line

3.5.1.1 Structures and requirements

Aerial structures

Support structures are used to keep the high voltage conductors separate from each other, and clear of the ground and other obstacles. Requirements for minimum clearance between energised conductors and various types of obstacles are specified in the *Electricity Safety Regulation 2013*, which is part of the *Electrical Safety Act 2002*. The distance or span between structures and their height is determined by the topography, average temperatures, sensitive environmental areas, clearance requirements and structure loading limits.

Structures are fabricated in a range of heights to allow optimum height to be provided at each site. Typically, shorter structures are found on elevated areas such as hills, with taller structures in gullies, or where additional clearance is required over a mid–span obstacle such as a road.

Various designs of conventional self-supporting towers have been used in Queensland for over 50 years and are the standard form of support structure for high voltage construction observed throughout the state. Guyed structures are also used in Queensland and other States.

For self-supporting towers, individual components are fabricated from galvanised steel angle sections (members) and steel plate and are assembled onsite. Individual foundations support the four legs of the tower. Treatments can be applied to the galvanised surfaces of the towers and poles to reduce visual impact where necessary. For self-supporting poles, individual components are fabricated from galvanised steel plate and bolted or sleeved together onsite. A large single foundation supports the pole.

Guyed structures are similar to self-supporting towers except they sit on one small foundation in the centre and are supported by several guy wires to ensure structural integrity. Compared to other structure types they are lightweight, easy to erect, capable of preassembly and require a simple foundation design. Figure 3-3 shows a guyed, single circuit structure (left) and self-supporting double circuit structure (right) in Central Queensland. Self-supporting structures may also be single circuit design. The final structure types will be chosen following completion of detailed design and whole of life cost analysis matched to the expected generation output.

Figure 3-3 Structure types – single circuit guyed structure (left); self-supporting double circuit structure (right)

Structure duties

There are two specific duties of structures **-** suspension and tension.

Suspension structures

Suspension structures are used where the transmission line follows a straight line or has a very small deviation angle (up to 2 degrees). They are designed to carry the weight (vertical load) of the conductors and transverse (horizontal) load from wind on the conductors.

An outline of a typical self-supported double circuit suspension tower is shown in Figure 3-4. Features of the suspension structures are relatively light construction, with cross–arms on each side of the upper part of the structure (superstructure) and insulator strings supporting the conductors.

Tension structures

Tension structures, are characterised by a ‘heavier’ appearance due to the larger steel section sizes and conductors ‘terminated’ onto the cross–arms using insulators in a near horizontal orientation. Tension structures are designed to carry the weight (vertical load) of the conductors, and transverse (horizontal) load from wind on the conductors and conductor and earth wire tension loads. These structures are required at all changes in direction of the line greater than two degrees or where termination sites have been predetermined to facilitate line construction and operation. These structures are designed to withstand high longitudinal loading on the structure, which cannot be accommodated by the lighter suspension structures.

Tension structures are also used in conductor ‘uplift’ positions. Conductor uplift is a term used to describe the loading condition where in the absence of sufficient vertical loading the suspension insulator string will swing unacceptably close to the body of the tower under certain loading conditions, thus reducing electrical clearance. This situation can occur on a structure located at the base of a hill or steep terrain and is resolved by using a tension structure with its different insulation configuration even though the loading conditions would not normally require one at this location. Another use is for terminations at the end of the line.

A suite of structures may be designed for a particular project to cover a range of angle duties. For example, an intermediate type may be designed for angles up to 40° and a 'heavy duty' type provided for angles up to 90 degrees and termination positions. An outline of a typical self-supporting double circuit tension tower is shown in Figure 3-4 and Figure 3-5.

