COPPERSTRING 2.0

BASE/

CopperString 2.0

Revised Project Description

Volume 4 Attachment B

Contents

Tables

Figures

2. Project description

2.1 Introduction

2.1.1 Project title and defined terms

The title of the project that is the subject of this Environmental Impact Statement (EIS) is CopperString 2.0 Project. The proponent is CuString Pty Ltd. Throughout this EIS the following terms may be used:

- 'The Project' – means the CopperString 2.0 Project
- 'CuString' – means CuString Pty Ltd, the proponent
- 'Corridor selection' – means the baseline investigation corridor of the transmission line (a nominal 1,000 km long corridor). The corridor selection is 120 m wide from Woodstock to Dajarra Road, however development will be contained to a 60m wide footprint along the southern side of the easement allocation. The corridor selection is 80 m wide from Dajarra Road Substation to Dugald River, and 60 m wide from Woodstock Substation to (Strathmore 275 kV) transmission line Mulgrave cut-in South and to (Ross 275 kV) transmission line Mulgrave cut-in North, Dajarra Road Substation to Mount Isa Substation, Dajarra Road Substation to the Ernest Henry and Chumvale Substation, Dajarra Road Substation to Selwyn Substation, and Selwyn Substation to Woodya Substation.

2.1.2 Project purpose and scope

The Project involves the construction and operation of approximately 1,000 km of extra high voltage overhead electricity transmission line that will connect the North West Power System (NWPS), and foundation customers at isolated mine sites along the Project route, to the state electricity grid. The Project overview is shown in Figure 2-1.

Currently, electricity consumers connected to the NWPS, which covers Mount Isa, Cloncurry, Gunpowder and Century Mine, do not have access to the National Electricity Market (NEM). Within the NWPS, electricity is supplied by bi-lateral agreements between generators and consumers. The system is managed under an access protocol authorised by the Australian Competition and Consumer Commission. Many of the mines in the North West Minerals Province (NWMP), such as Phosphate Hill Mine, Mount Dore Mine and Cannington Mine, currently generate their own electricity. Electricity generation for the NWPS and isolated mines is mainly based on gas or diesel as fuel.

Access to the state electricity grid will be provided through connection to the Powerlink transmission network, at a location near Mulgrave (between Collinsville and Townsville).

The Project will facilitate the participation of this economically important region in the NEM, substantially reducing the cost of electricity delivered to the region. This reduction in the cost of electricity is expected to facilitate substantial growth in the resources sector by reducing the cost of mining and minerals processing. A simplified network diagram is shown in Figure 2-2.

The Project will also pass through the southern extent of the North Queensland Clean Energy Hub, a renewable energy zone containing both 'A' class wind and 'A' class solar resources. The Project includes construction of a major substation south-west of Hughenden that can facilitate NEM participation of future renewable energy-based generation from these resources.

The Project is divided into the following six sections:

1. Woodstock Substation

   The Woodstock Substation will connect the CopperString transmission network to the existing Powerlink 275 kV transmission network and will transform voltage between 275 kV and 330 kV.

   The connection to the existing Powerlink 275 kV Strathmore to Ross transmission network consists of the Mulgrave Substation (within the same development footprint as the Woodstock substation) and two sections of 275 kV double circuit transmission line, each about 1 km long. The Mulgrave Substation will be contiguous with the north-eastern boundary of the Woodstock Substation.

2. Renewable Energy Hub

   The first 342 km of the Project from the Woodstock Substation, consisting of a double circuit 330 kV transmission line and the Flinders Substation (south-west of Hughenden) to which it connects, forms the Renewable Energy Hub.

3. CopperString Core

   Moving further westward, the next 395 km of the Project, consisting of a double circuit 330 kV transmission line and the Dajarra Road Substation to which it connects, forms the CopperString Core. The CopperString Core connects the eastern-most bulk supply substation of the NWPS 220 kV network, at Cloncurry, to the Flinders Substation.

   The Dajarra Road Substation will transform the voltage between 330 kV and 220 kV (the NWPS transmission voltage) for connections to the Ergon Energy Chumvale Substation, Dugald River Mine, Ernest Henry Mine, and the Southern Connection.

4. Mount Isa Augmentation

   The Mount Isa Augmentation will upgrade and supplement the transfer capacity between the Chumvale Substation and the Mica Creek Complex at Mount Isa. The Mount Isa Augmentation will consist of a new substation south of Mount Isa, near the Mica Creek complex, with a double circuit 220 kV transmission line connection to the Dajarra Road Substation.

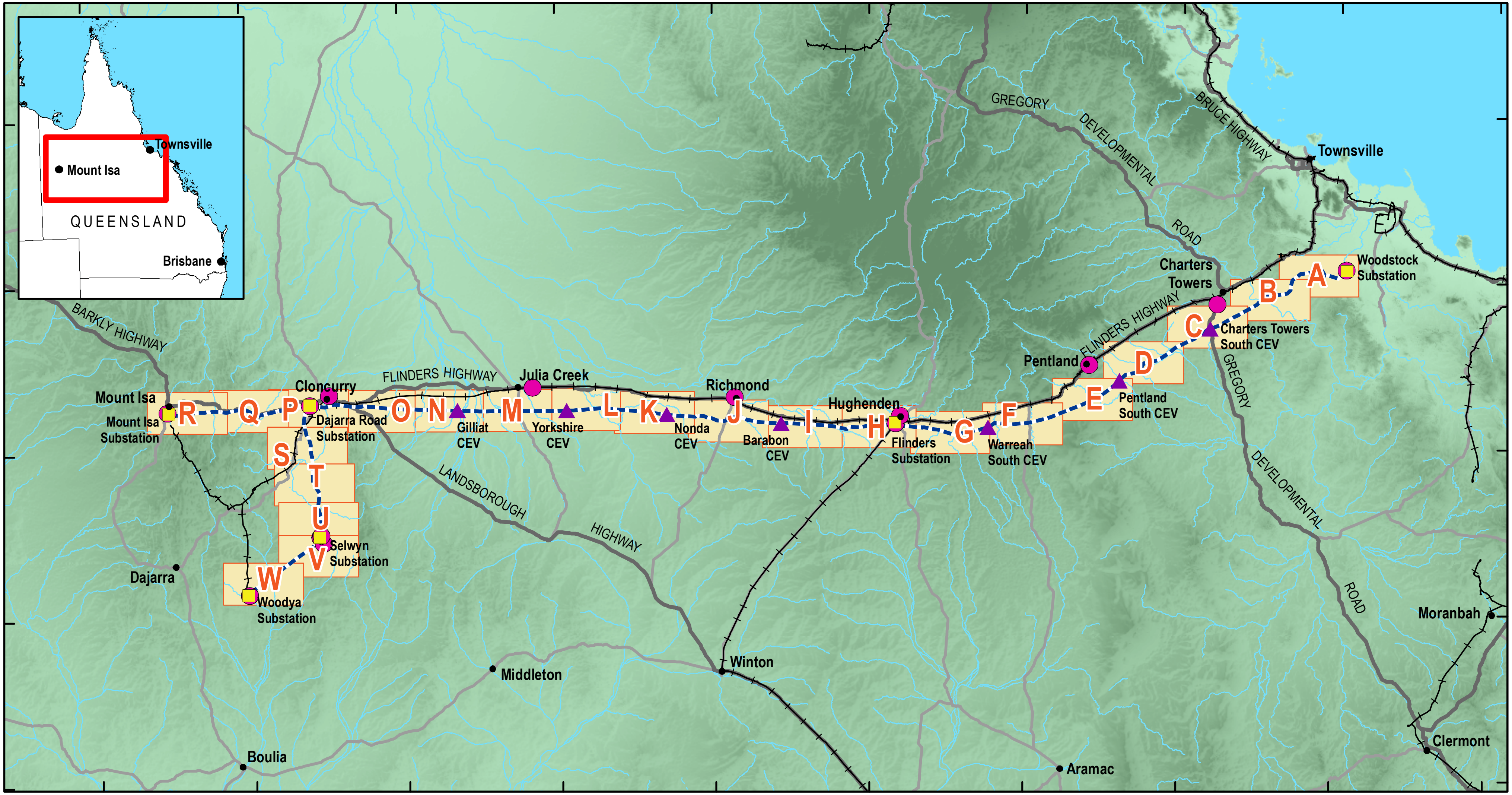
5. Southern Connection

   Running south from Dajarra Road Substation, a 90 km double circuit 220 kV transmission and the Selwyn Substation, to which it connects, form the Southern Connection. The Southern Connection will enable connection of the southern mines, such as Mount Dore Mine and Phosphate Hill Mine that are presently not connected to the NWPS. The Selwyn Substation will form a transmission node to supply nearby energy consumers such as the Mount Dore Mine.

6. Woodya Connection

   Running south-west from Selwyn Substation, a double circuit 132 kV transmission line and the Woodya Substation, to which it connects, form the Woodya Connection. The Woodya Substation will form a transmission node to supply nearby energy consumers such as the Phosphate Hill Mine.

The project will utilise conventional alternating current and will comply with all relevant aspects of the National Electricity Rules (NER), including those required for system security, positively impacting the quality and reliability of supply.



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WKSP Project_Overview_Detail_Map_Index_RevC

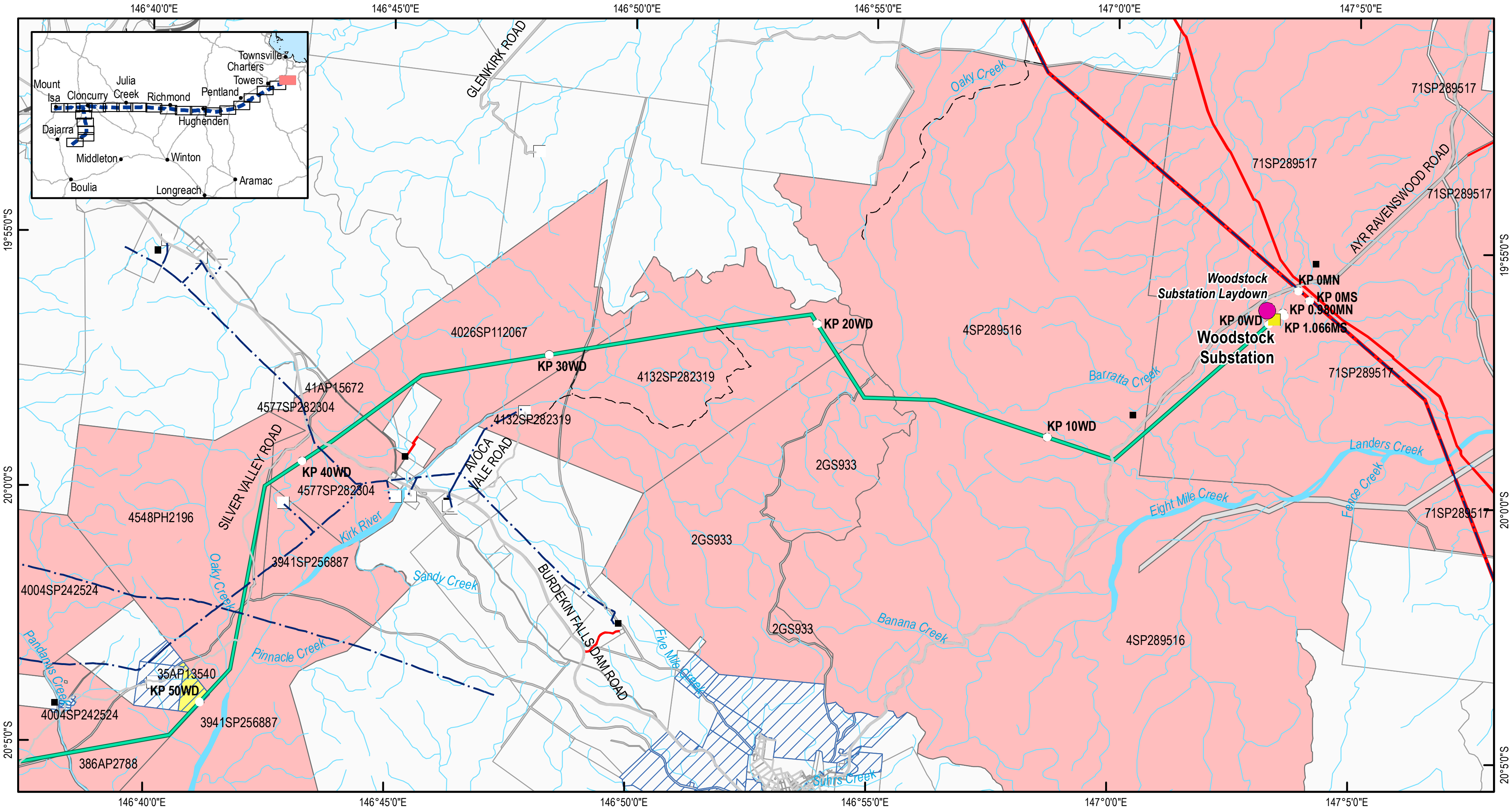
CopperString 2.0 EIS

Figure 2.1 - Project Overview Map Index

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

CopperString 2.0 EIS

Figure 2.1A - Project Overview



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Watercourse Parcel
- Registered Easement
- Strata Title / Covenants
- Kilometre Post
- 120m Easement

0 1 2 3 4 5

Kilometres

Coordinate System
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Notes/Data Sources

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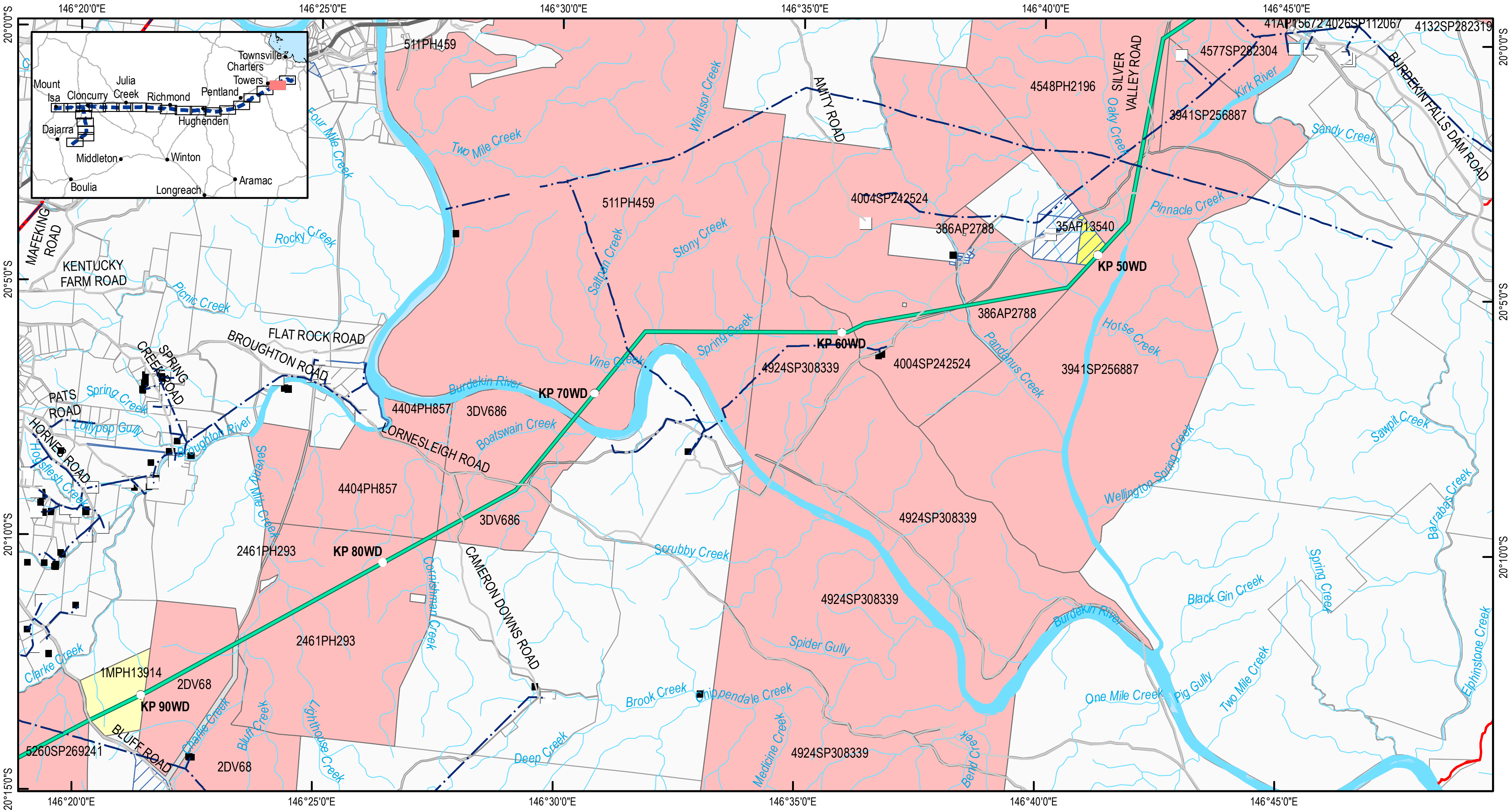

Legend

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- Indicative Camp/Laydown Site
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Figure 2.1B - Project Overview

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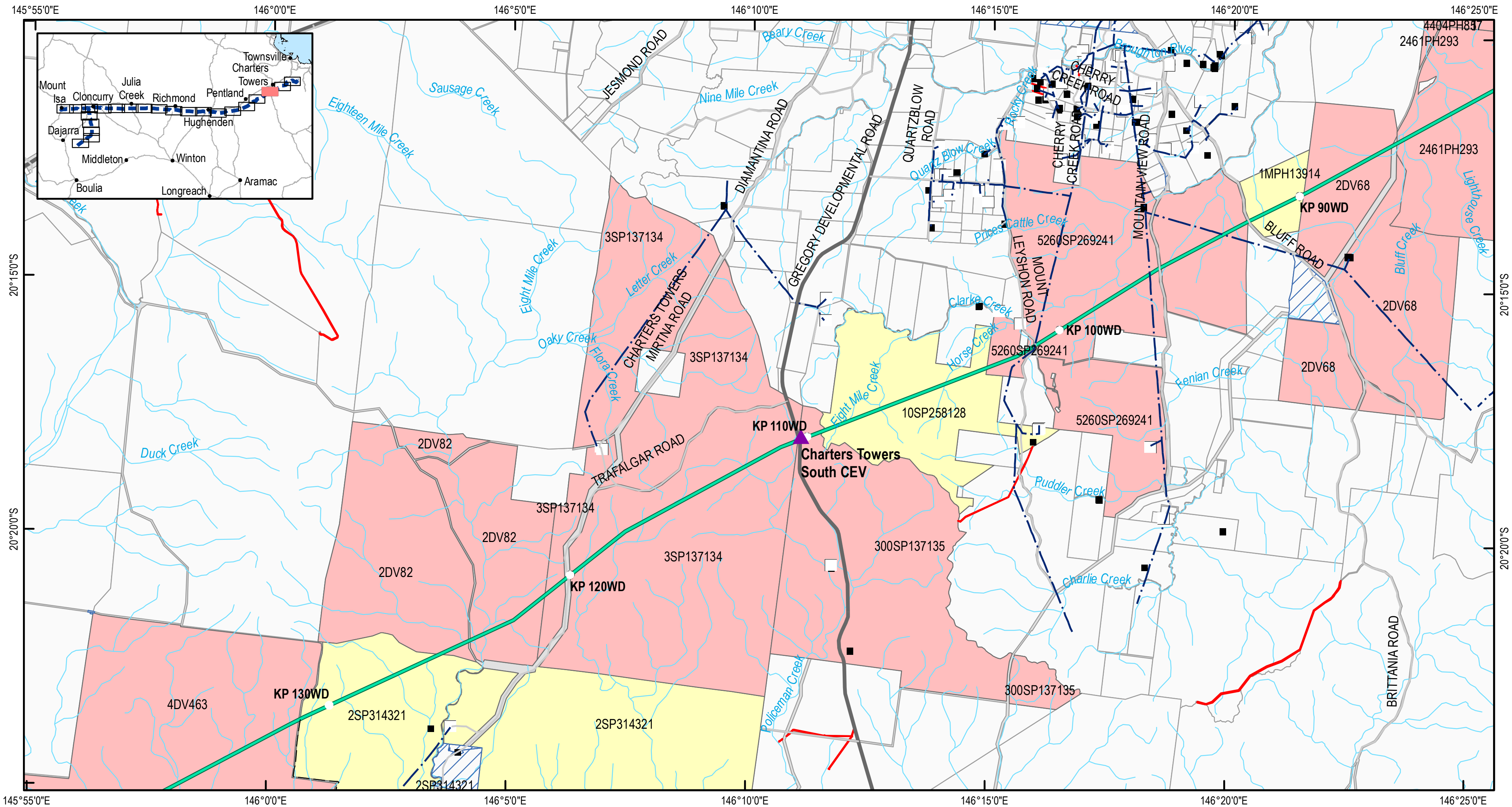

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Kilometres
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CopperString 2.0 EIS

Figure 2.1C - Project Overview

COPPERSTRING 2.0
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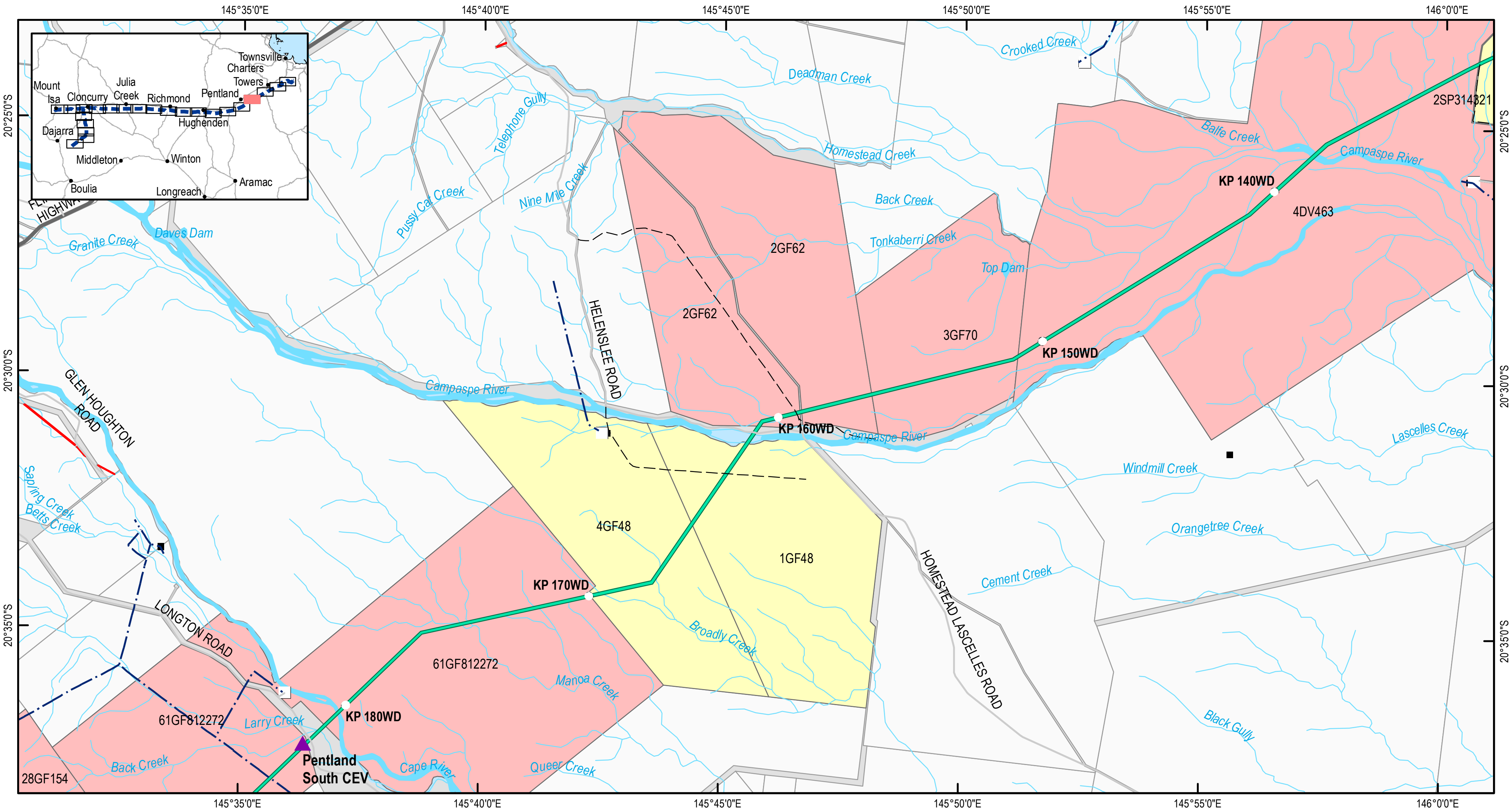

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Figure 2.1D - Project Overview

COPPERSTRING 2.0
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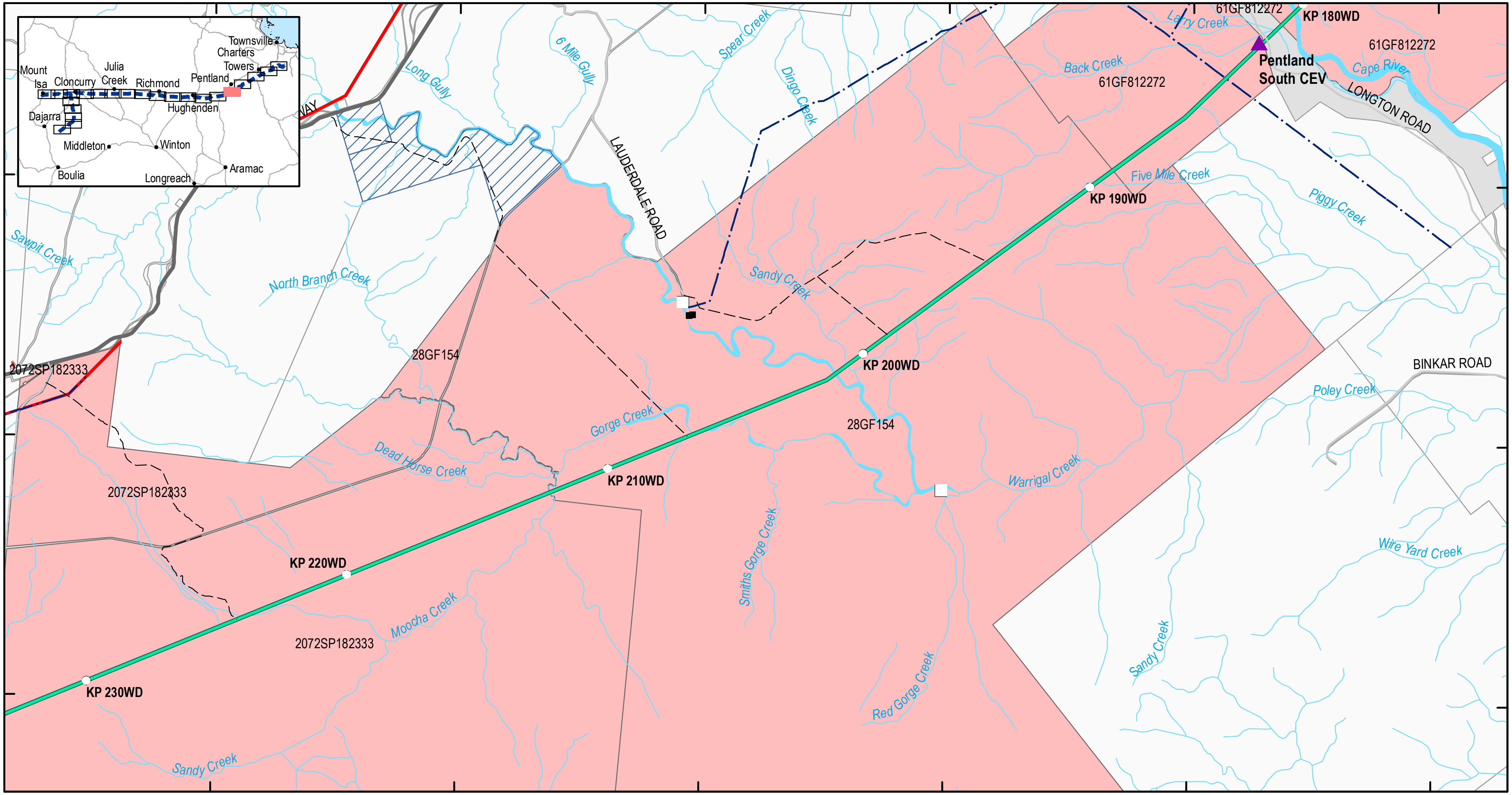

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Figure 2.1E - Project Overview

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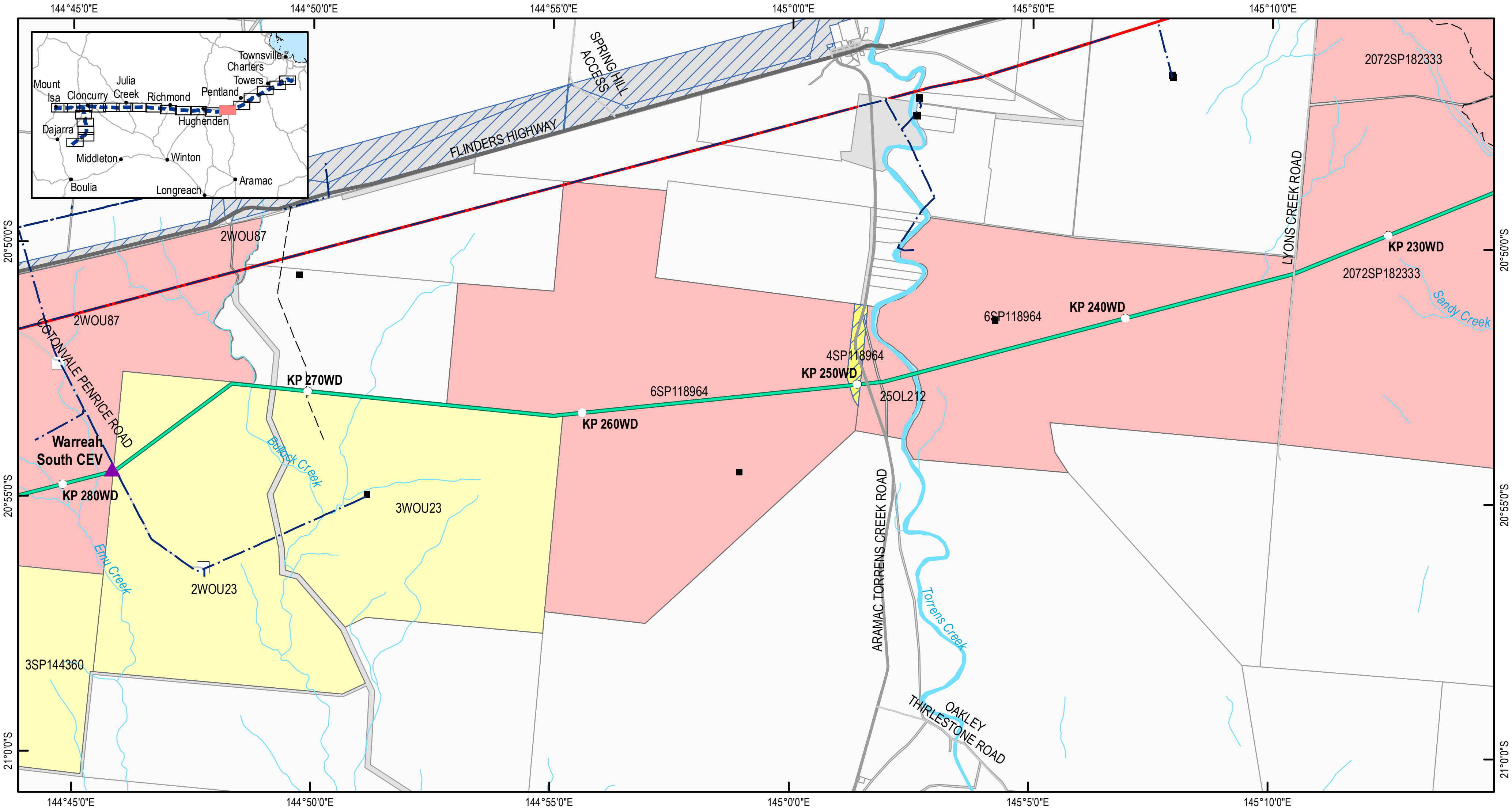

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Figure 2.1F - Project Overview

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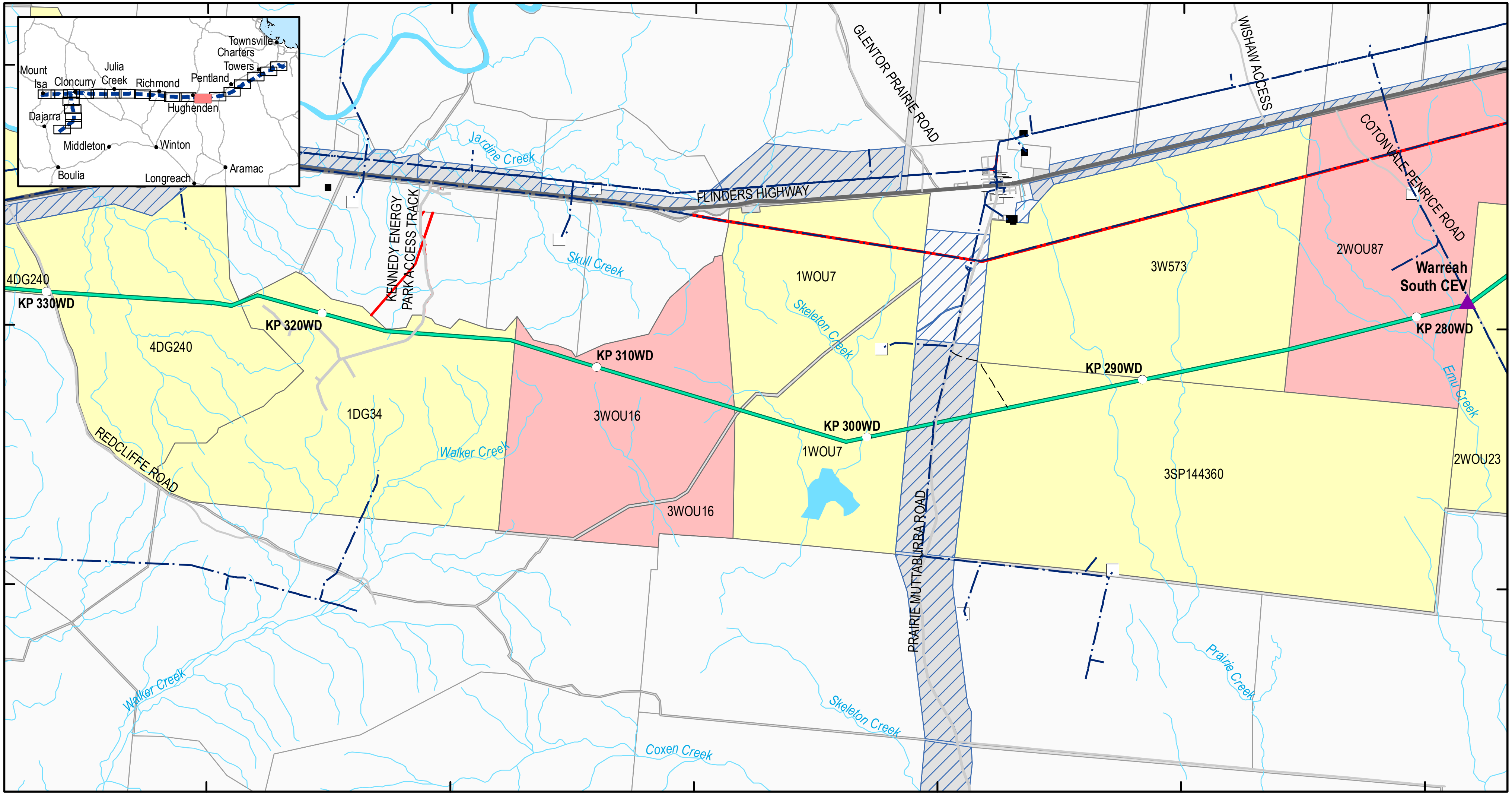
CopperString 2.0 EIS

Figure 2.1G - Project Overview



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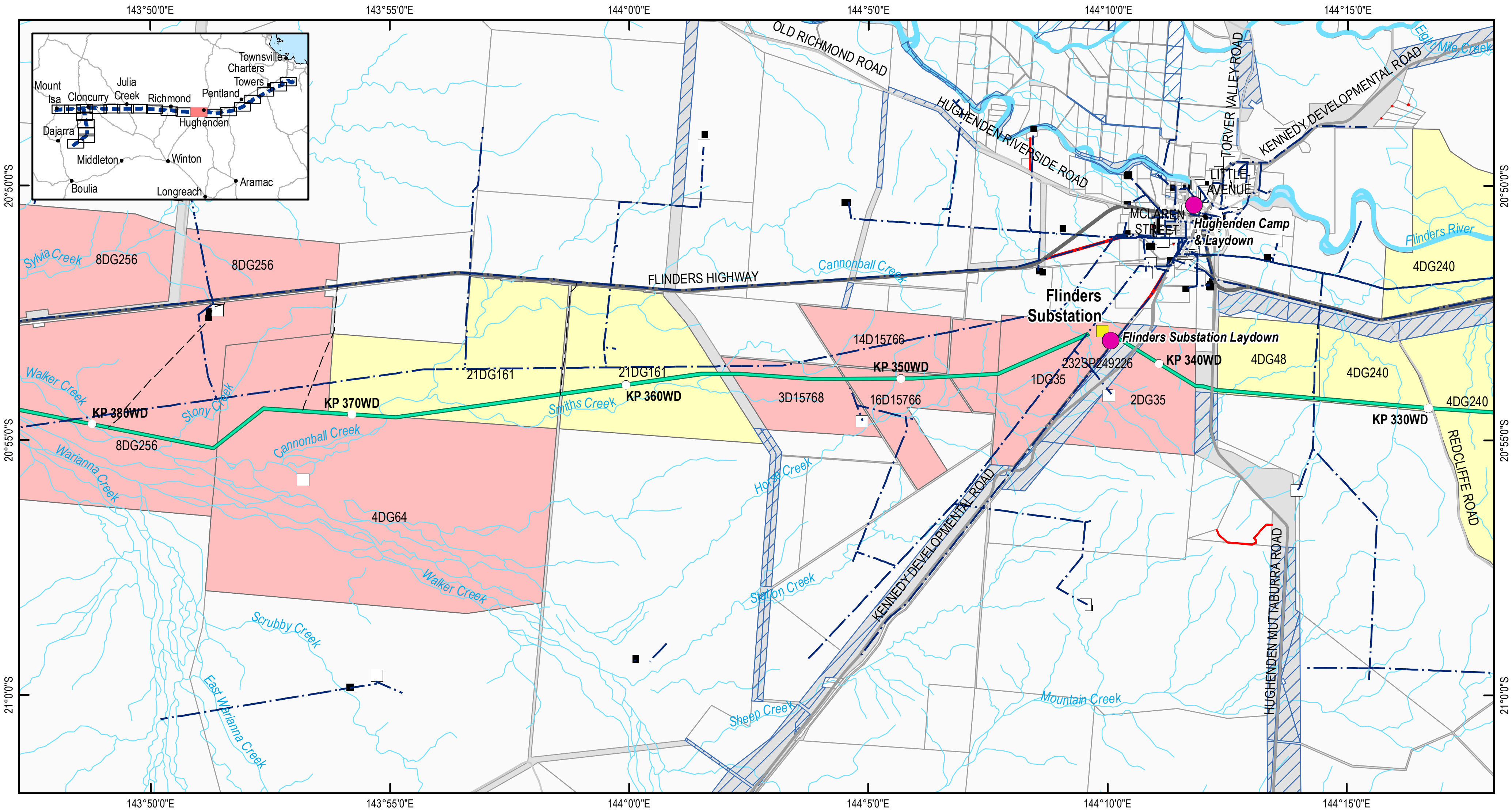

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Figure 2.1H - Project Overview