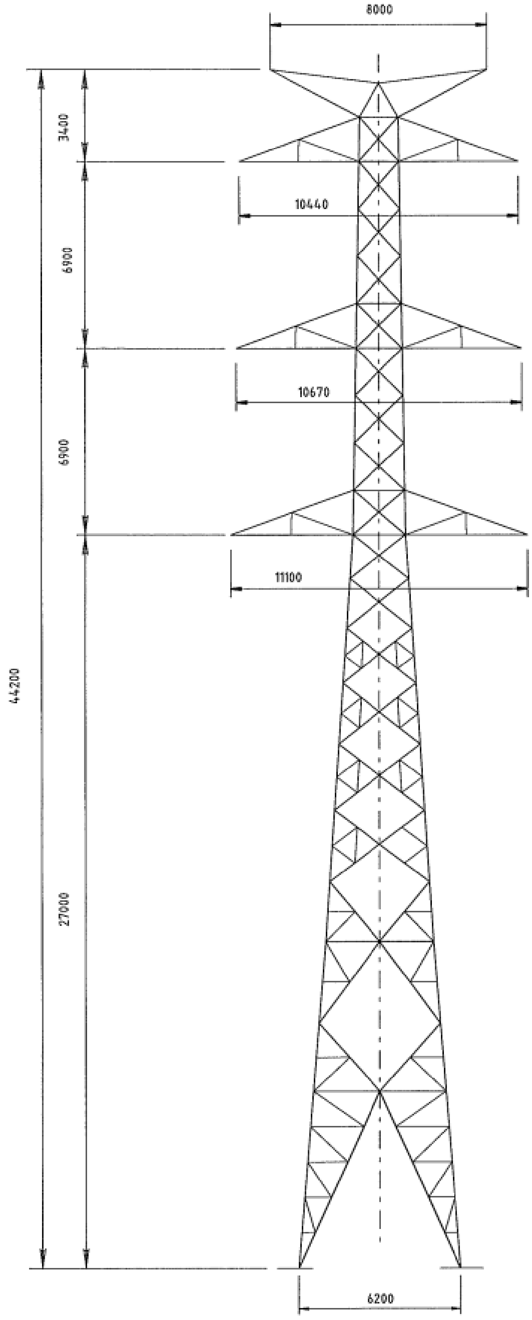


Figure 3-4 Outline of a typical suspension structure

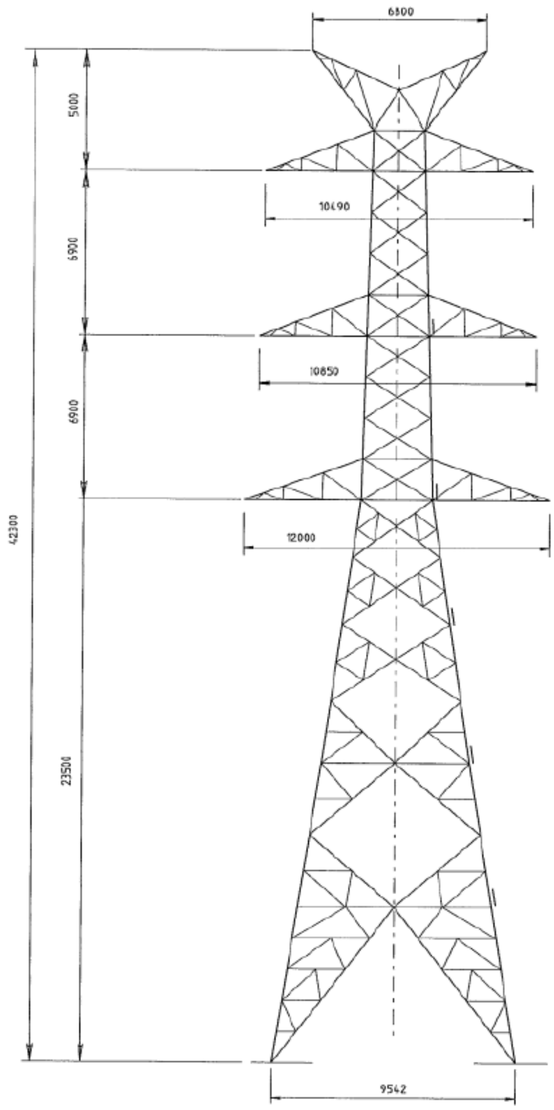


Figure 3-5 Outline of a typical 275 kV tension tower

Conductors, earth wires, insulators and fittings

Conductors

For double circuit configuration, each structure will support 12 individual conductors, configured in three pairs of twin conductors and two smaller diameter earth wires. For single circuit configuration, each structure will support 6 individual conductors, configured as three twin conductors and two smaller diameter earth wires.

Earth wires

Overhead earth wires provide protection to the conductors from direct lightning strikes to safely dissipate earth fault currents and are also used as a support for optical fibre cables for communication purposes.

Insulators and fittings

Insulators are used to provide a connection between conductors and structures and to provide electrical insulation between the high voltage electricity and the (earthed) structure. The length of insulators in a string is determined by line voltage, clearance requirements and environmental (e.g. pollution) considerations. For this Project, insulators will be ceramic disc type.

Special galvanised steel or aluminium fittings connect both the line end of the insulator to the conductors and the tower end to the structure. A typical insulator string is shown in Figure 3-6.

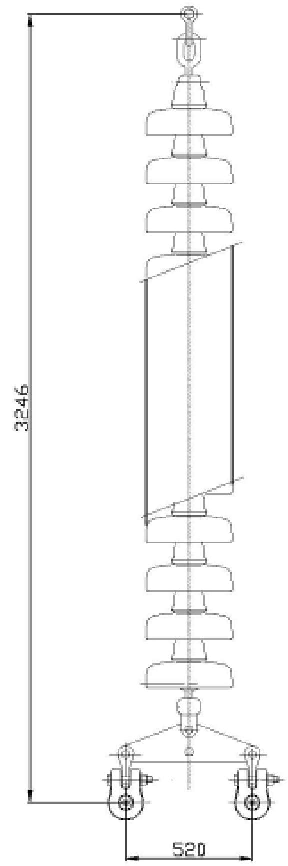


Figure 3-6 Typical insulator string

Telecommunications

Telecommunications infrastructure will include dual communication paths via OPGW for protection signalling, operational telephony, OpsWAN and SCADA data (including customer SCADA data).

3.5.1.2 Easement and access

3.5.1.2.1 Easement

For the vast majority of cases, Powerlink Queensland transmission lines are constructed on easements. An easement is a registered interest in a parcel of land providing Powerlink Queensland with a right of way allowing the transmission line to be built, operated and maintained on part of a property with ownership of the land remaining with the landholder. Restrictions are placed on activities permitted on an easement to maintain public safety and ensure the line can operate reliably. Compensation is paid to directly affected landholders in accordance with the heads of compensation in the *Acquisition of Land Act 1967.*

Easement width is determined by the size and type of line, and the need to maintain safe electrical clearance between the high voltage conductors and any object or structure adjacent to the line under all conditions. This includes safe electrical clearance to vegetation in and adjacent to the easement.

For a 275kV transmission line, a 60 m wide easement will be acquired.

3.5.1.2.2 Access tracks

Heavy vehicle access to the transmission line is required during construction and for ongoing operation and maintenance. In steeper terrain or where creeks or gullies intersect the easement, tracks may need to detour off the easement. Where access is generally available from adjacent public roads, limited access track construction to the structure site is normally all that is required for both construction and maintenance activities. In all cases, maximum use is made of existing public and privately owned roads and tracks.

Where the proposed transmission line is co-located with the existing Ergon 66 kV and 132 kV lines, existing Ergon access tracks will be upgraded where necessary to facilitate construction and maintenance activities. The location of access tracks on each property will be confirmed closer to the construction phase in consultation with each landholder.