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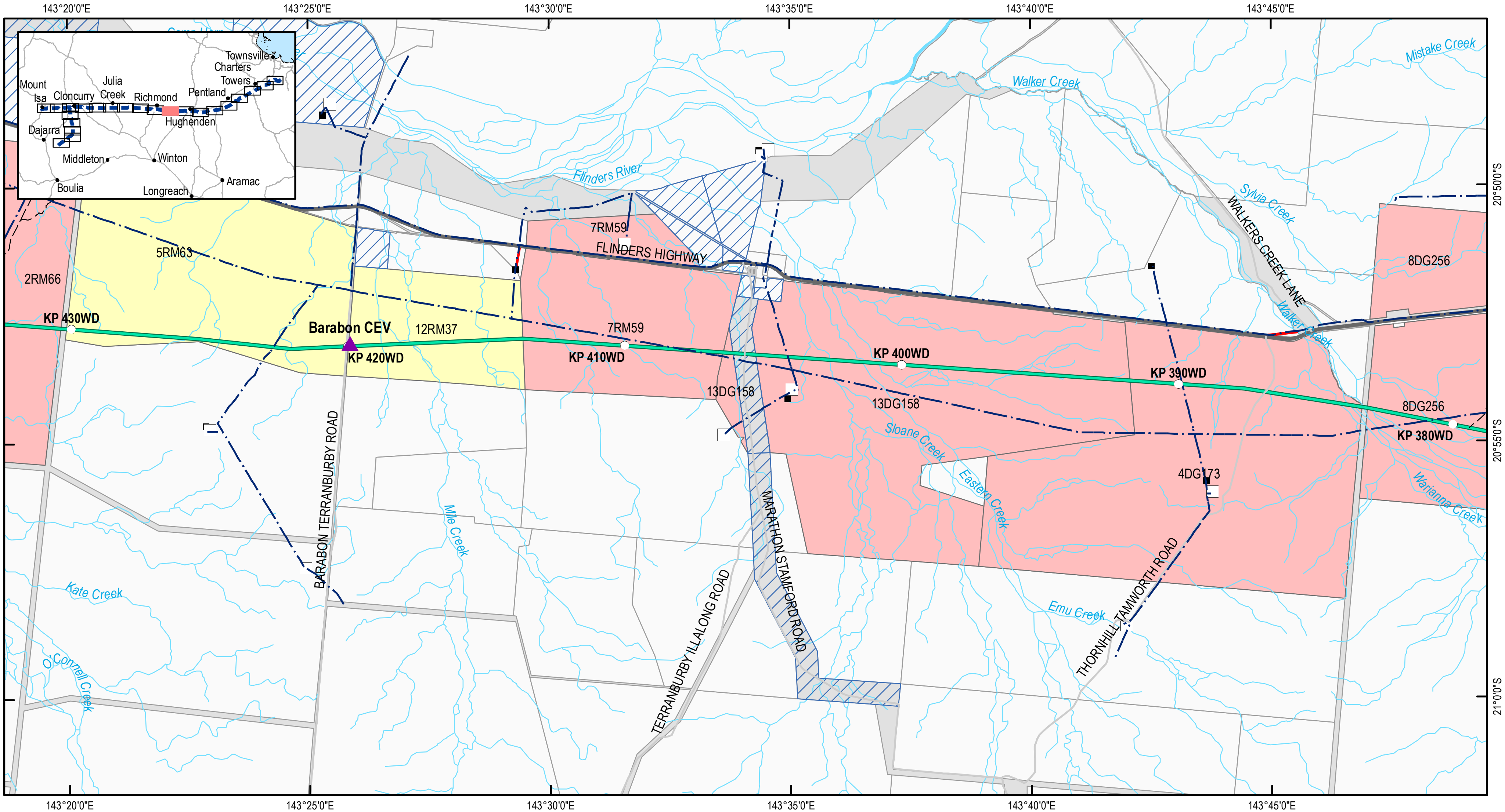

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Figure 2.1l - Project Overview

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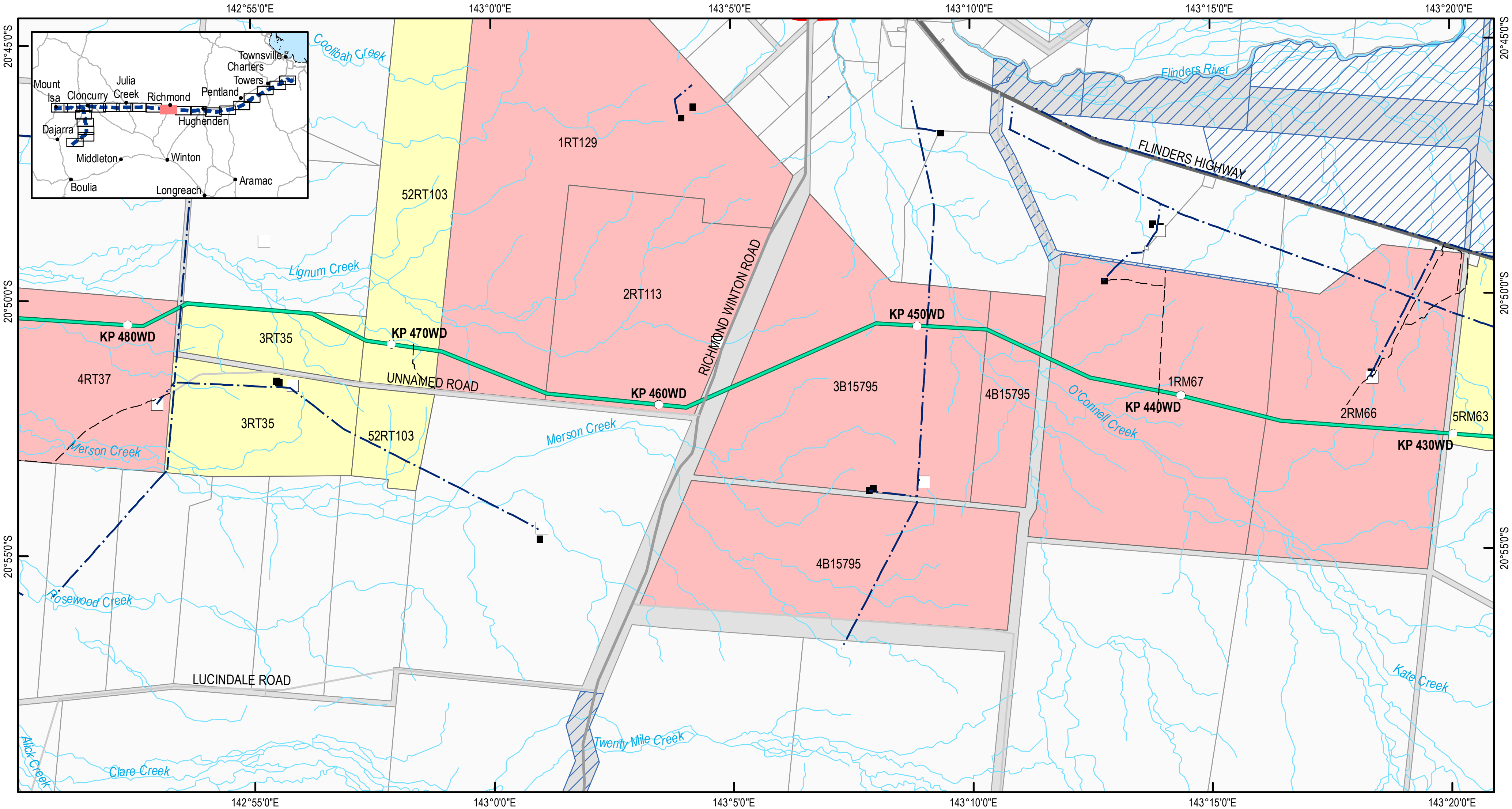
CopperString 2.0 EIS

Figure 2.1J - Project Overview



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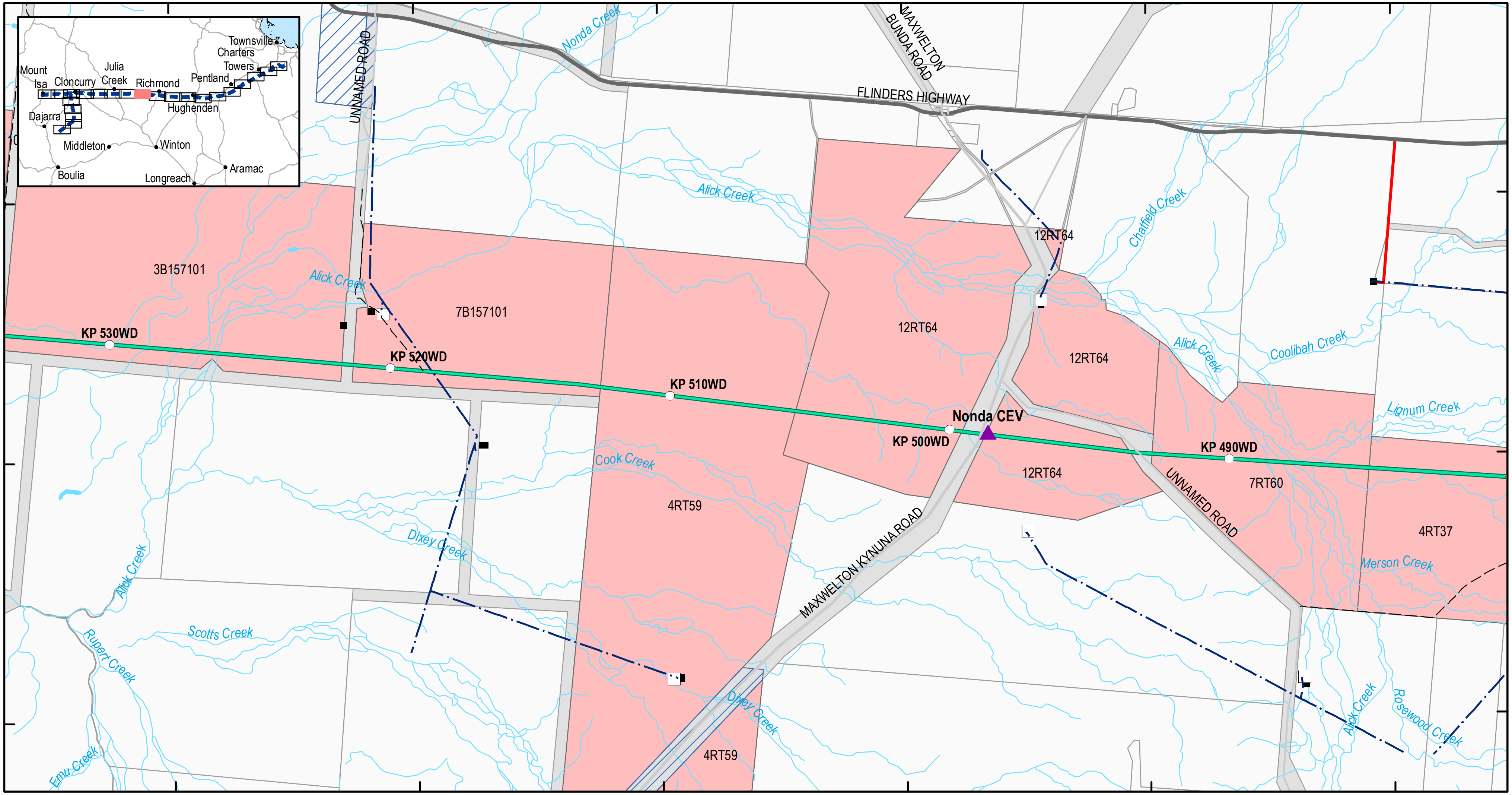

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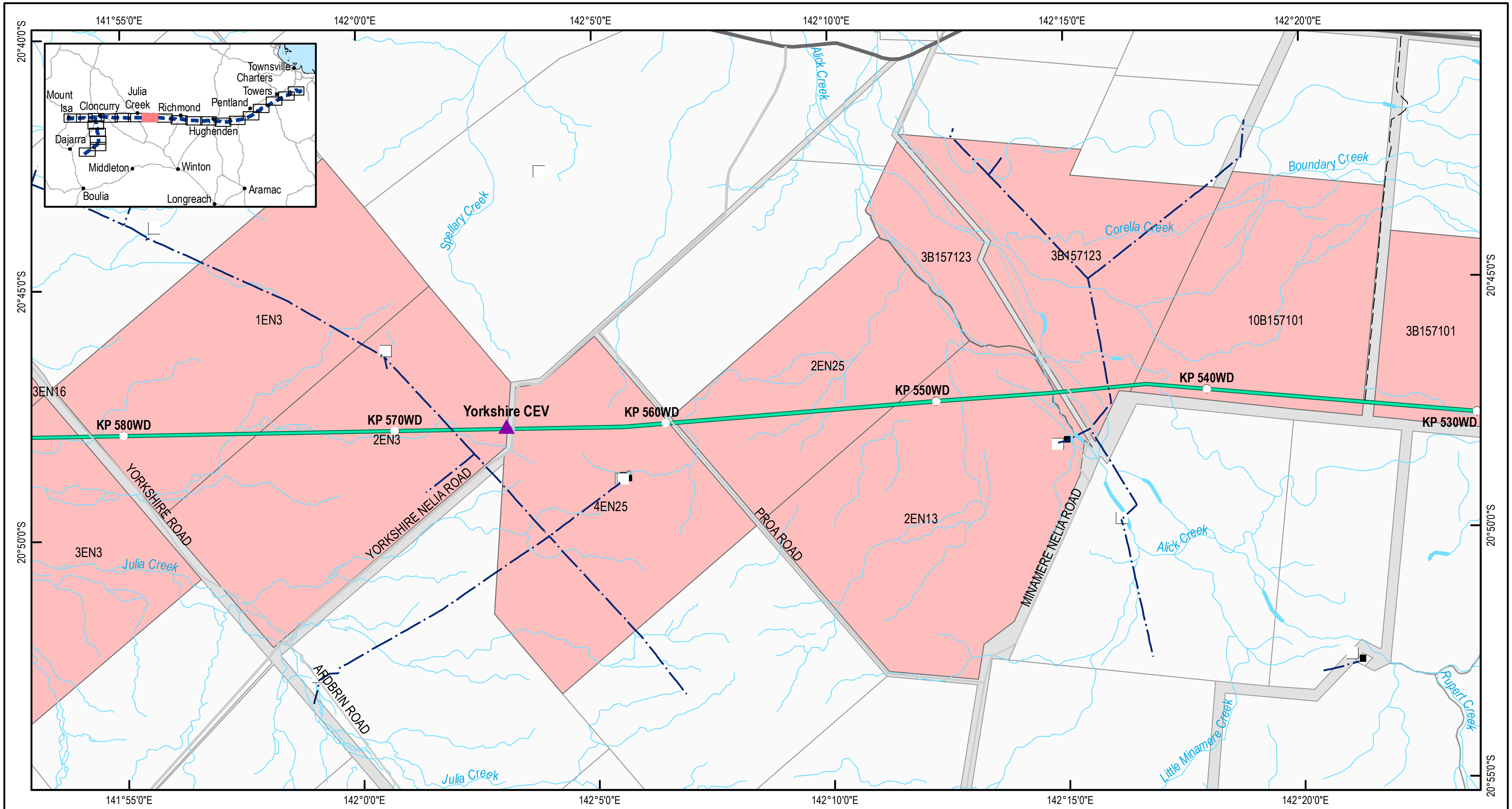
Figure 2.1K - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

CopperString 2.0 EIS

Figure 2.1L - Project Overview



Legend

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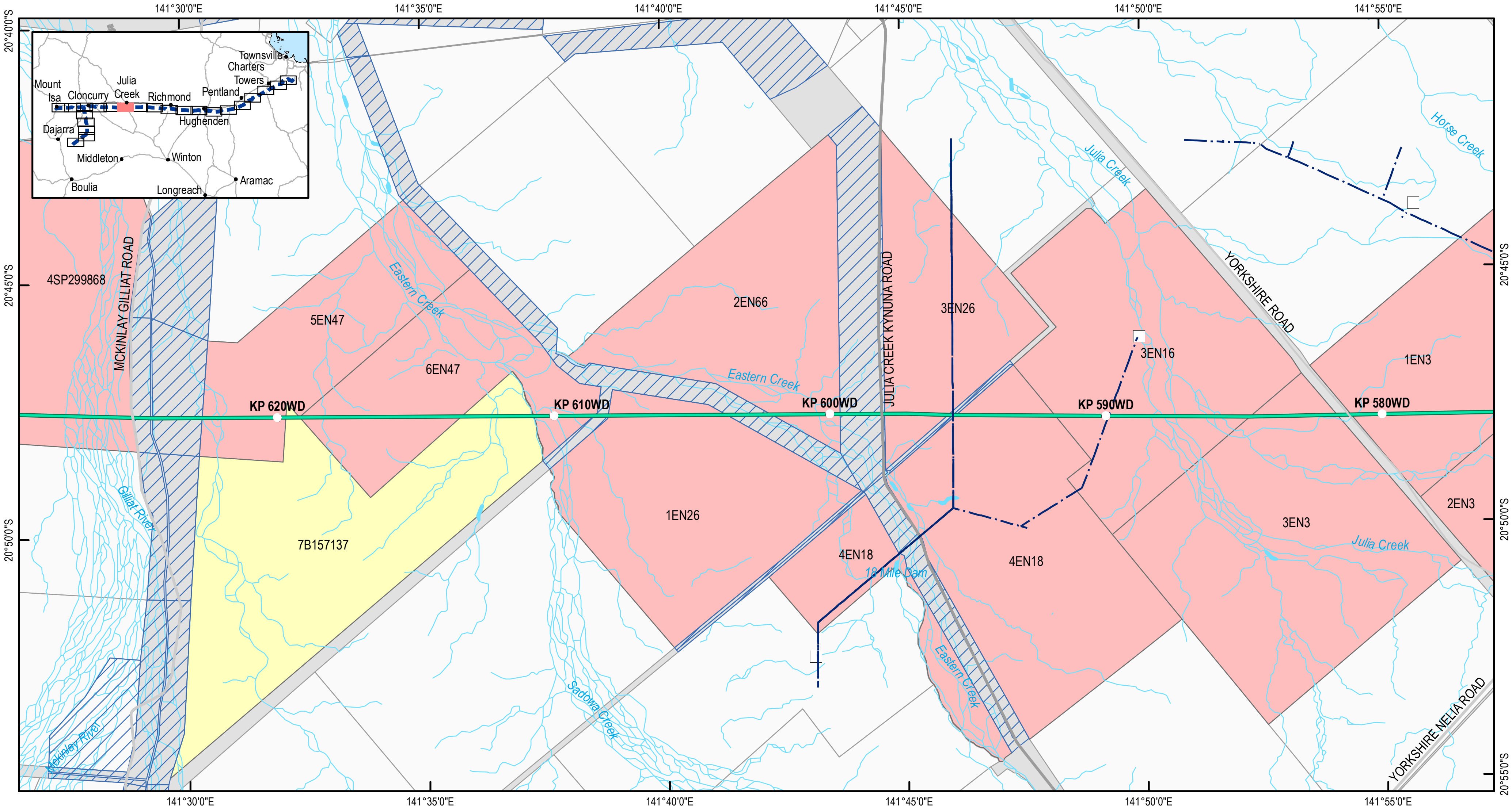

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- 120m Easement

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Kilometres
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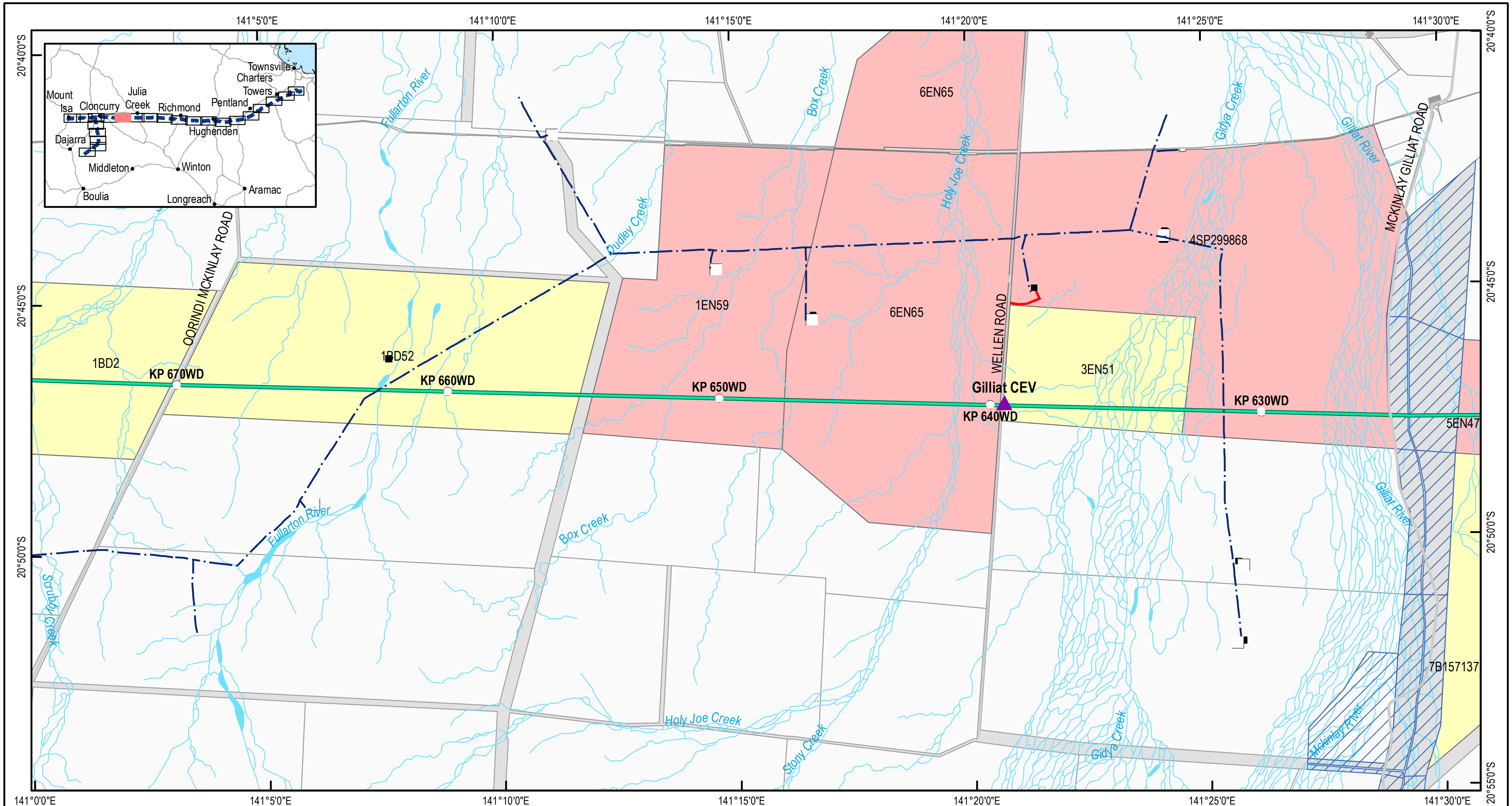
Disclaimer

WKSP Project_Overview_Detail_RevC

CopperString 2.0 EIS

Figure 2.1M - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

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- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
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CopperString 2.0 EIS

Figure 2.1N - Project Overview

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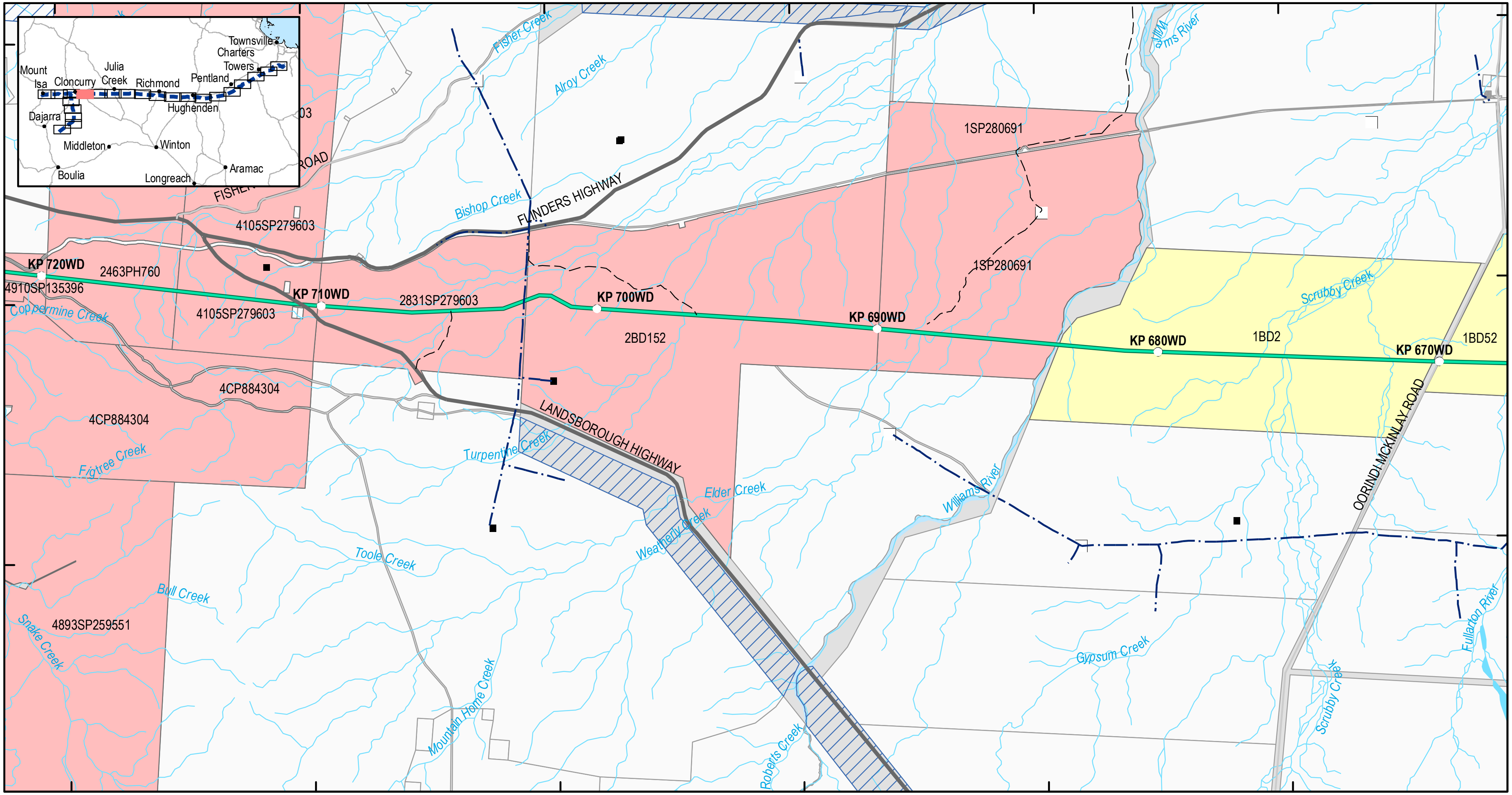
BORN, BRED & OWNED IN NQ



Legend

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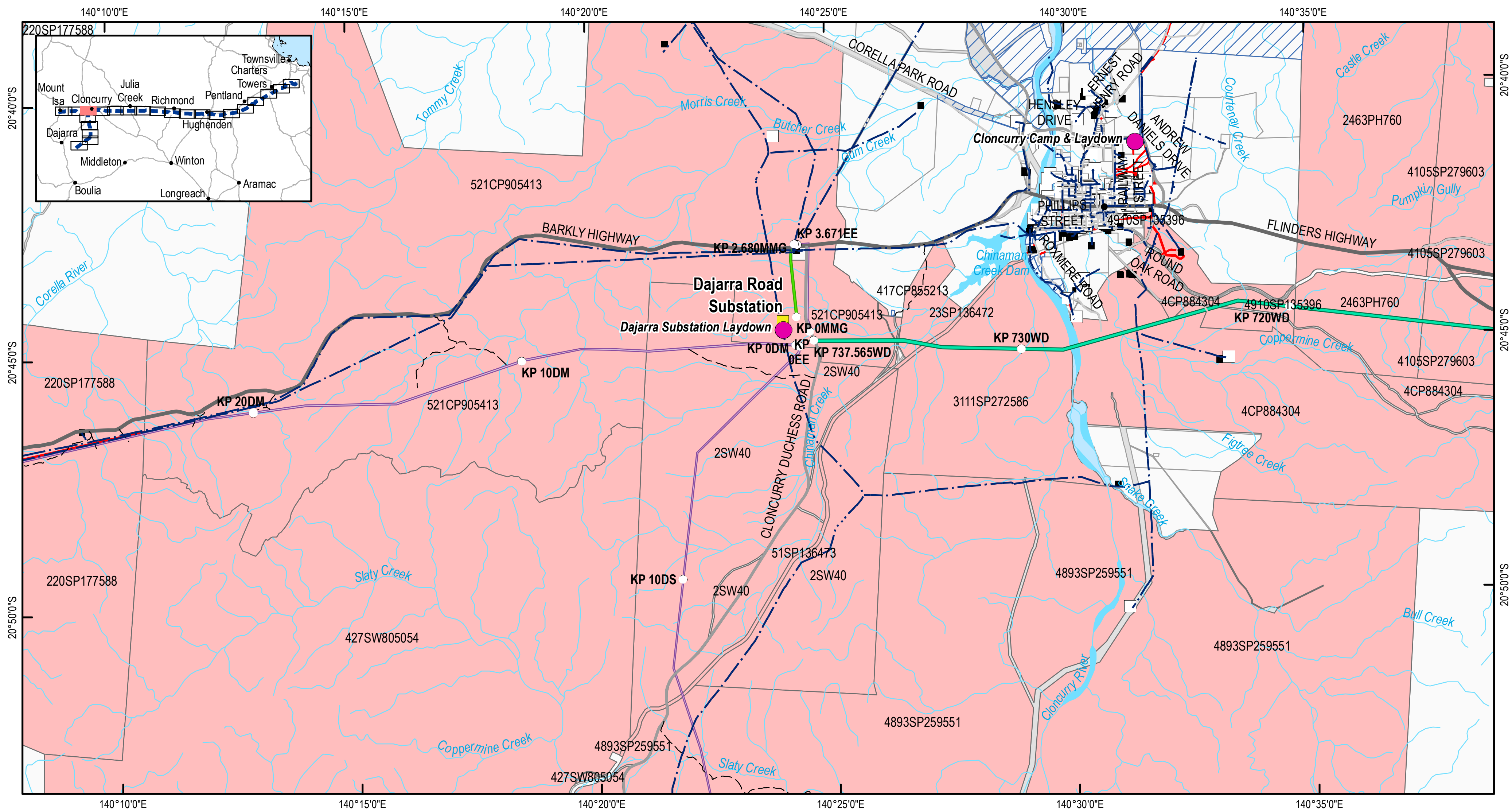
WKSP Project_Overview_Detail_RevC

CopperString 2.0 EIS

Figure 2.10 - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

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Land Tenure

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- Road Reserve
- Watercourse Parcel
- Registered Easement
- Strata Title / Covenants
- Kilometre Post
- 60m Easement
- 80m Easement
- 120m Easement

0 1 2 3 4 5

Kilometres

Coordinate System
MGA1994 Zone 54\55

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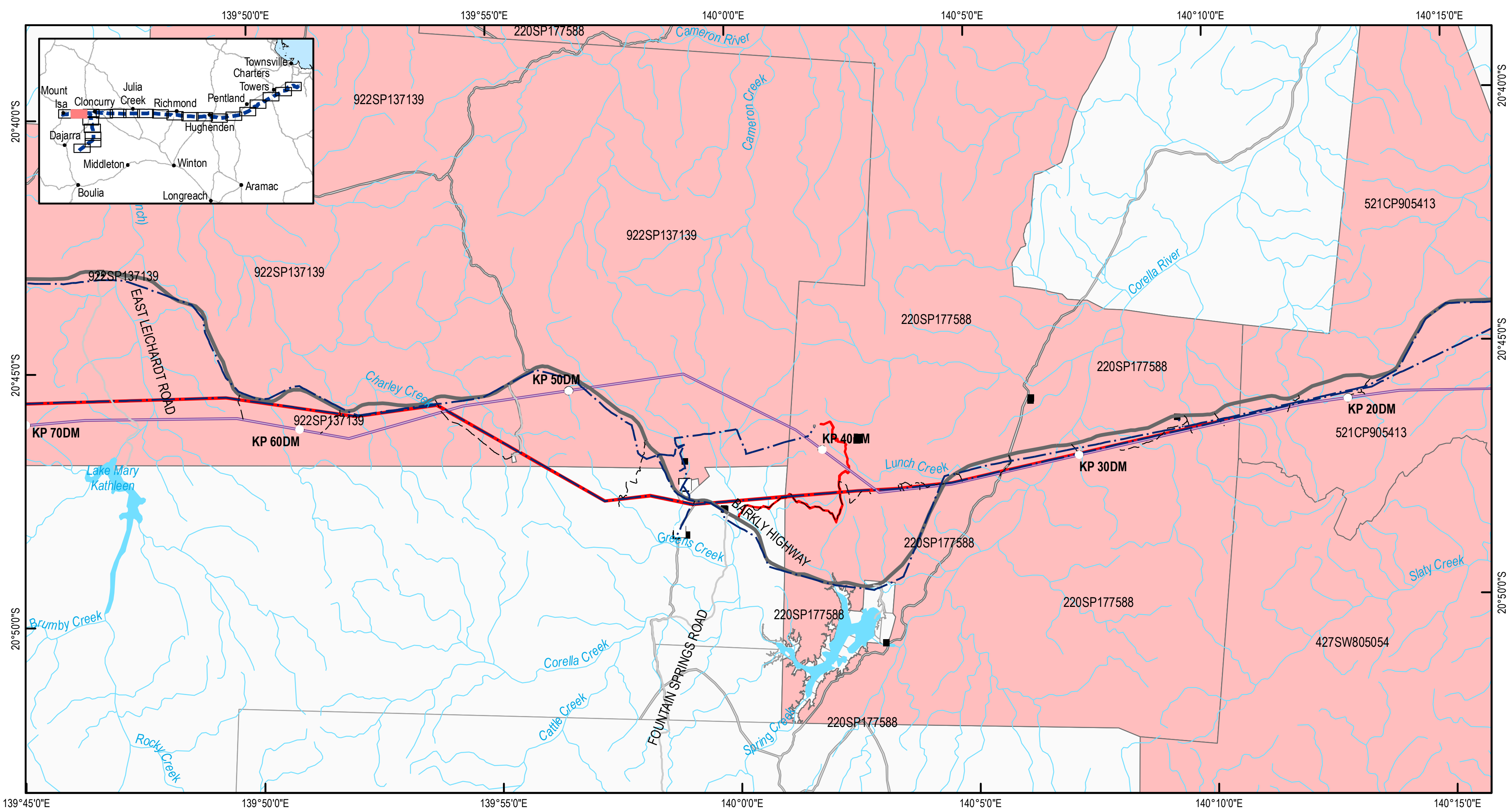
Figure 2.1P - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Registered Easement
- Kilometre Post
- 60m Easement

0 1 2 3 4 5

Kilometres

Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources

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Figure 2.1Q - Project Overview

COPPERSTRING 2.0
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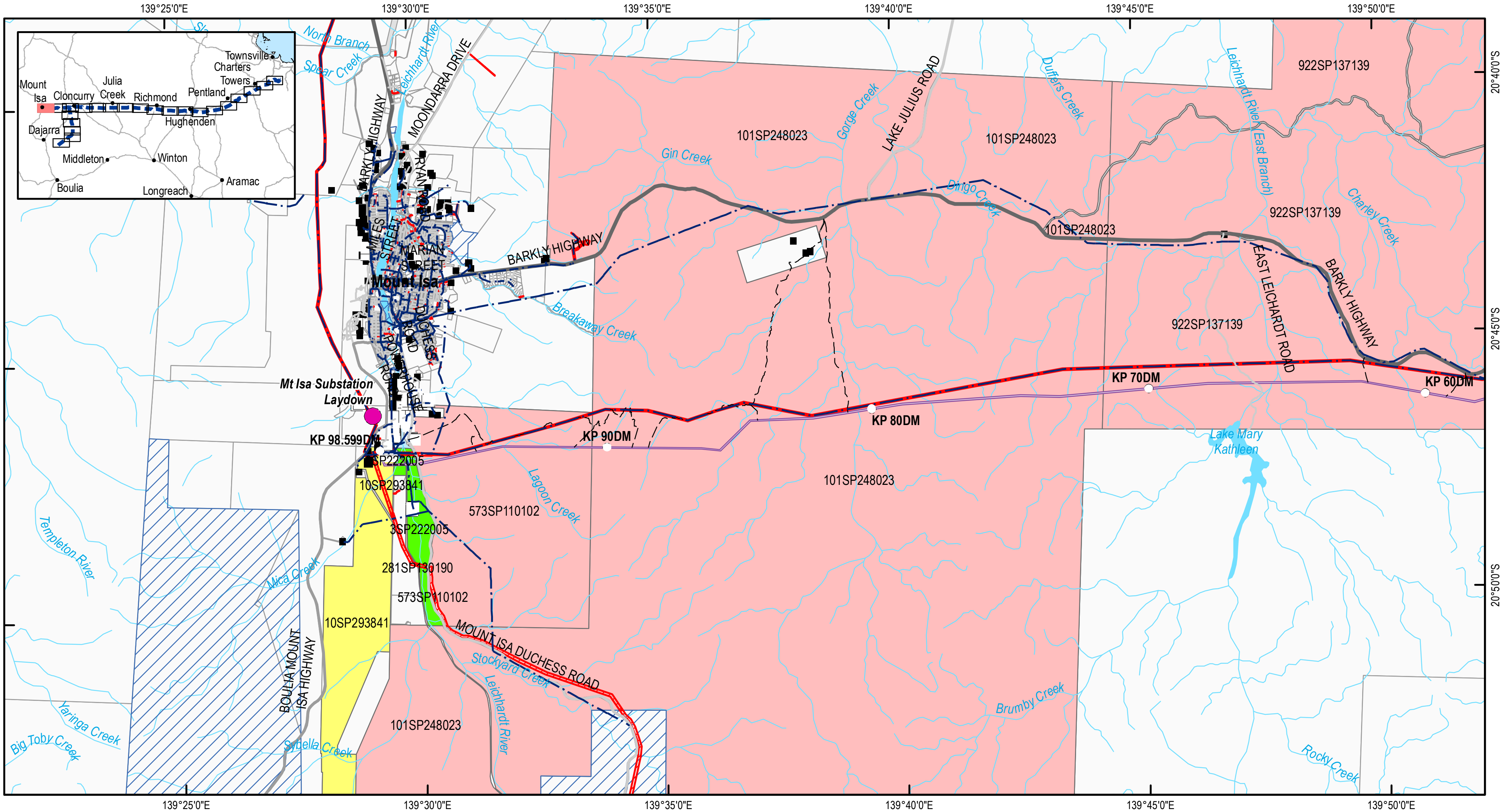

Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Watercourse Parcel
- Registered Easement
- Strata Title / Covenants
- Kilometre Post
- 60m Easement