3.5.2 Construction

Construction of a transmission line involves a series of field activities which are broadly grouped as follows:

- site set out
- flora and fauna surveys
- mobilisation, including establishment of accommodation camps, laydowns and offices
- installation of gates, grids, cleandown bays and access tracks
- vegetation clearing
- tower site benching
- foundation installation
- structure assembly and erection
- conductor and earth wire stringing
- site rehabilitation
- demobilisation.

3.5.2.1 Site set out

Following cadastral survey of the transmission line easement, the location of the transmission line within the easement is then set out. Structure sites are marked and orientated using design information. Structure locations are based on the technical characteristics of the structures and conductors, topographical constraints, landholder requirements and environmental considerations.

Easement boundaries will be identified and marked prior to vegetation clearing.

3.5.2.2 Flora and fauna surveys

A pre-construction weed survey will be undertaken prior to construction activities commencing and a post-construction weed survey will be undertaken after the first wet season once construction is finalised. The surveys will occur along the easement and access tracks and will identify weeds of national significance, restricted and invasive matters and regionally declared weed species.

Pre-clearance habitat surveys will be undertaken immediately prior to clearing to identify any active breeding places and where possible relocate fauna to an undisturbed location.

3.5.2.3 Vegetation clearing

The amount of vegetation clearing required is dependent on terrain, vegetation type and significance, and landholder requirements (where feasible). The aim is to clear vegetation sufficient to meet Powerlink Queensland’s safety, reliability and operational requirements for the transmission line.

In non–sensitive areas, the most effective and efficient clearing method for large scale clearing is by bulldozer, often fitted with a ‘stick rake’ or ‘tree spear’ to push over larger trees or use of a mega-mulcher. Timber of commercial value may be recovered just prior to clearing. Depending on land use, landholder requirements, environmental constraints and maintenance requirements, cleared vegetation may be dealt with in the following ways:

- chipped or mulched on site and used for easement revegetation
- stacked and windrowed - any stacked and windrowed vegetation must be placed in a manner which does not concentrate overland flow or create erosion
- stacked and burnt - any burning of cleared vegetation may only occur in accordance with a permit from the Fire Brigade and so as not to create any additional hazard to the surrounding environment or transmission line.

In sensitive areas, such as steep or erosion prone terrain, near watercourses or other environmentally sensitive areas, alternative methods of clearing such as hand clearing (chainsaw) or the use of a fella-buncher (or excavator with cutting attachment) may be appropriate. These techniques are more labour intensive and time consuming than other mechanical means but achieve the desired clearing outcome. In steep terrain or environmentally sensitive areas, trees may be cut above ground level, felled along the contour and allowed to decompose naturally or mulched. In areas where hand clearing is required stump heights will be discussed and agreed with the landholder. Lower vegetation is typically retained along road corridors to provide a visual screen, where visual impacts are identified. In these areas, supplementary planting of suitable species may be used to improve screening.

Chemical treatment may also be used for selective treatment of incompatible vegetation while minimising ground disturbance. The method may be through stump injection, cut stump or overall spray technique and is mostly suitable for regrowth vegetation.

Clearing for the Project is carried out in accordance with the requirements specified in the Environmental Management Plans (Refer to Appendix I Environmental Management Plans).

3.5.2.4 Foundation installation

Geotechnical assessments are undertaken prior to construction to determine the appropriate foundation type for each structure. Bored foundations are often used, and are shown on. Alternative foundation types (i.e. mass concrete, micro-piles, mini-piles) are used in situations where ground conditions are not suitable for bored foundations.

The choice of foundation type is dependent on the specific nature of the soil and rock and takes into account soil/concrete friction strength, water levels, soil bearing capacity, construction constraints, rock levels, and soil properties.

Construction of tower foundations usually consists of the following steps:

- setting out
- excavation/boring
- leg stub/base set up
- placement of reinforcing steel/concreting
- concreting of excavated foundations
- installation of earthing.

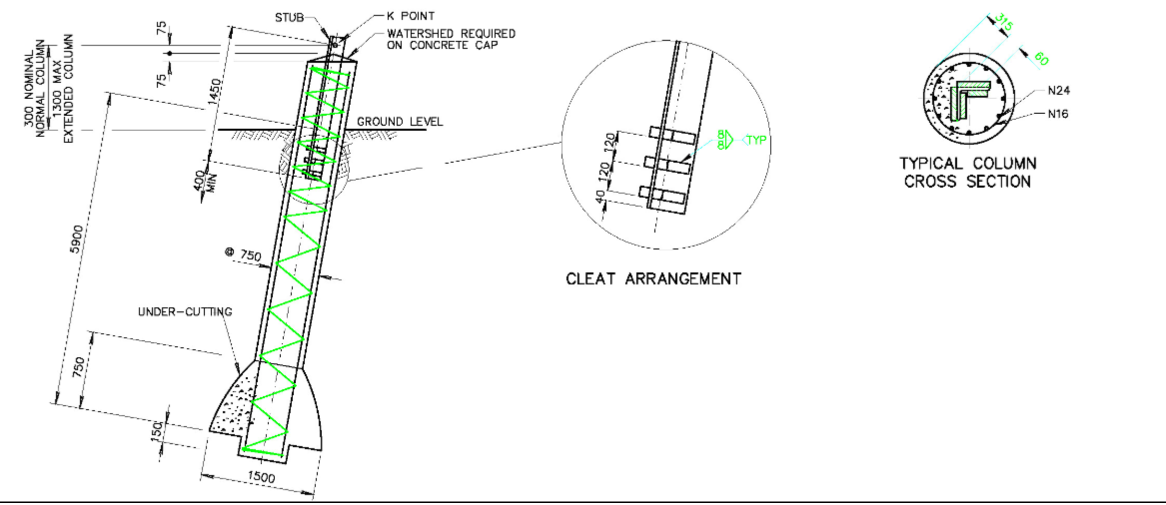
Setting out involves the placement of temporary pegs on site to mark the location of the excavation. Dimensions of foundations are determined by structure type and height and soil conditions at the site.