0 1 2 3 4 5

Kilometres

Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources

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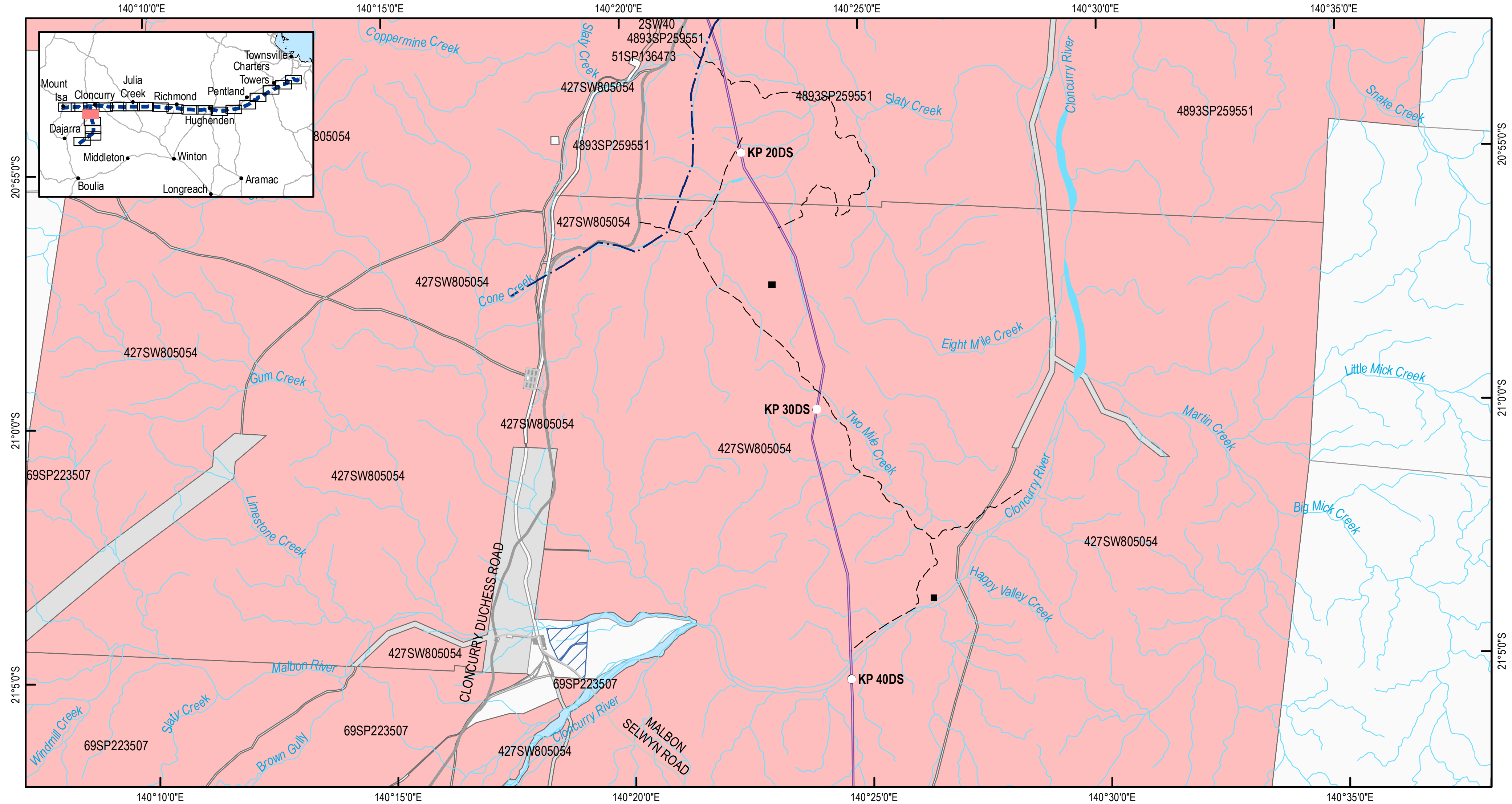
Figure 2.1R - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Watercourse Parcel
- Registered Easement
- Strata Title / Covenants
- Kilometre Post
- 60m Easement

0 1 2 3 4 5

Kilometres

Coordinate System
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Figure 2.1S - Project Overview

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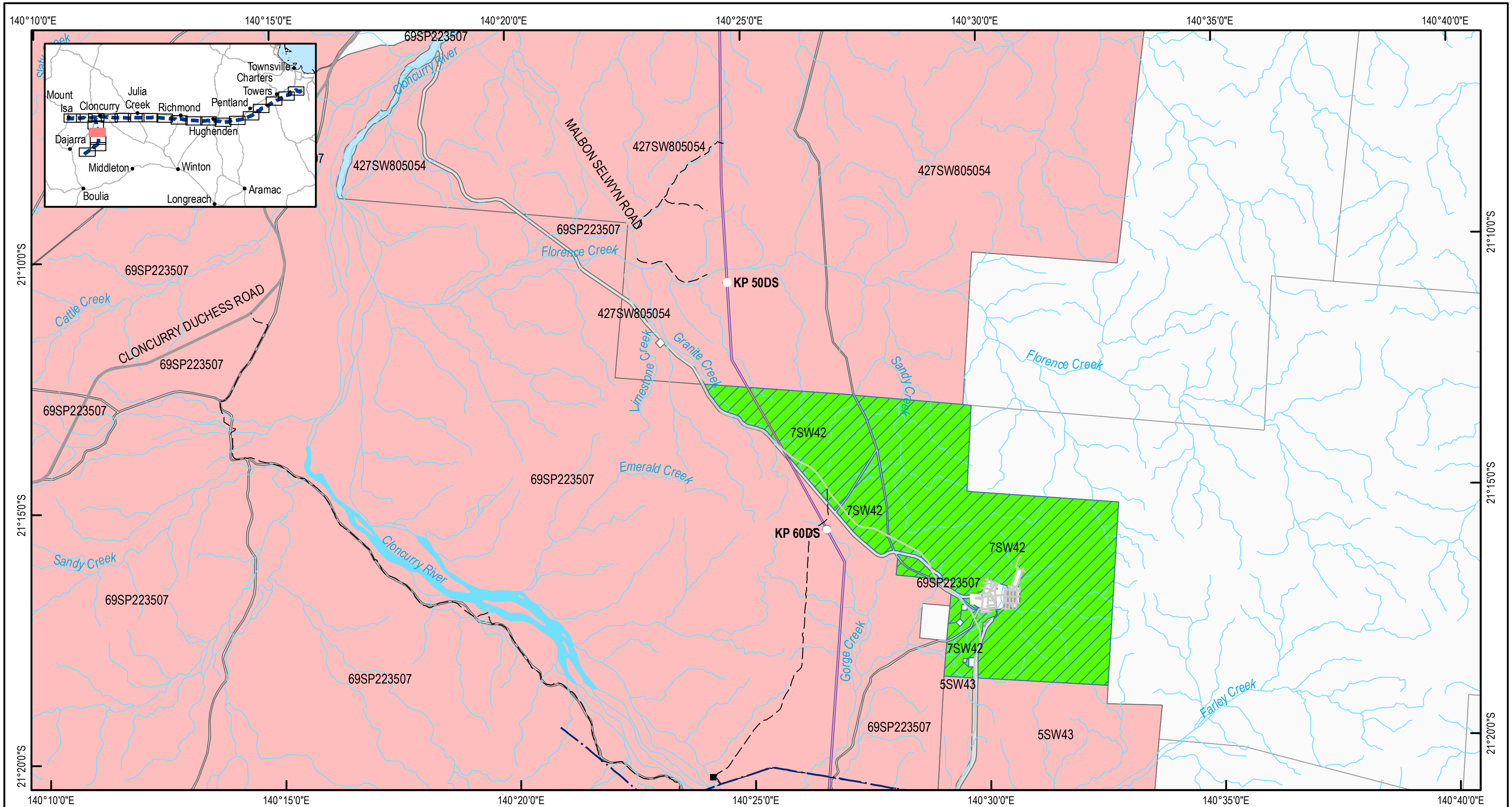
BORN, BRED & OWNED IN NQ



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Watercourse Parcel
- Registered Easement
- Strata Title / Covenants
- Kilometre Post
- 60m Easement

0 1 2 3 4 5

Kilometres

Coordinate System
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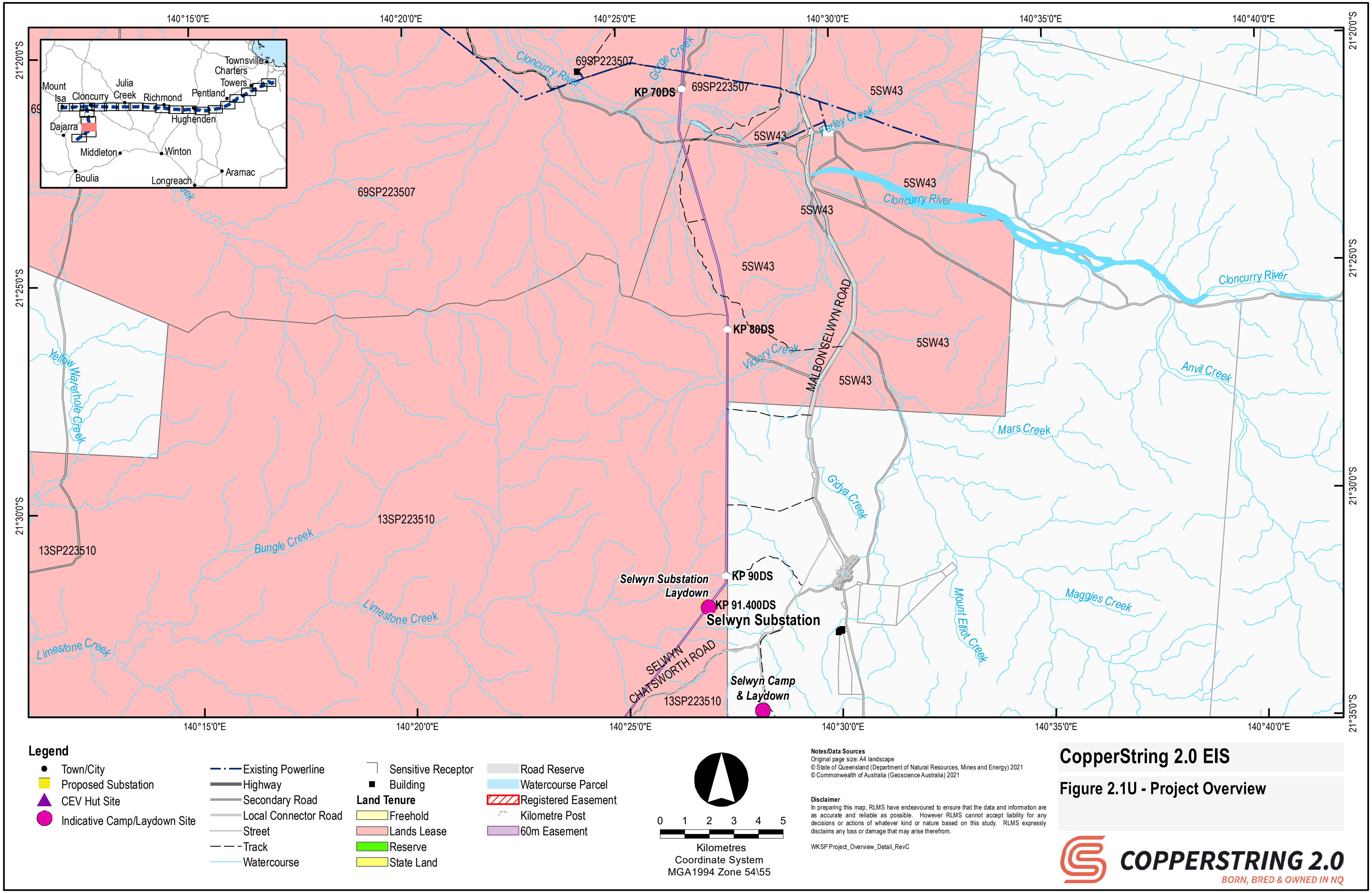
CopperString 2.0 EIS

Figure 2.1T - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



140°15'0"E
140°20'0"E
140°25'0"E
140°30'0"E
140°35'0"E
140°40'0"E
21°20'0"S
21°25'0"S
21°30'0"S
21°35'0"S
Townsville
Charters Towers
Mount Isa
Cloncurry
Julia Creek
Richmond
Pentland
Hughenden
Dajarra
Middleton
Winton
Boulia
Longreach
Aramac
69SP223507
KP 70DS
KP 80DS
KP 90DS
KP 91.400DS
5SW43
13SP223510
Cloncurry River
Gorge Creek
Yellow Waterhole Creek
Victory Creek
MALBON SELWYN ROAD
SELWYN CHATSWORTH ROAD
Anvil Creek
Mars Creek
Gidya Creek
Bungle Creek
Limestone Creek
Maggies Creek
Mount Elliot Creek
Selwyn Substation Laydown
Selwyn Substation
Selwyn Camp & Laydown
Legend
Town/City
Proposed Substation
CEV Hut Site
Indicative Camp/Laydown Site
Existing Powerline
Highway
Secondary Road
Local Connector Road
Street
Track
Watercourse
Sensitive Receptor
Building
Land Tenure
Freehold
Lands Lease
Reserve
State Land
Road Reserve
Watercourse Parcel
Registered Easement
Kilometre Post
60m Easement
0 1 2 3 4 5
Kilometres
Coordinate System
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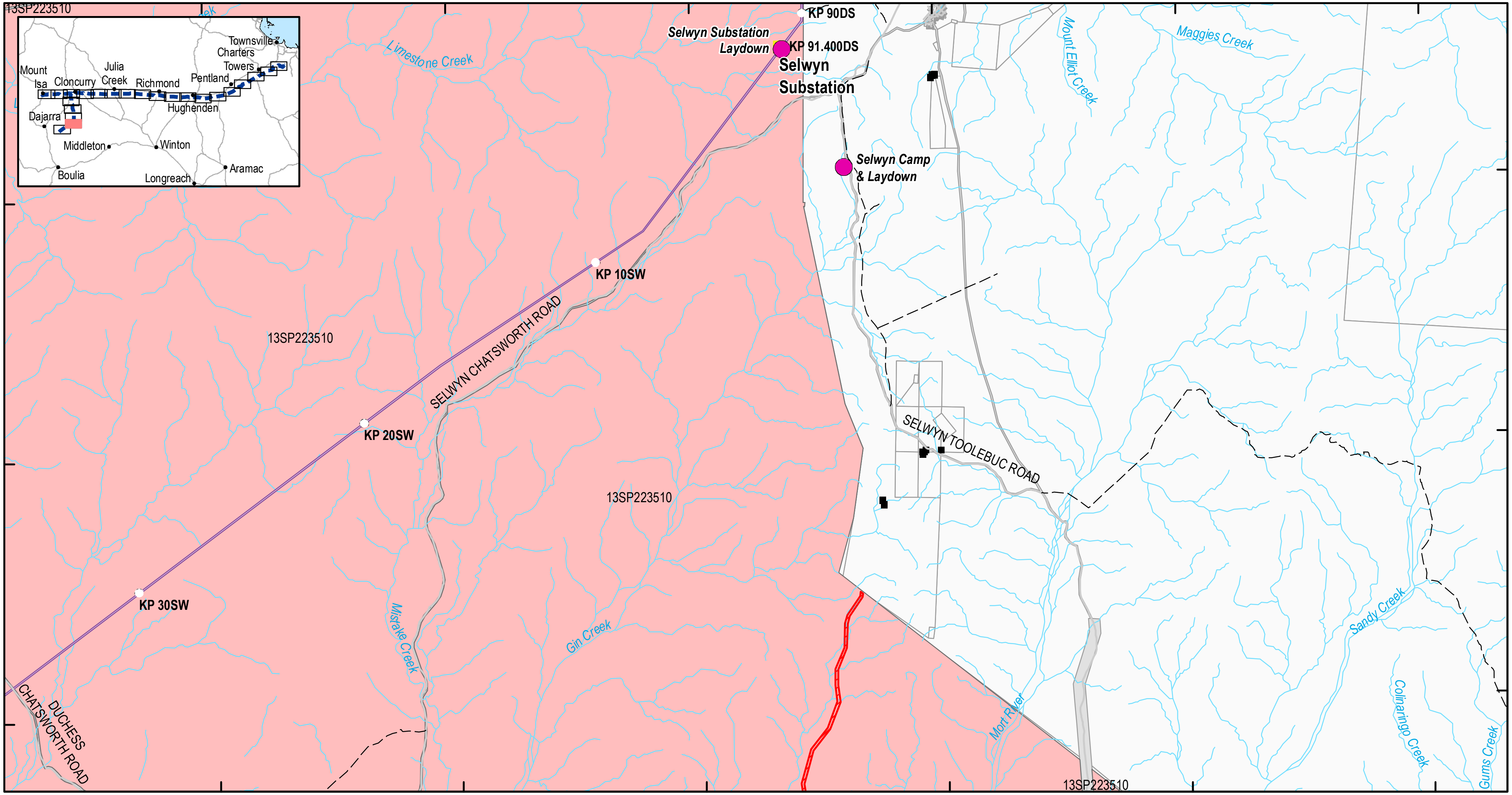
WKSP Project_Overview_Detail_RevC
CopperString 2.0 EIS
Figure 2.1U - Project Overview
COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Registered Easement
- Kilometre Post
- 60m Easement

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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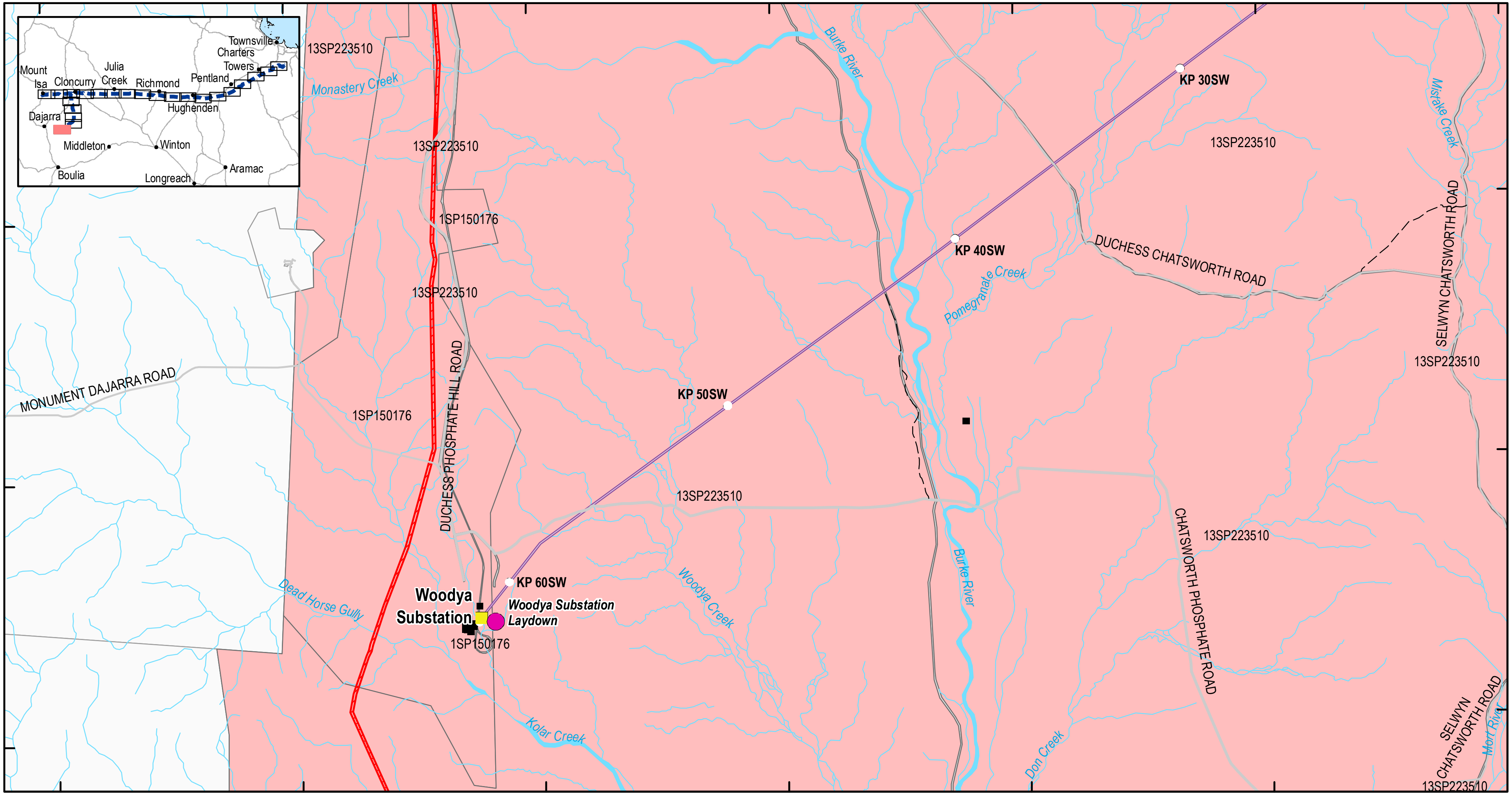
WKSP Project_Overview_Detail_RevC

CopperString 2.0 EIS

Figure 2.1V - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Indicative Camp/Laydown Site
- Existing Powerline
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track
- Watercourse
- Sensitive Receptor
- Building

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land
- Road Reserve
- Registered Easement
- Kilometre Post
- 60m Easement

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WKSP Project_Overview_Detail_RevC