Excavation of bored foundations may be by truck mounted auger, backhoe or track mounted excavator. The excavation is bored at the same inclination as the structure leg. In unstable ground conditions, the excavation may be stabilised by the insertion of a steel ‘liner’ in a bored foundation and shoring or timbering for a mass concrete foundation. Although dependent upon the geology of the surrounding soil, foundations are typically excavated to approximately 8–12 m.

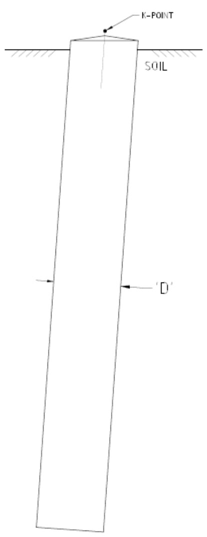
Micro or mini piles involve small diameter 50-300 mm diameter drilled holes which are designed to have a centrally placed steel reinforming member. Subject to ground conditions, the foundation design and the size of the drilling equipment being used, a range of piles, from 3-12 are drilled per leg. These small and grouped piles are then bonded and tied back into a pile cap and/or column forming a tower leg foundation. Micro or mini pile foundations are the preferred foundation for difficult drilling conditions including hard rock, saturated and collapsing soils.

Leg stub setup is the process of placing an extension of the tower leg (the ‘stub’) in the correct position and inclination within the excavation, in preparation for concreting in place. A temporary jig or template is used to hold the stub firmly in place in the correct horizontal and vertical alignment and is removed after concreting. Reinforcing steel is required in tower foundations, with the amount varying with tower and foundation type. Temporary formwork is also used for the foundation column above ground (bored foundations) and above the base (mass concrete foundations). Concrete is placed in accordance with normal construction procedures and formwork removed after an appropriate curing time.

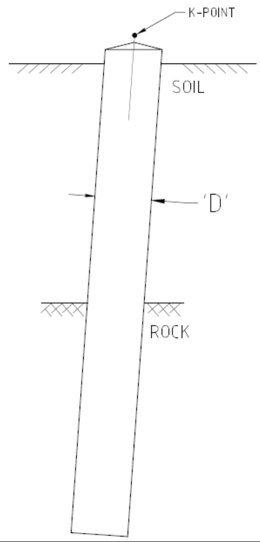
Backfilling of mass concrete foundations is completed using the excavated material if suitable, or imported fill. Surplus material is spread evenly about the site or removed, depending on quantity and suitability.



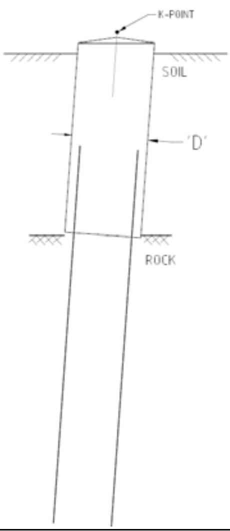
Bored undercut foundation



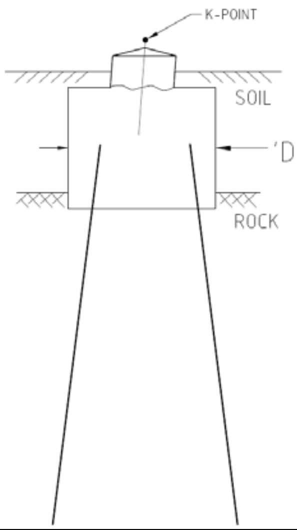
Bored straight side



Bored rock socket (low to hard strength rock)



Bored rock anchor (medium to hard strength rock)



Bored rock anchor (medium to hard strength rock)

Figure 3-7 Typical bored foundation types

3.5.2.5 Structure assembly and erection

The term ‘structure assembly and erection’ refers to a sequence of activities from delivery to site, preassembly, erection, tightening and inspection tower components of each structure.

Steel for lattice towers is fabricated, galvanised, sorted and bundled ready for delivery at a contractor’s facility off site and transported to the final location in two or more pieces, typically by semi–trailer. Preassembly of the tower is usually carried out adjacent to its final site and involves assembly of a number of sections, which will allow convenient erection at the following stage.

Where practical, bolts holding the members together are tightened at this stage. Larger or heavy towers may require the use of a small mobile crane at this stage to move members and sections about the site. A large mobile crane (Plate 3-1) is used to erect the tower in sections with a work crew installing and tightening all bolts, and checking that the structure is complete.

Plate 3-1 Transmission conductor drums and mobile crane utilised in structure erection

3.5.2.6 Conductor and earth wire stringing

Conductor and earth wire stringing is usually carried out in sections of varying length of up to 10 km between termination structures, depending on constraints, terrain, and access. Existing infrastructure such as buildings, roads and fences may require hurdling which is a method that adopts a protective barrier to prevent contact and potential damage. Additionally existing distribution and transmission feeders which intersect the proposed Draft Alignment may require other electrical entity works to facilitate stringing. This may include but is not limited to:

- undergrounding existing distribution feeders
- supply of additional generation to impacted feeders
- network outages
- live line hurdling which involves the installation of a portable undercrossing protective barrier.

The conductor and earth wire stringing process requires the use of specialised equipment, and is briefly described as follows.

- A powerful winch (puller) is set up at one end of the stringing section, and a braking device (tensioner) at the other. These designated ‘brake and winch’ sites are typically 40 m x 40 m and predominately on easement. In some instances off easement brake and winch sites may be required due to topographical constraints and constructability requirements. These brake and winch sites are generally cleared and stripped of the topsoil layer, which is stockpiled separately and used for rehabilitation of the site at completion of stringing.
- Specially designed pulleys (stringing sheaves) are fixed at each conductor and earth wire attachment point on each structure in the section (Plate 3-2).
- Multiple high strength, non–rotating steel winch ropes are threaded continuously through the corresponding sheave on each structure between the winch and the tensioner. This is often facilitated by threading light polypropylene ropes through the sheaves as they are installed. These ropes are used to pull the winch rope through the sheaves at each structure without the requirement for a worker to climb the structure.
- For each stringing section, for each conductor and earth wire individual winch ropes will be runout.
- The conductors (electrical cables) are then pulled out under tension through the stringing sheaves on each structure and through to the winch. The tension in the winch ropes is continuously monitored to avoid over tensioning. Workers carry out visual checks through the stringing section to ensure that the conductor run out proceeds smoothly and wires remain clear of all obstructions.
- At the completion of the run out of all conductors and earth wires, they are attached to structures or temporary anchorages.
- Conductor and earth wire tensions are adjusted to give the design sag (i.e. the correct ground clearance).
- Conductors are clamped in final positions at the end of insulator strings at each suspension structure, and terminated on insulator strings at each tension structure.
- Conductor spacers are installed between sub–conductors (sometimes from a helicopter).
- Earth wires are clamped or terminated as required at each structure earth wire peak.
- Equipment is repositioned and the above process is repeated for subsequent stringing sections.

A variation of the above process uses a helicopter to undertake the direct run-out of conductor and/or earth wire (Plate 3-2). It is quite similar to the above process but differs in that no steel winch rope is used.

Plate 3-2 Stringing sheaves and helicopter stringing

3.5.2.7 Road crossings

Where transmission lines cross road reserves, approval will be sought from the relevant road authority under Section 102 of the *Electricity Act 1994*.

3.5.2.8 Watercourse crossings

Where possible, structures will be located 50 m from watercourses. Where the transmission line crosses watercourses, previously cleared tracks for existing crossings will be preferentially used to minimise new watercourse crossings. Where new crossings are required, the construction methodology will be dependent upon the size of the watercourse, however are generally developed in line with accepted development requirements for operational work that is constructing or raising waterway barrier works.

The construction of bed-level crossings typically involves the excavation of the crossing bed to an appropriate depth to provide a stable base. The excavation is then lined with a heavy duty geo-fabric, and filled with aggregate using a combination of rock sizes up to150 mm to lock the rock into place. In some instances where it is not practical to undertake excavation works due to unfavourable soil properties, alternative solutions may be required which may include, but are not limited to:

- installation of bog mats
- installation of geomaterials.

3.5.2.9 Laydown areas

Laydown and staging area requirements will be determined by the Project contractor, however it is anticipated that a laydown area will be required at each temporary accommodation camp. Where laydown and staging areas are proposed outside of the easement, they will be subject to applications and assessment by the relevant State and/or local regulators.

3.5.2.10 Site reinstatement

Reinstatement will be undertaken progressively during construction, where practicable, and Powerlink Queensland will ensure that all disturbed areas impacted from construction are reinstated at the end of the Project. The short-term goal of reinstatement is the stabilisation of soils to provide a suitable matrix for vegetation establishment to aid in preventing erosion. Reinstatement also includes the replacement of topography, topsoil, and fences where disturbed.

3.5.3 Operation and maintenance

3.5.3.1 Operation

After completion of construction and commissioning of the transmission line, the amount of activity on site decreases substantially. During operation, normal practice is for maintenance staff to carry out scheduled inspections of the line, easement and access tracks on average twice per year.

These inspections (patrols) are either by vehicle or helicopter. Additional inspections may be required to perform such activities as emergency repairs.

3.5.3.2 Maintenance

3.5.3.2.1 Structures, conductors and fittings

Structures, conductors and fittings are inspected for any signs of unusual wear, corrosion or damage. Transmission lines are designed for a 50 year in-service life and are very reliable under most conditions. Maintenance staff normally conduct a detailed visual inspection about once every two to three years.

Provision may be made for some structure and conductor maintenance tasks to be carried out from a helicopter, with the line either energised or de–energised. Typically, insulators are replaced every 25 years with the majority of the remaining equipment designed to last the life of the line.

3.5.3.2.2 Easements

Inspection of the easements is carried out on each scheduled line patrol, with the main aim being to record the type, density and height of vegetation regrowth. Additional matters of interest include new under–crossings (e.g. distribution powerlines) or other activity or construction within the easement, which may affect operation or maintenance of the line.

Powerlink Queensland's policy is for the landholder to be contacted prior to any vegetation control work on a property and the landholder's agreement obtained regarding the treatment method to be employed. This is particularly important if herbicides are involved for withholding periods for meat production.

Easement vegetation management is important to ensure the safe operation of the transmission line. Vegetation management is undertaken in accordance with Powerlink Queensland's standards and procedures.

Three techniques for vegetation management are employed:

- mechanical
- hand clearing
- chemical (herbicides).

The technique adopted for each area takes into account a number of issues such as landholder requirements, type of regrowth, terrain and the local environmental conditions. Mechanical clearing is usually by a tractor driven slasher or similar vehicle, and is suitable for shrubs and smaller trees. It is limited to relatively flat and accessible terrain due to the type of vehicle used.