CopperString 2.0 EIS

Figure 2.1W - Project Overview

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

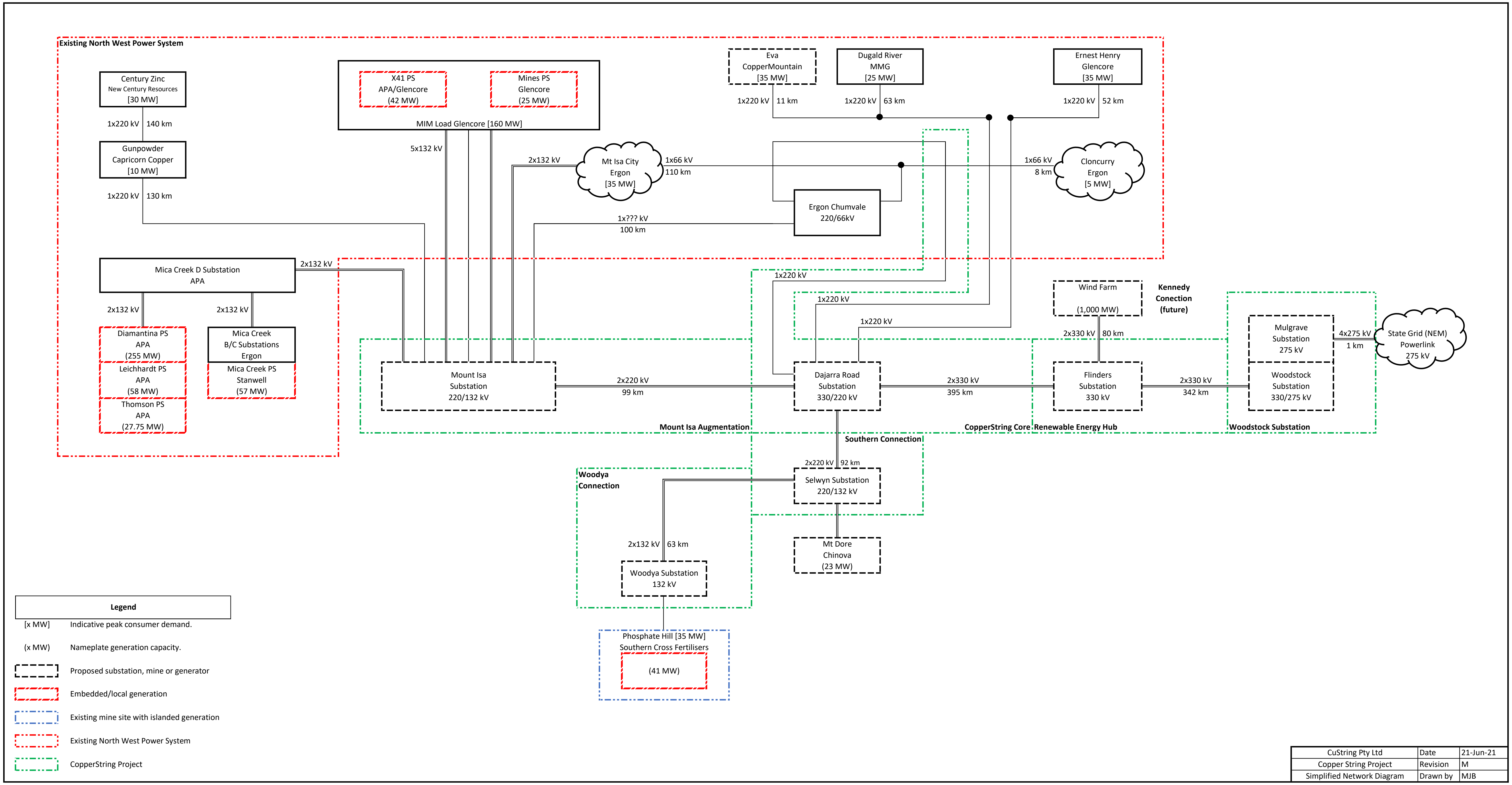


Figure 1-2 Simplified Network Diagram

2.1.3 Project history

The CopperString 1.0 Project was developed as a proposal in 2007 around the time of the Northern Economic Triangle Infrastructure Plan 2007-2012 and, since the Sims Review (2009), the major energy users of the NWPS have engaged with CuString on a commercial basis as the preferred transmission project.

On 18 June 2010, the Coordinator-General declared the CopperString 1.0 Project to be a 'significant project for which an EIS is required' under Section 26(1)(a) of the *State Development and Public Works Organisation Act 1971* (SDWPO Act).

On 29 August 2010, the Commonwealth Minister for Environment Protection, Water, Heritage and the Arts determined that the project was a 'controlled action' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to the potential impact on matters of national environmental significance. Consequently, the project required assessment and approval under the EPBC Act, which was to be conducted under a bilateral agreement between the Australian and Queensland Governments.

The CopperString 1.0 Project was approved as an 'infrastructure facility of significance' (IFS), under the SDPWO Act, on 25 May 2011 as its significance was recognised, particularly economically and socially, to Queensland and the north and north-west statistical divisions, including the local government areas in which the project was to be constructed. Under Section 125 of the SDPWO Act, a project's declaration as an IFS gave the Coordinator-General the power to take land for an infrastructure facility.

Baseline data had been collected and an assessment of impacts undertaken for the CopperString 1.0 Project when the project was suspended in 2011.

The Project has subsequently been revisited and in April 2019, the CopperString 2.0 Project was designated as a coordinated project under the SDPWO Act (note that the term 'coordinated project' has replaced the previous designation 'significant project'). The decision was published in the Queensland Government Gazette [vol 380, No. 93 of 26 April 2019].

Amendments to the SDPWO Act, that took effect on 21 December 2012, replaced the term 'infrastructure facility of significance' with 'private infrastructure facility', meaning Section 125 of the SDPWO Act now gives the Coordinator-General the power to take land for a private infrastructure facility; however, existing IFS designations remain recognised.

Additionally, the Project was declared to be a 'controlled action' under the EPBC Act on 14 May 2019. As such, the Project will be assessed under the bilateral agreement between the Queensland and Commonwealth Governments.

The Draft Terms of Reference for the EIS were placed on public display from Monday 8 July 2019 to Friday 2 August 2019.

2.1.4 Project objectives

The objective of the Project is to construct an electricity transmission system that will facilitate access to the state electricity grid and participation in the NEM for electricity consumers and generators along the Project corridor selection, including existing connections, and future connections to islanded electrical systems, such as the NWPS and isolated mines in the NWMP. This will consequently provide benefits to the region through reliable and more competitively priced electricity.

The Project will also facilitate development of the proposed North Queensland Clean Energy Hub, a Queensland Government initiative to develop strategic electricity transmission infrastructure to host renewable energy transmission from significant wind and solar resources in north Queensland.

2.1.5 Expected capital expenditure

The Project is estimated to have a capital expenditure of approximately $1.75 billion.

2.2 Rationale for the project

2.2.1 Overview

The NWMP is the dominant source of base metals in Queensland and an extremely prospective, mineral rich region. The geographic remoteness of the region however has historically constrained its development. Although early projects in the region developed their own energy and transport infrastructure, some regional infrastructure has been developed. Current energy prices (electricity and gas) in the NWPS are high by national and international standards and supply options are limited. Access to competitively priced electricity, through a transmission network with the capacity to both import and export electricity, will significantly contribute to the prolonged economic development of the region, with considerable social benefits for local communities.

The Project traverses an identified region of significant renewable energy resources that are currently constrained by the lack of access to the state electricity grid. Connection to the state electricity grid and participation in the NEM would improve the economic feasibility of these projects.

2.2.2 Commonwealth Government support

In 2009, the Commonwealth Government identified the extension of the national electricity grid to the NWMP as a national infrastructure priority, in the report National Infrastructure Priorities: Infrastructure for an economically, socially, and environmentally sustainable future (Infrastructure Australia, 2009).

The ongoing development of the NEM requires the establishment of new generation, including wind and solar based renewables.

The Australian Government published Our North, Our Future White Paper on Developing Northern Australia in 2015. The white paper identifies that:

- Infrastructure plays an integral role in unlocking economic opportunities.
- The correct infrastructure can be transformative for regions.
- Conversely, wrong infrastructure can waste resources and lock communities into poor outcomes.
- There are significant infrastructure gaps throughout the region.
- Outside of electricity networks, towns and cities run on stand-alone power systems (off grid).
- A commitment by the Commonwealth Government to ensure northern Australia has the appropriate infrastructure to support economic and population growth.
- Identification that public and private sector investment is required to deliver the stated goal of developing northern Australia.

The Project is consistent with the White Paper. The development of the Project will support the following:

- Access to competitively priced energy, which will further diminish the risk of energy price instability from a single primary source.
- Increased resource exploration in north-west Queensland (NWQ) by providing competitive and reliable energy supply for the processing of products.
- Access to the state electricity grid by small mining operations that will decrease reliance on diesel power generation.
- Decreased risk of supply interruptions to industrial users and communities.

The economic development opportunities that will result from the Project will apply to all sectors of the economy including mining, agriculture, manufacturing and processing, and residential. The Project will support and stimulate both domestic and export opportunities.

The Project will provide direct employment opportunities during construction and operation. It is anticipated that 750 people will be employed during the construction of the Project and 30 people will be required to operate and maintain the infrastructure.

Indirect employment opportunities will occur as a result of the construction and commissioning of the Project by means of further regional development and an expansion to the exploration, mining, and resources processing of the region, due to the provision of competitive and reliable electricity. The paper, Re-powering the Townsville & North West Minerals Province Industrial Economy, estimates an average of 3,560 full-time equivalent jobs for at least 25 years across the Townsville to NWMP corridor, as a result of increased production in the NWMP supported by providing access to the NEM via the Project (CuString, 2020).

In the Australian Government's 2018-19 Mid-Year Economic and Fiscal Outlook, the Government provided $4.7 million to CuString Pty Ltd to support the development of the CopperString 2.0 Project.

Following the initial grant, the Australian Government's 2020-21 Budget, JobMaker Plan: Improving energy affordability and reliability, indicated the Government will provide funding from 2020-21 to support investment in dispatchable generation and reliable energy supplies in the NEM. This includes funding for the CopperString 2.0 Project to progress to a final investment decision, to stimulate the economy and create jobs in regional Queensland.

The Council of Australian Government (COAG) Energy Council (superseded in May 2020 by the Energy National Cabinet Reform Committee) has recognised the challenge many renewable energy projects face in accessing the NEM and the importance of facilitating the efficient expansion of the electricity supply network to address this issue. At the COAG Energy Council meeting on 20 March 2020, ministers discussed renewable energy zone connections and requested that rule changes be developed to implement renewable energy zones (COAG Energy Council, 2020a). The COAG Energy Council recognised that the forecast of new utility scale renewable generation capacity is greater than the currently available hosting capacity in the relevant areas of the grid (COAG Energy Council, 2020b).

The Project provides an expansion of the state electricity grid consistent with the objective of the COAG Energy Council to connect recognised renewable energy resources in northern Queensland. The access advantages that will be provided to the clean energy corridor between Townsville and Mount Isa will assist projects that will contribute to the Queensland Government and the Australian Government's Renewable Energy Targets and meeting the needs of future national carbon emissions reduction obligations or schemes.

2.2.3 Queensland government support

The Queensland Government has recognised the development potential of the NWMP. This region is a world class resources region and is home to some of the worlds' super giant ore bodies such as Mount Isa's lead-zinc-silver ore body and it is the primary driver of regional employment and economic growth. The Queensland Government has recognised there are challenges that may prevent the ongoing economic development of the region. There is a long history of government initiatives associated with the development of the region, as shown in Table 2-1.

Table 2-1 Queensland government support

Date	Development plan or publication
Mid-to-late 1990s	Northwest Queensland Development Initiative
2007	Northern Economic Triangle Infrastructure Plan (NET Infrastructure Plan)
2007	NET Infrastructure Plan Progress Report (progressing priority actions)
2009	Review of North West Queensland Energy Delivery (the Sims Review)
2010-2013	North West Regional Plan
November 2015	North West Minerals Province Taskforce
June 2016	Advancing North Queensland: Investing in the future of the north
June 2017	Powering Queensland Plan: an integrated energy strategy for the state including the Powering North Queensland Plan
July 2017	Strategic Blueprint for Queensland's North West Minerals Province
May 2020	Queensland's Economic Recovery Strategy: Unite and Recover for Queensland Jobs

In 2007, the Queensland Government developed the NET Infrastructure Plan, which included strategies to drive economic development in the geographic triangle linking Townsville, Mount Isa and Bowen, with a focus on mining, minerals processing, and industrial development over the next 50 years. Providing access to competitively priced and reliable energy in north Queensland and NWQ, including the NWMP, was identified as a key action to achieve the strategic objectives of the NET Infrastructure Plan.

In 2009, the Queensland Government and Queensland Resources Council jointly commissioned an independent review of options capable of satisfying the long-term energy supply requirements of NWQ, known as the Sims Review. The Sims Review considered several options including:

- Redevelopment of the Mica Creek Power Station
- Self-supply by large regional customers
- Electricity transmission links to the state electricity grid
- Development of renewable energy generation projects.

The Sims Review concluded that at the time there was insufficient information to determine the lowest cost option for the customers, recommending the Queensland Government facilitate a customer driven, competitive process to determine the optimum energy solution.

The 2010 North West Regional Plan put the NET Infrastructure Plan and the Sims Review into a broader regional context. It developed energy strategies and land use policies in recognition of a lack of price parity with regions connected to the NEM, the potential economic and community benefits that could be unlocked, and the infrastructure required to harness potential renewable energy resources in the region (DIP, 2010).

In 2015, the North West Minerals Province Taskforce identified that there is a general lack of enabling infrastructure in the region.

The 2016 Advancing North Queensland: Investing in the future of the north paper, identified the Queensland Government's commitment to grow the economy of the region, including initiatives to improve infrastructure and connectivity. The Project is ideally placed to assist with the delivery of the stated goals of this paper through providing a new and stable infrastructure connection to the state electricity grid.

The 2017 Powering Queensland Plan recognised the very significant and valuable contribution that the world class renewable resources west of Townsville can make to achieve the state objective of 50 percent renewables by 2030. The Powering North Queensland Plan identifies the importance of diversity in energy supply in northern Queensland. The Project supports these objectives by providing the infrastructure for connection of the large renewable resources available in the region as well as providing NEM access for the current isolated gas fired generation in Mount Isa. These renewables and the NWPS gas generation will be vital to achieving the state's low emissions target.

The 2017 Strategic Blueprint for Queensland's North West Minerals Province identified three strategic priorities including facilitating continued resources sector development and delivering integrated and appropriate services.

In May 2020 the Queensland Government's Queensland's Economic Recovery Strategy: Unite and Recover for Queensland Jobs indicated $14.8 million was allocated to continue investigating the feasibility of the Project to connect the NWMP with the NEM to lower energy costs.

In October 2020 the Queensland Government announced it had signed the CopperString 2.0 Implementation Agreement as part of Queensland's ongoing COVID-19 economy recovery plan. Under the Agreement the Government will underwrite additional development costs, through to a final investment decision.

2.2.4 Regional government support

A BIS Shrapnel Report of March 2010, commissioned by the Mount Isa to Townsville Economic Development Zone Incorporated (MITEZ), concluded that renewable projects identified at the North Queensland Renewable Energy Roundtable Forum in November 2009 have the potential for up to 900 megawatts (MW) of installed renewable energy capacity to be connected to the state electricity grid, for participation in the NEM. This preliminary work was also supported by an analysis of the renewable energy potential of the region, including the report Growing Queensland's Renewable Energy Electricity Sector a parliamentary submission by the United North Queensland Regional Development Organisation.

CopperString 2.0 has established a Northern Queensland Sustainable Resources Corridor Regional Reference Group with representatives of the northern Queensland community including the Cloncurry Shire Council and the Burdekin Shire Council.

The Terms of Reference for the Regional Reference Group include a number of objectives, including:

- The interdependence of the Townsville economy and the NWMP, and the whole corridor between Townsville and Mt Isa, and particularly the significance of this export supply chain to the greater Townsville regional economy and employment

- The importance of common user infrastructure to underpin the economic health of Townsville and NWMP regions and the entire Sustainable Resources Corridor
- The opportunity to underpin the long-term viability of mining and minerals processing for domestic and export markets through reduction in energy costs
- The integration of the high-quality natural energy resources in the Sustainable Resources Corridor with the mining and processing of base metals and rare earth products

The North West Queensland Regional Organisation of Councils (NWQROC) Burke Shire Council, Doomadgee Aboriginal Shire Council, Carpentaria Shire Council, Richmond Shire Council, McKinlay Shire Council, Mount Isa City Council, Cloncurry Shire Council and Flinders Shire Council were briefed by CuString on the project at their NWQROC meeting on 9 July 2020. NWQROC were provided with a project overview and status, outline of Queensland and Australian Government support / COVID Economic Response, impacts and benefits of Common User Infrastructure, High speed broadband opportunities – QCN Fibre and Local Government engagement.

2.2.5 Conclusion

The Project addresses the key priorities and goals of both the Australian and Queensland Governments by maximising the economic opportunities for mining and processing in the NWMP within acceptable social and environmental standards. Further economic opportunities will be maximised by encouraging the development of alternative energy sources and geographically challenged commercial operations in addition to delivery of more competitively priced, secure and reliable energy, which aligns with the objectives of the North West Regional Plan (DIP, 2010) and the NET Infrastructure Plan (DIP, 2007).

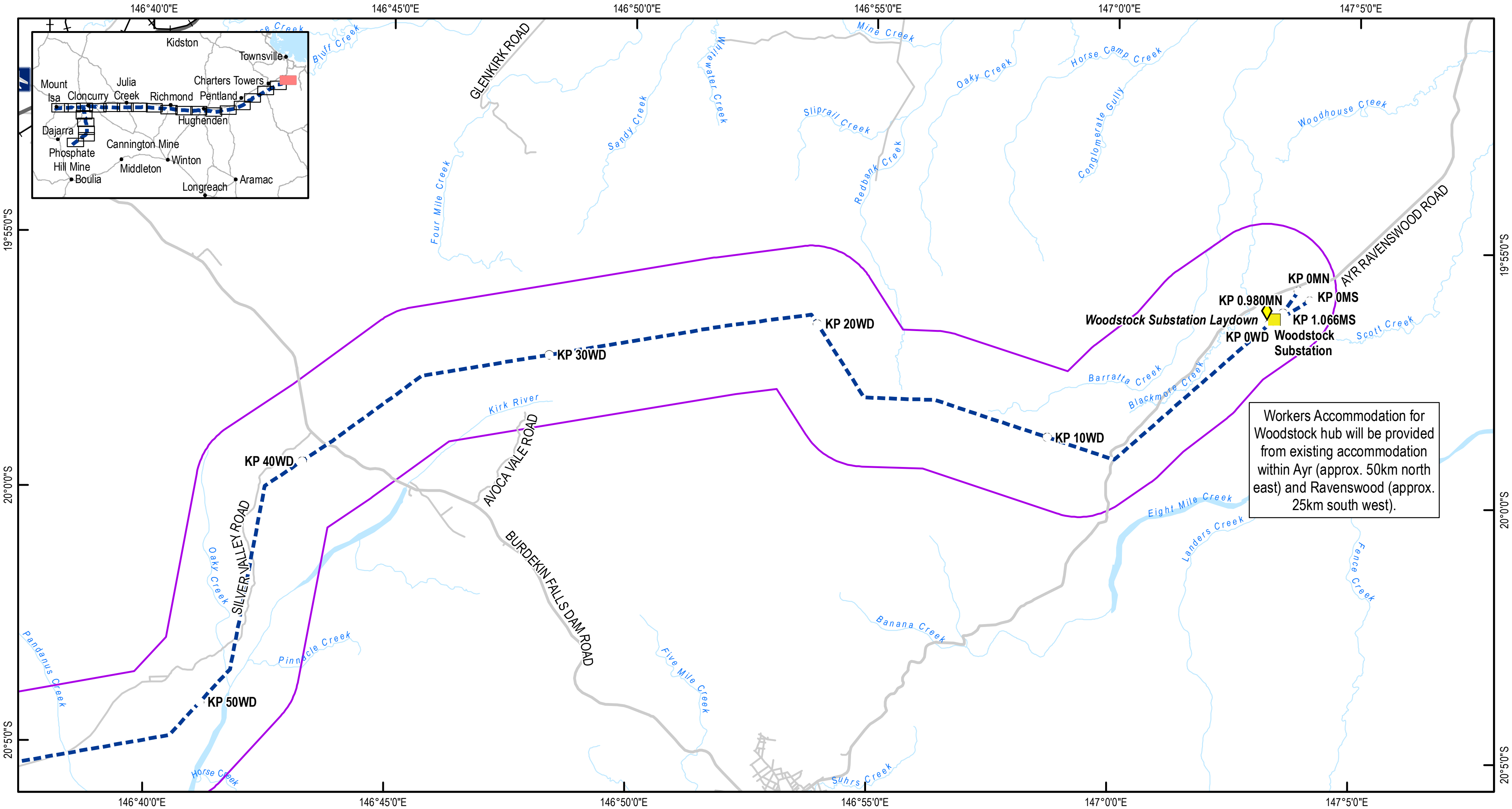
The Project is a private sector initiative that will deliver significant community benefits within the local, regional, and national contexts. Based on the recommendations of various reviews of the NWMP energy market, the Project will upgrade the electricity supply to the NWPS to foster the continued economic, social and community growth of the region. Furthermore, the Project will enable development of identified renewable energy resources in the region, providing these with access to the NEM that is currently a constraint on their development.