Hand clearing is labour intensive but allows the vegetation clearing to be quite selective and ensures that disturbance to non-target species is minimised. Hand clearing can be employed in areas where vehicle access is not available. Lopping of larger trees is also an option near urban or in visually sensitive areas.

Chemical treatment may also be used for selective treatment of incompatible vegetation while minimising ground disturbance. The method may be through stump injection, cut stump or overall spray technique and is mostly suitable for regrowth vegetation.

3.5.3.2.3 Access tracks

Maintenance of access tracks is required to ensure that vehicle access to structure sites is available for inspections and structure maintenance. Techniques employed should be appropriate for the area. For example, a grader may be required in hilly terrain where some reshaping of drainage is necessary, but a slasher could be preferred in open grasslands.

The work should minimise disturbance to natural groundcover, thus reducing erosion potential and subsequent maintenance requirements. Maintenance of access provided by others is undertaken in consultation with the appropriate authority.

3.5.4 Decommissioning

Typically a transmission line has a 50 year operational life and after this time may:

- be replaced with a transmission line designed for the revised environmental constraints and electrical system requirements at the time
- if the line were no longer required, be dismantled and the easements may be surrendered to the property owner.

At the time when the transmission line is decommissioned, it will be de–energised, dismantled and removed.

3.5.4.1 Dismantling and removal of the transmission line

The process of dismantling and removal of the transmission line is a staged process, which includes the following.

- Lowering the overhead conductors and earth wires to the ground and cutting them into manageable lengths to roll onto drums or reels. These are removed from the site and sold as scrap. Some minor damage to vegetation results, but other clearing is not normally required for this operation.
- Removing insulators and line hardware from structures at the site and disposal at an approved local authority waste facility.
- Dismantling towers in manageable sections and removing from site and usually selling steel as scrap. Steel poles are cut into pieces small enough to be handled and transported, then removed from site.
- Demolition of foundations is normally carried out as follows:
  - the ground surrounding each foundation (tower leg/holding down bolts and encasing concrete) is excavated to a depth of approximately 600 mm below the natural surface level
  - the concrete is broken away and the tower leg or holding down bolts and reinforcing steel cut off about 500/600 mm below ground
  - demolished concrete and steel are removed from site for disposal (usually at an approved local authority waste facility) or recycling
  - the excavation is backfilled and compacted with suitable (imported, if necessary) material.
- In specific situations such as cultivation, some variation would be necessary, for example foundations may be cut off deeper (to avoid any potential interference with ploughing machinery) and backfilled with better quality soil.

3.5.4.2 Environmental management, easement restoration and rehabilitation

Given the typical operational life span of a transmission line is 50 years, it is considered unneccessary at this stage to identify specific environmental management, easement restoration and rehabilitation measures which will be undertaken at the time of decommissioning.

It is expected, in the coming years, that legislative frameworks, regulatory provisions and best practice strategies with regard to environmental management will continually improve. Therefore, identifying and committing to current environmental management standards for decommissioning works would not utilise or take advantage of any future improvements made in this area and is therefore considered inappropriate at this stage.

However, broad environmental management strategies which will be employed during decommissioning can be identified and are discussed below. Powerlink Queensland is committed to employing environmental management strategies during the decommissioning phase which meet or exceed legislative, regulatory and best practice requirements current at the time. All necessary permits and/or approvals which are required to undertake decommissioning works will be sought and received prior to decommissioning works commencing.

- Soils – both temporary and permanent erosion and sediment control strategies and/or devices will be implemented during decommissioning works to ensure that transmission line structure sites are left as stable landforms. Surface stabilisation (e.g. mulching or grass seeding) may be undertaken where necessary to ensure that large scale erosion does not occur and sites are returned to the equivalent surrounding landscape. All excavations made in order to remove structure footings to a depth of 1 m below ground level will be filled and covered over.
- Water quality – as for construction phase works, water quality protection measures will be implemented during decommissioning works. Where access tracks have been constructed across drainage lines and/or watercourses and are not required by the landholder after decommissioning, these structures will be removed and bed and bank profiles returned to surrounding waterway profile.
- Air quality – decommissioning works will involve land surface disturbance, excavation, use of machinery and possibly clearing of vegetation regrowth – all activities which have the potential to cause impacts to local air environments and nuisance to sensitive receivers in close proximity. Therefore, as for construction phase works, management measures to reduce the occurrence, duration or intensity of potential air quality impacts will be implemented.
- Noise – as with air quality considerations, decommissioning works will involve activities which have the potential to impact on local acoustic quality and sensitive receivers. Therefore, management measures will be implemented to reduce actual or potential acoustic impacts. All decommissioning works will comply with operational hours specified by local authorities or relevant agencies.
- Infrastructure – during decommissioning, assets will be dismantled and/or cut on site into manageable sections which can be loaded and removed from the easement. The decommissioning process will generate traffic on local roads comprising standard vehicles utilised for staff movement, trucks and heavy vehicles for collection of dismantled assets and heavy vehicle movements to deliver and remove machinery required to undertake decommissioning works. Whilst traffic movements associated with decommissioning are not expected to exceed those associated with construction works, traffic management on local roads will be employed where required.
- Vegetation – clearing of vegetation regrowth along sections of easements and access tracks may be required in order to gain appropriate access to transmission line assets.
- Easement rehabilitation – should the easements no longer be required, passive rehabilitation such as natural regrowth of vegetation over the easements would be allowed and encouraged. Active rehabilitation including planting of native, endemic species, including control of significant weed infestations may be undertaken where warranted. Monitoring of rehabilitation will be undertaken to ensure success.
- Access track rehabilitation – access tracks not required by landholders would also be allowed to passively rehabilitate. In some circumstances, light scarifying and seeding may be undertaken to promote vegetative regeneration.
- Waste – decommissioning of the transmission line will result in waste products including cleared vegetation regrowth, steel, concrete, cable, insulators, conductors etc. Where recycling facilities for these waste materials exist at the time of decommissioning, these waste materials will either be re–used or recycled. If no recycling facilities exist, waste materials will be disposed of in accordance with regulatory requirements.