2.3 Regional and local infrastructure context

The corridor selection traverses a large, linear area and is expected to directly impact 121 land parcels with additional land parcels impacted by the construction of access tracks. The predominant land uses on the impacted land parcels is rural grazing and cattle breeding.

The footprint of the Project in relation to regional and local infrastructure is shown in Figure 2-3.

Further details about connections with existing infrastructure is included in Section 2.5.



Legend

- CEV Hut Site
- Proposed Camp/Laydown
- Proposed Substation
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
Original page size: A4 landscape

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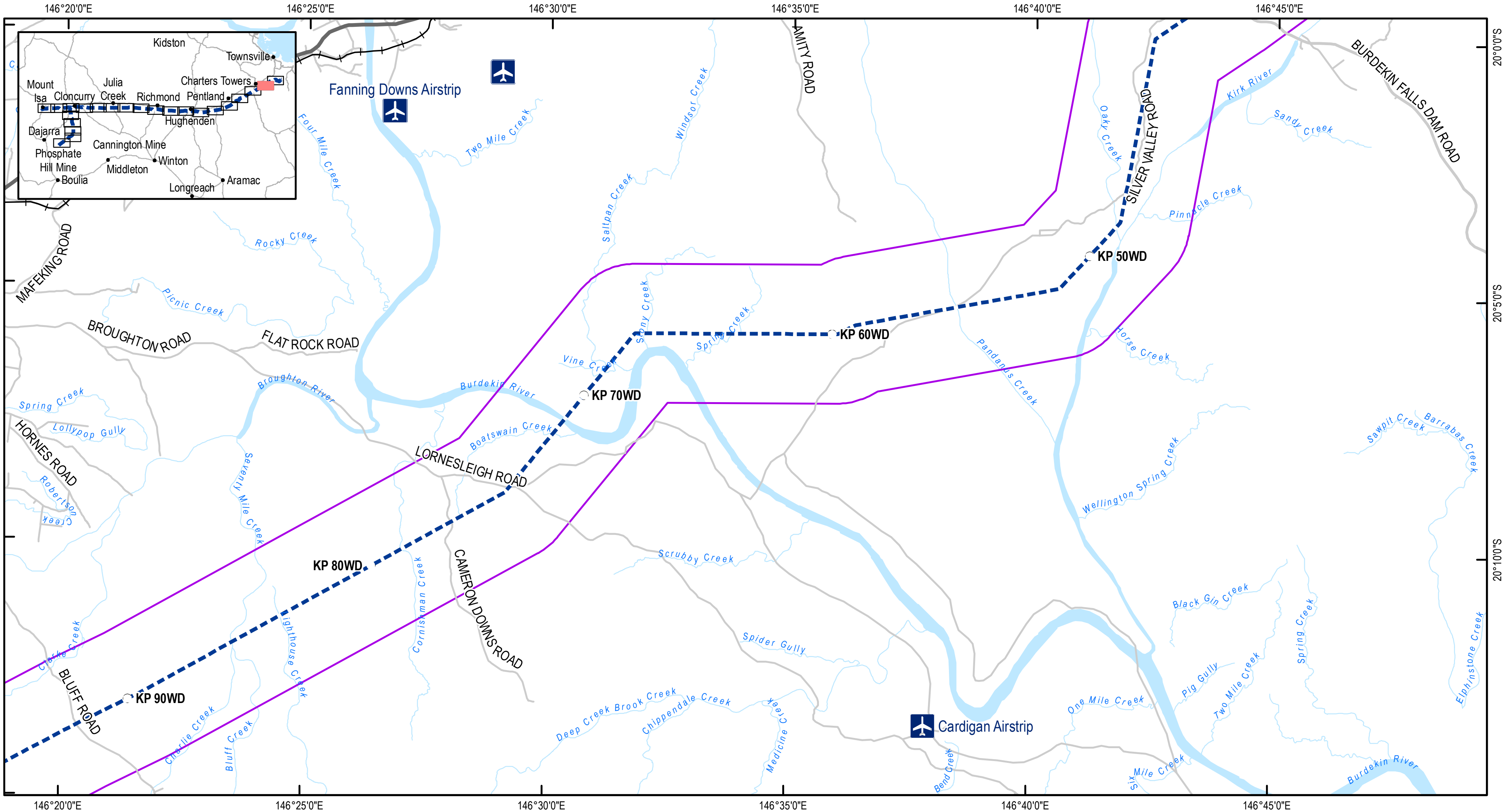
Figure 1-4A - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

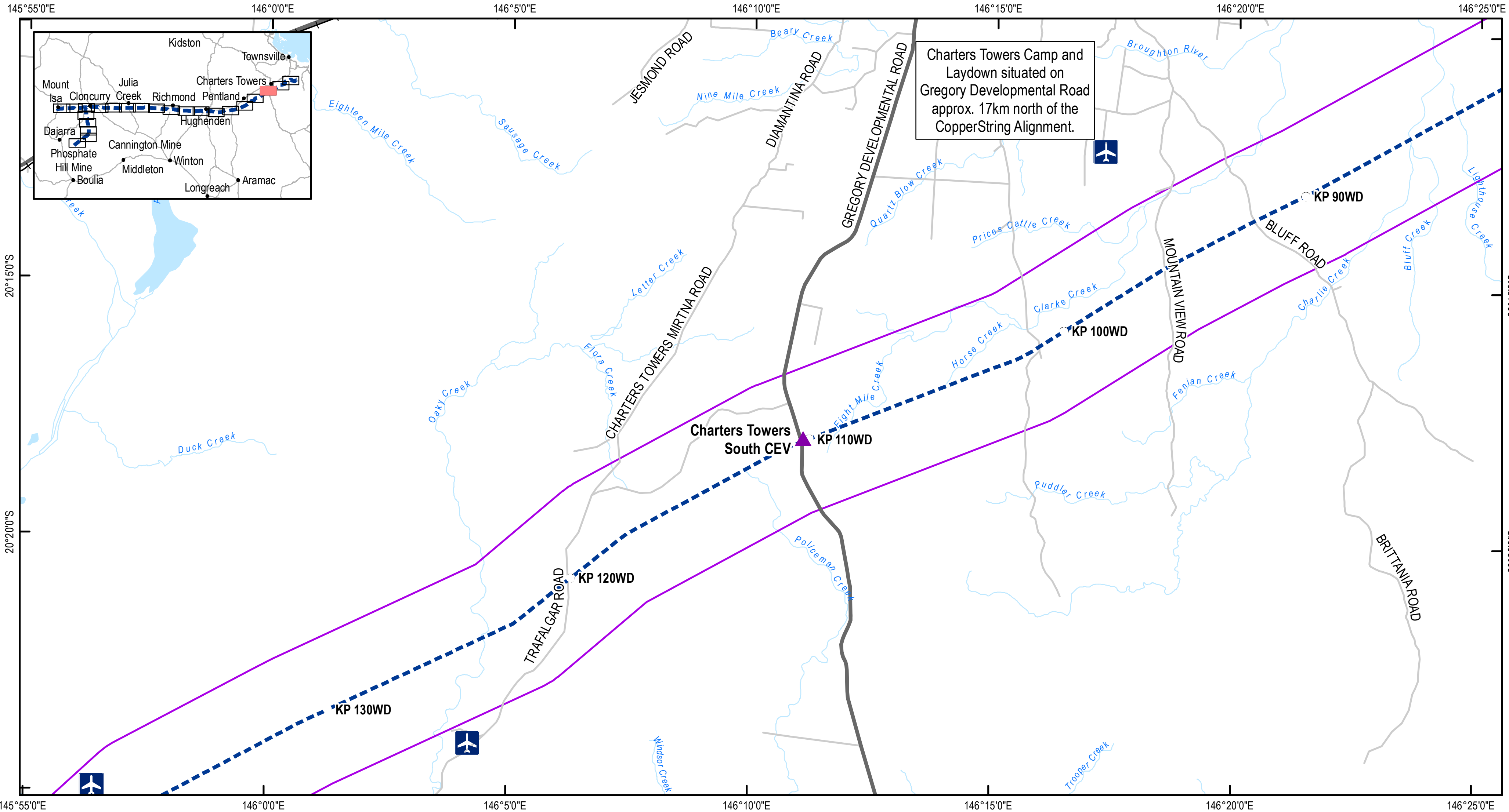
Notes/Data Sources
Original page size: A4 landscape

WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4B - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
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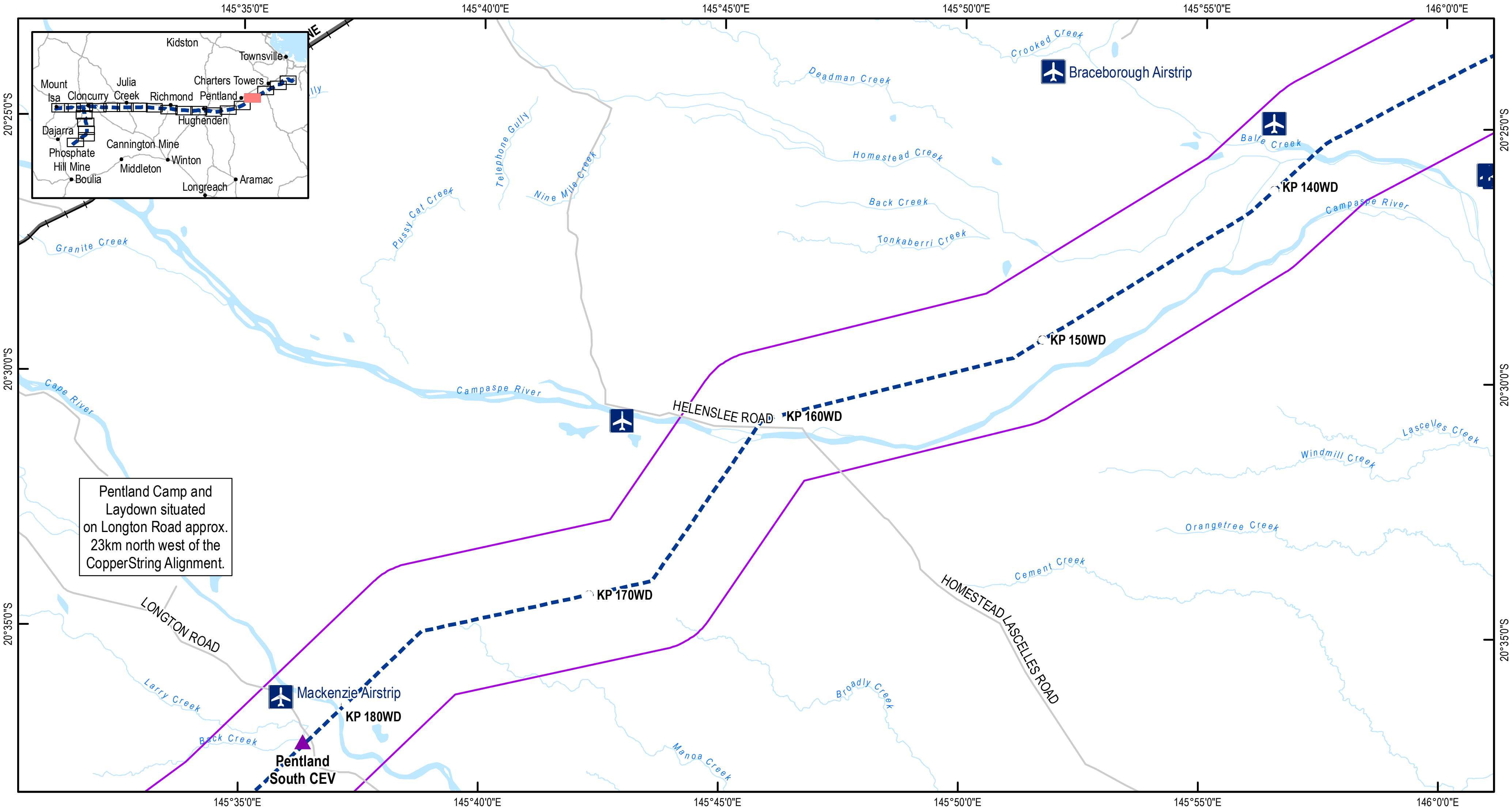
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4C - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

CEV Hut Site	Railway	Named Watercourse
Kilometre Post	Highway	Watercourse Area/Lake/Reservoir
CopperString Alignment	Secondary Road	LandingGround
	Local Connector Road	2.5 km buffer (study area)
	Street	

0 1 2 3 4 5

Kilometres

Coordinate System MGA1994 Zone 54\55

Notes/Data Sources

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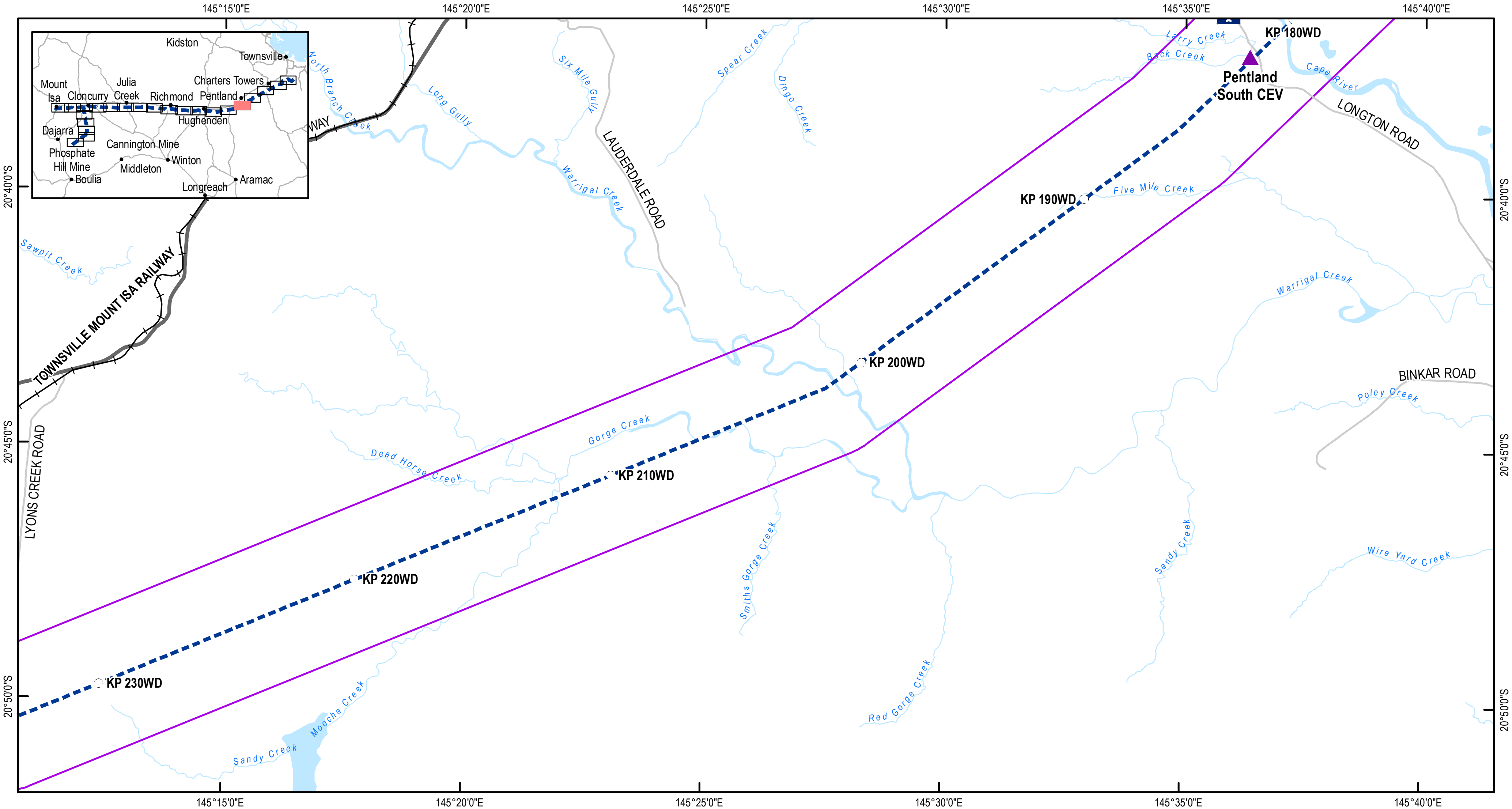
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4D - Regional and local infrastructure

COPPERSTRING 2.0

BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
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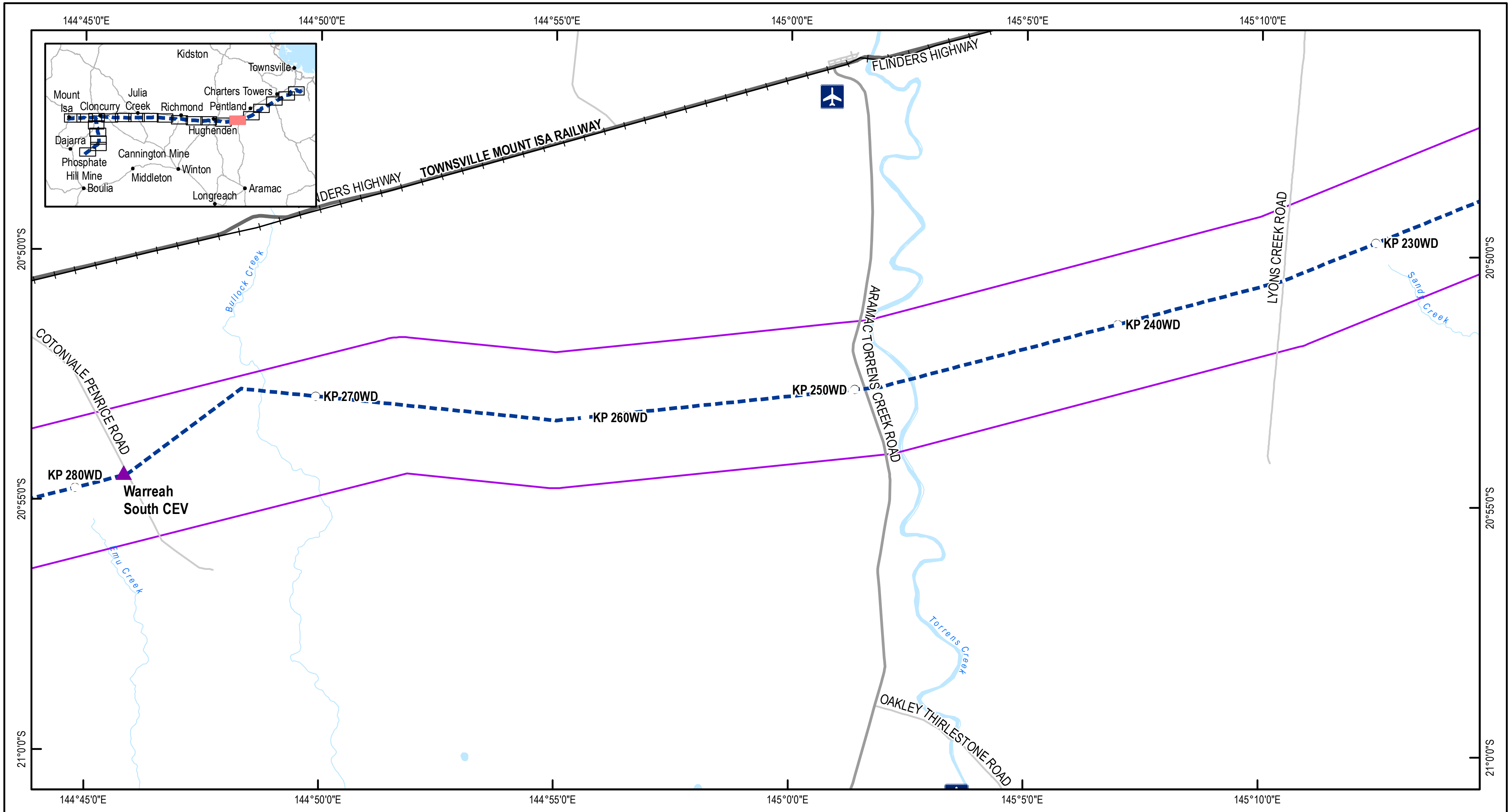
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4E - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