3.5.4.3 Decommissioning Management Plan

Prior to decommissioning of the transmission line, a Decommissioning Management Plan which provides detail regarding the proposed decommissioning works, environmental risks associated with decommissioning and management and mitigation measures will be prepared. This plan will utilise environmental management strategies, practices and technologies current at the time of decommissioning to comply with regulatory provisions and to appropriately manage environmental issues which may be associated with decommissioning of the transmission line.

3.6 Substations

3.6.1 Physical details of the substations

A typical substation layout and structures are shown in Plate 3-3.

3.6.1.1 Aerial structures

Aerial structures comprise of galvanised tubular steel acting as:

- strain beams for terminating the transmission line conductors
- poles for supporting aerial earth wires over the substation.

3.6.1.2 Gantry structures

Gantry structures are of steel construction and are used to support high voltage conductors throughout the substation that interconnect sections of electrical equipment. Requirements for minimum clearance between energised conductors and various types of obstacles are specified by the Electricity Safety Regulation 2013. The distance between structures and their height is determined by the equipment layout and these clearance requirements.

3.6.1.3 Support structures

Support structures are used to maintain ground clearance to the various items of electrical equipment. Support structures at the substation will be of conventional fabricated steel and tubular steel construction.

3.6.1.4 Busbars

Busbars act as high capacity connectors between pieces of equipment. They are made of tubular aluminium.

3.6.1.5 Buildings

The proposed substations will contain the following buildings:

- an air–conditioned combined demountable control/communications building
- an air–conditioned demountable amenities building
- a storage shed on a concrete slab.

The proposed substations will include a site office building which is likely to include office space, a kitchenette and ablutions facilities. Reticulated water supply is not available at the proposed substation locations and is not proposed to be extended to the site. Rainwater tank(s) will be provided at each substation site for general use excluding drinking water. Water tanks will be enclosed and provided with first flush devices in order to improve quality of rainwater caught and stored on site for use.

3.6.1.6 Electrical equipment

Electrical equipment is grouped into:

- primary plant involved in the transformation, switching and isolation of high voltage electricity
- secondary systems associated with the protection, metering and control of the primary plant
- communication systems linking the automated control and signalling equipment in the substation to remote control facilities as well as voice and data communications facilities.

Plate 3-3 Typical substation layout

3.6.2 Geotechnical investigations

Geotechnical assessments are undertaken prior to construction to determine to allow for the detailed design of the substation. This typically involves the use of a large truck mounted drilling rig.

3.6.3 Construction

Construction of the proposed substations will involve a series of field activities including:

- a detailed site survey to allow detailed structure and substation design
- vegetation clearing
- earthworks and levelling for the substation platform and access road
- site fencing
- installation of a site drainage system
- installation of a substation cable trench and conduit system
- installation of the substation earthing mat
- installation of the substation structure and building foundations
- buildings, structure and electrical equipment erection
- conductor and earth wire stringing
- site rehabilitation.

3.6.3.1 Vegetation clearing

The area affected by the construction of the built elements of the substation must be fully cleared.

3.6.3.2 Earthworks

A level surface is required for the construction of the substation, therefore the initial stage of construction is earthworks, usually by a cut and fill process to bench the pad, the extent of which will depend on the site profile. Earthworks for the site comprises compacted fill approximately 1 m above surrounding ground level. Fill may be required to be imported to meet specification requirements.

3.6.3.3 Platform surfacing

A 100 mm thick platform road base surface will be laid as part of initial earthworks. This will extend up to 3 m outside the future compound fence alignment all around the site, excluding the future roads. A final 100 mm thick platform of additional road base surfacing finish covering the same area will be laid after completion of civil works. A further 100 mm thick gravel surface will be placed within the compound after completion of civil works.

If space permits, excavated spoil material is to be mounded with the available mulch onsite and used as a planting bund for landscaping around the periphery of the site. Surplus clean fill material will be removed from site and appropriately disposed.

3.6.3.4 Site access

Road works will comprise:

- the access road to and within the substation
- parking around the substation buildings.

Access to each substation site will be from the nearest road.

3.6.3.5 Cable ducts

Underground cable trenching within the substation includes cable trenches, cable pits and conduits as required for multicore cables.

3.6.3.6 Site fencing

The substation will be surrounded by a 2.4 m high chain wire security fence, topped with several strands of barbed wire. Gates will be provided and locked to allow entry by authorised vehicles and personnel.

3.6.3.7 Civil works

This phase of the work involves the installation of the substation security fencing, drainage, roads, cable trenches, substation earthing and installation of structure foundations. The substation copper electrical earthing mat will be installed across the site at a depth of approximately 600 mm. The disturbed soil will then be compacted and covered to prevent erosion.

Drainage work consists of the installation of all drains, pits and culverts necessary to control the flow of stormwater from the site. All roads into the substation compound and equipment area will be either gravelled or bitumen sealed to prevent erosion.

It is expected that structure foundations will be one of two main types, broadly described as bored and excavated. Bored concrete foundations are used in most situations whilst excavated foundations are used where pad type footings are required.

Isolated concrete plinths and foundations will then be constructed to support the site infrastructure. Concrete for foundations will be supplied from the nearest commercial batching plant and poured in accordance with normal construction procedures. Formwork will be removed after an appropriate curing time. Other foundation requirements such as those for the control and communications buildings are normally completed at this time.

3.6.3.8 Structure and building erection

The steel for the lattice and tubular structures will be fabricated, galvanised, sorted and bundled ready for delivery at a factory or workshop off site. Pre–assembly of the structures will be carried out on site and will involve assembly of the individual members into a number of sections, which will allow convenient erection by a mobile crane.

The demountable control building and amenities building will both be of a transportable prefabricated building design with ‘colorbond’ walls and roofing. They will be delivered complete to site and installed on their foundations using a mobile crane. The storage shed will typically be galvanised metal walls and roofing.

3.6.3.9 Erection of landing beams, gantry structures, conductors and busbars

Once all strain beams, gantry and support structures have been erected, the busbars and high voltage electrical equipment will be placed in position and all electrical connections made. Cables that carry the control and protection signals to the control equipment located in the bay buildings will be laid and all connections made. Conductors are strung between the high–level gantries and connections made to the high voltage equipment. The final connection to be made is that of the incoming transmission lines.

3.6.4 Operation and maintenance

After the completion of construction and commissioning of the substations, the amount of activity on site will decrease substantially as the substations are designed to be monitored and controlled remotely. For safety and security reasons, only authorised personnel are permitted access to substation compounds. Regular security checks will also be carried out. Remotely controlled operational cameras will be installed as remote video monitoring of the substation enables a quick response to issues.

Facilities exist for manual and emergency site control, should this be necessary. Maintenance staff will carry out routine inspections of the substation and detailed maintenance of all plant and equipment at regular intervals. Additional inspections may be required as a result of equipment failure, damage, modifications and upgrades.

During the routine inspections, the substation and items of plant will be inspected for signs of unusual wear, corrosion or damage. Faults and defects will be reported to maintenance staff who will rectify any problems identified.

Substation equipment is designed with a service life in excess of 40 years with refurbishment scheduled every 15 years and is very reliable under most conditions. Apart from the detailed visual inspections that maintenance staff undertake, routine maintenance will be carried out periodically depending on the type and make of the item of plant concerned.

Vegetation regrowth control within the substation compound and under the incoming power supply transmission lines will be undertaken to maintain electrical safety clearances between the conductors and vegetation.

3.6.5 Decommissioning

The design life of the substation is typically around 40 years. However, after that time it would be reasonable to expect that replacement or refurbishment work would occur to bring the equipment to the required level of performance and reliability. If the substation were ever considered no longer necessary, it would be removed and remediation works undertaken.

3.6.5.1 Dismantling and removal of the substation

Decommissioning the substations would involve removal of all substation structures, equipment and associated infrastructure. The process of dismantling and removal of the substation would include:

- removal of transformers and static containments units
- dismantling of all above ground structures (aerial structures, gantry structures, busbars etc.)
- removal of footings to typically 1 m below ground level (with the lower end of the footing remaining in place).

3.6.5.2 Environmental management, site restoration and rehabilitation

Any decommissioning works would be undertaken in accordance with legislative, regulatory and best practice requirements current at the time that decommissioning is undertaken. General decommissioning environmental management principles employed by Powerlink Queensland are discussed in Section 3.5.4.2.

3.6.5.3 Decommissioning Management Plan

Prior to decommissioning of the substations, a Decommissioning Management Plan which provides detail regarding the proposed decommissioning works, environmental risks associated with decommissioning and management and mitigation measures will be prepared. This plan will utilise environmental management strategies, practices and technologies current at the time of decommissioning to comply with regulatory provisions and to appropriately manage environmental issues which may be associated with decommissioning of the substations.

3.7 Temporary Infrastructure Requirements

The following temporary infrastructure is anticipated to be required.

- Project Office, Depot and temporary accommodation (approx. 50 beds), located in Greenvale.
- Temporary accommodation (approx. 40 beds) near Kidston for construction of the substation.
- Temporary accommodation (approx. 40 beds) near Mount Fox for construction of the substation.
- Temporary accommodation (approx. 120 beds) between Greenvale and Mount Fox for construction of the transmission line.
- Temporary accommodation (approx. 120 beds) between Greenvale and Kidston for construction of the transmission line.

The location and scale of these facilities will be defined during detailed design, and will be subject to assessment and approval by the relevant local council. Approvals for these facilities will not form part of the ID process.

3.8 Workforce

The anticipated peak construction workforce will be approximately 370 persons, occurring over a one to two month peak period. A workforce of approximately 40 personnel is anticipated for the construction of each substation, with the remainder of personnel engaged in construction of the transmission line. Five temporary accommodation camps for the Project workforce are proposed.

3.9 Materials

3.9.1 Concrete batching

Several concrete batching plants are anticipated to be required for construction of the Project. Concrete batching plants will likely be located at the Mount Fox, Greenvale and Conjuboy. There is also the potential for a truck mounted batching plant to be required in the vicinity of the Copperfield River substation.

3.9.2 Quarry material

The Project will require access to quarry materials during construction for access tracks, waterway crossings, erosion and sediment controls, foundations and also further access to materials for ongoing maintenance. These materials include, but are not limited to, rock, gravel, sand and soils.

Where available these materials will be source from local registered quarries. In the absence of available registered quarries, permits will be sought for the extraction of required materials.

3.9.3 Water supply

General construction water to be used for dust suppression, access track construction etc., will be sourced from local dams and bores in consultation with landholders. Extraction of water from local rivers and creeks will be undertaken in accordance with the requirements under the *Water Act 2000.*

Water used for the batching of concrete requires specific parameters e.g. salinity and pH.

Potable water for human consumption will be sourced from tested and treated water sources.

3.9.4 Power generation

Generators are required to power camp sites, site offices and will also be required at each substation location for power generation.

3.9.4.1 Project fuel requirements

Project vehicles, machinery and equipment are anticipated to be fuelled by either diesel or unleaded petrol.