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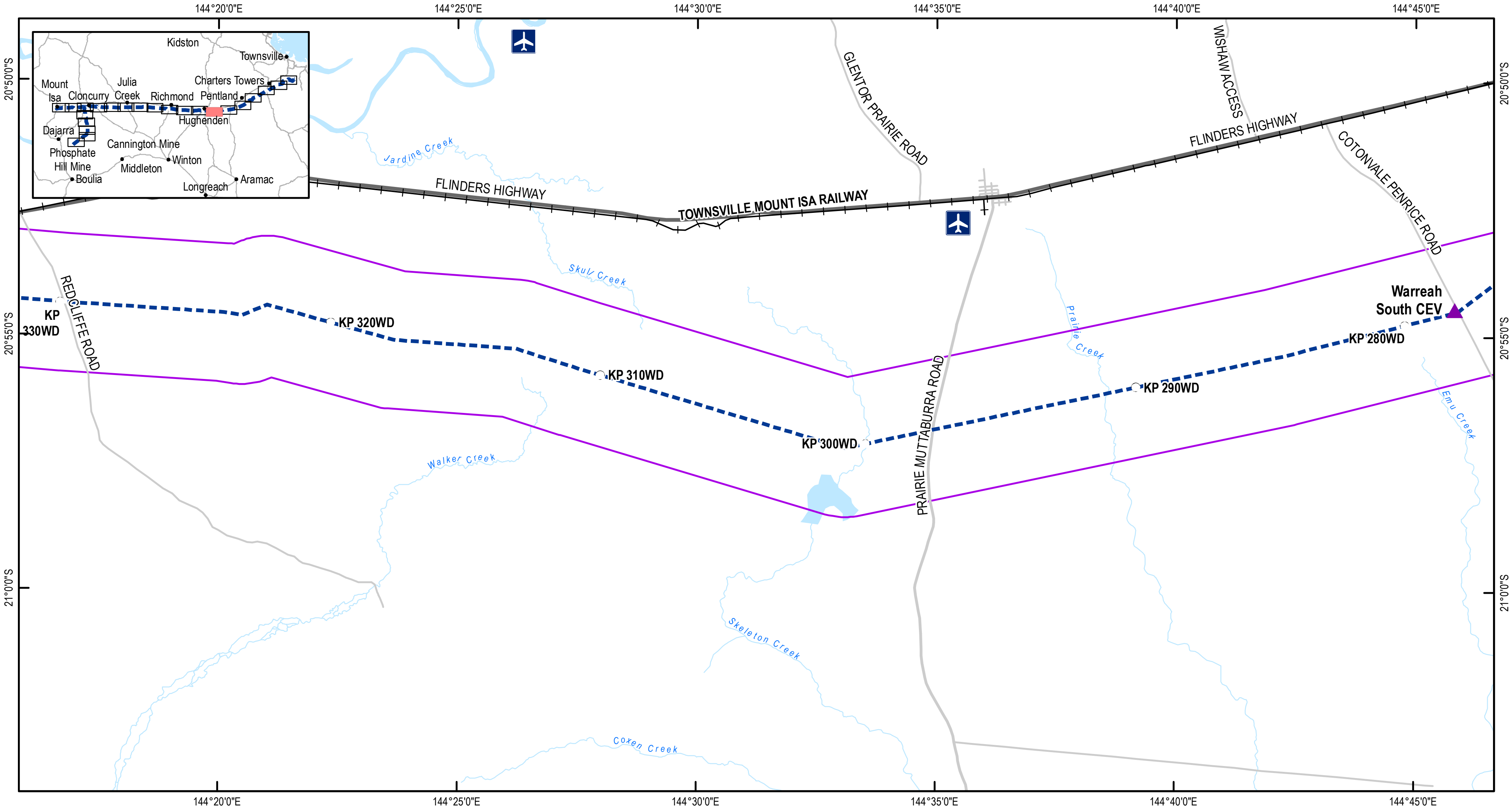
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4F - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5

Kilometres

Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources

Original page size: A4 landscape

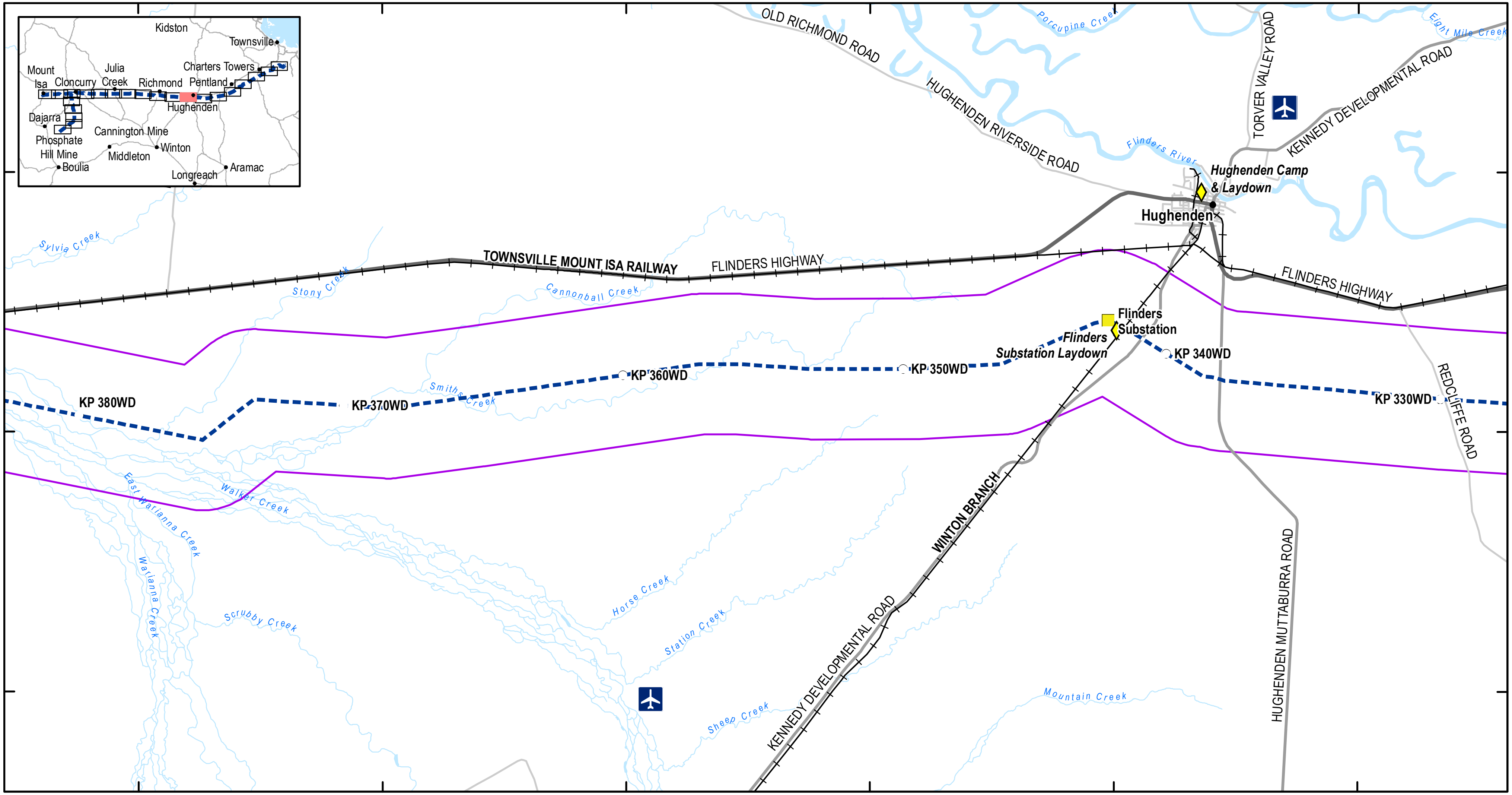
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4G - Regional and local infrastructure

COPPERSTRING 2.0

BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Proposed Camp/Laydown
- Proposed Substation
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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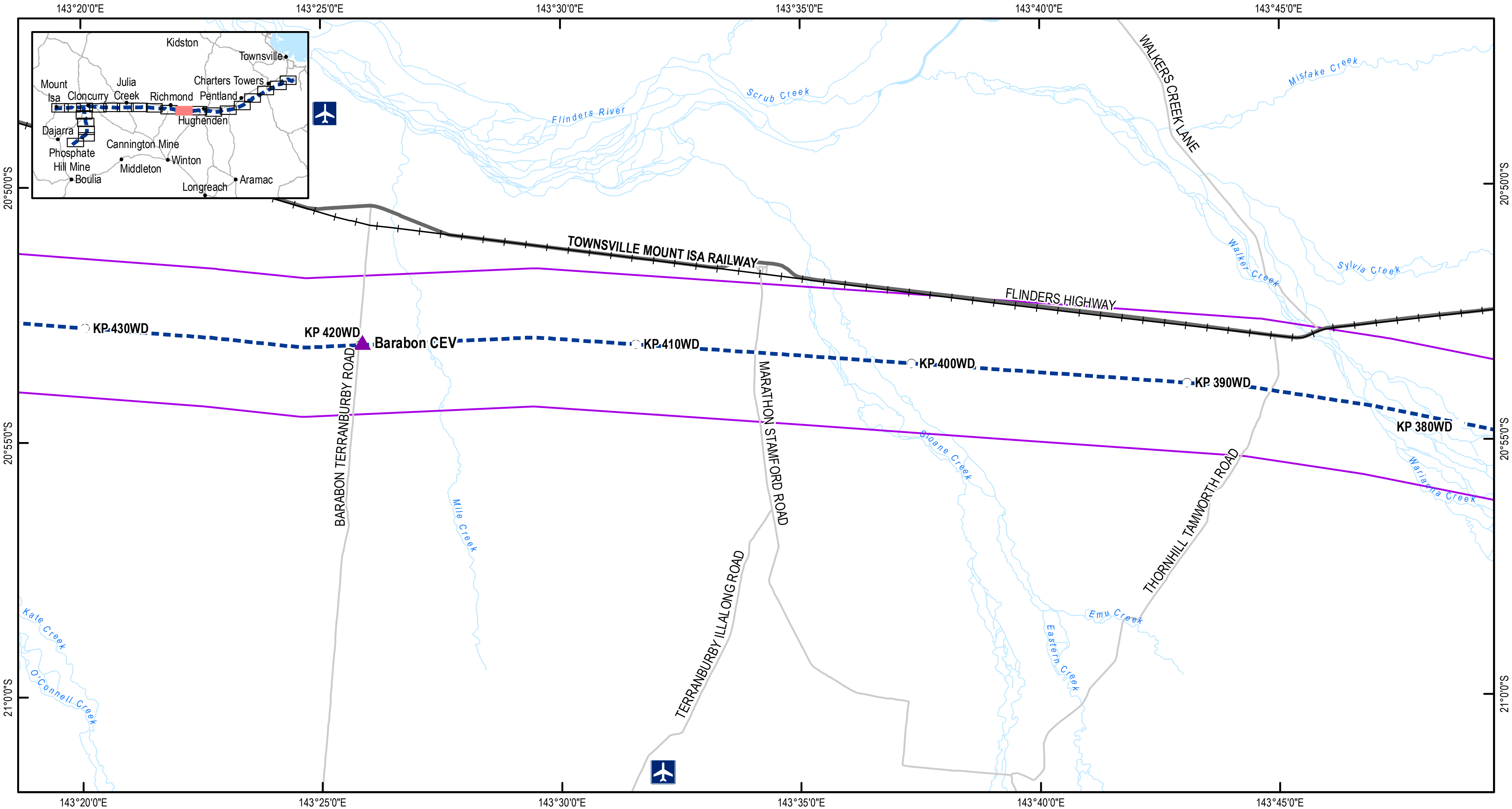
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4H - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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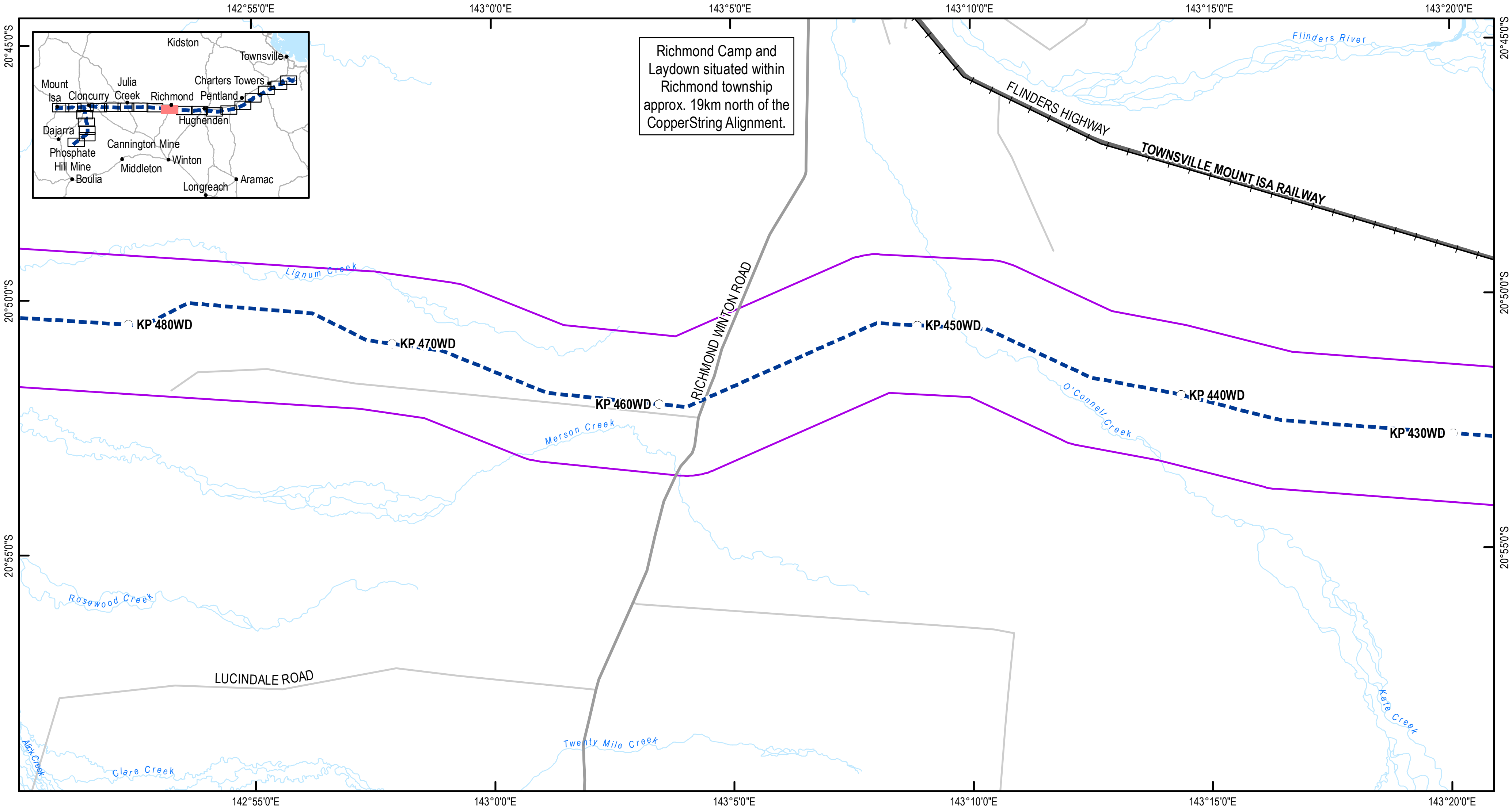
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4l - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- 2.5 km buffer (study area)

0 1 2 3 4 5

Kilometres

Coordinate System
MGA1994 Zone 54\55

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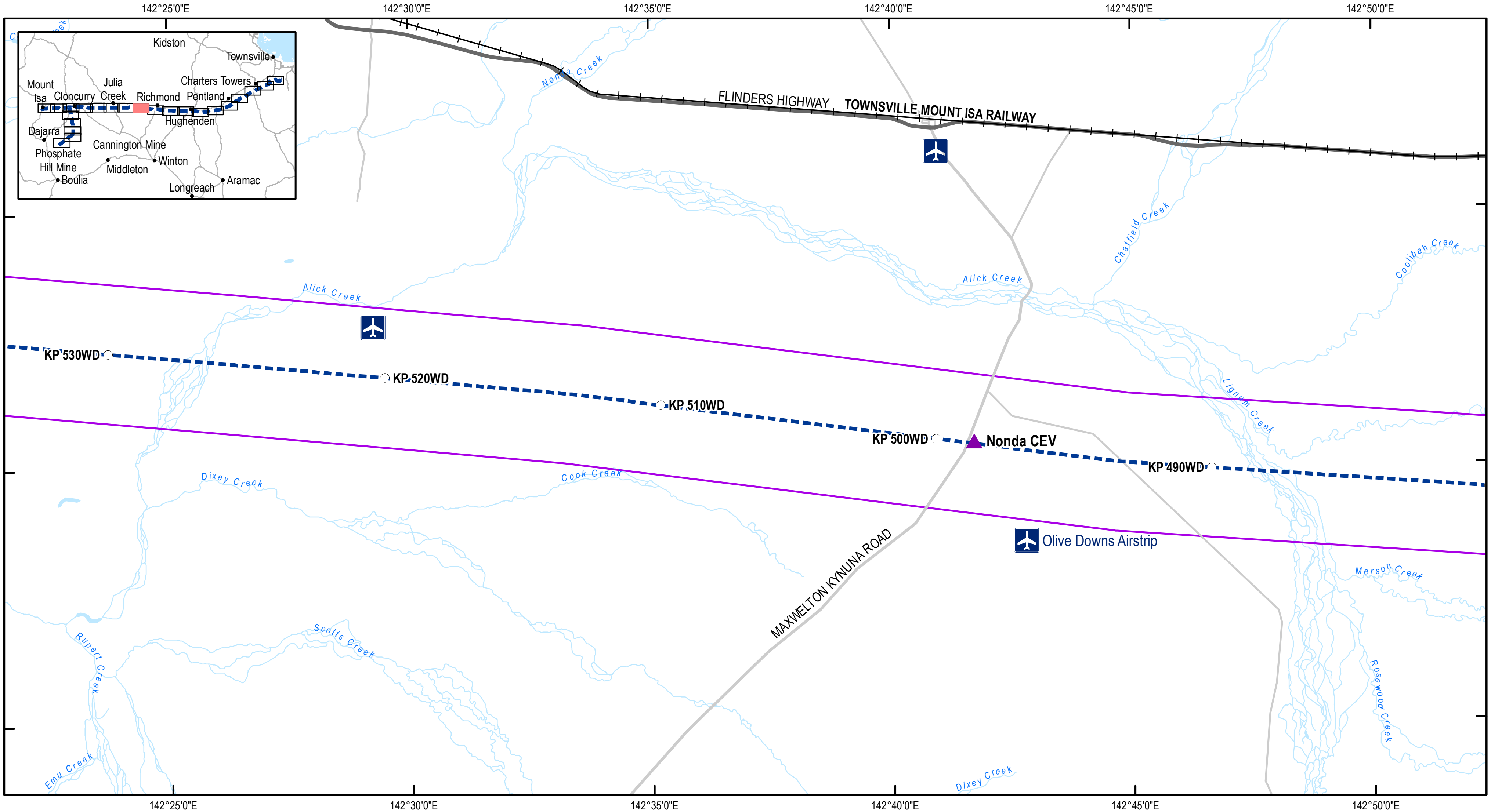
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4J - Regional and local infrastructure

COPPERSTRING 2.0

BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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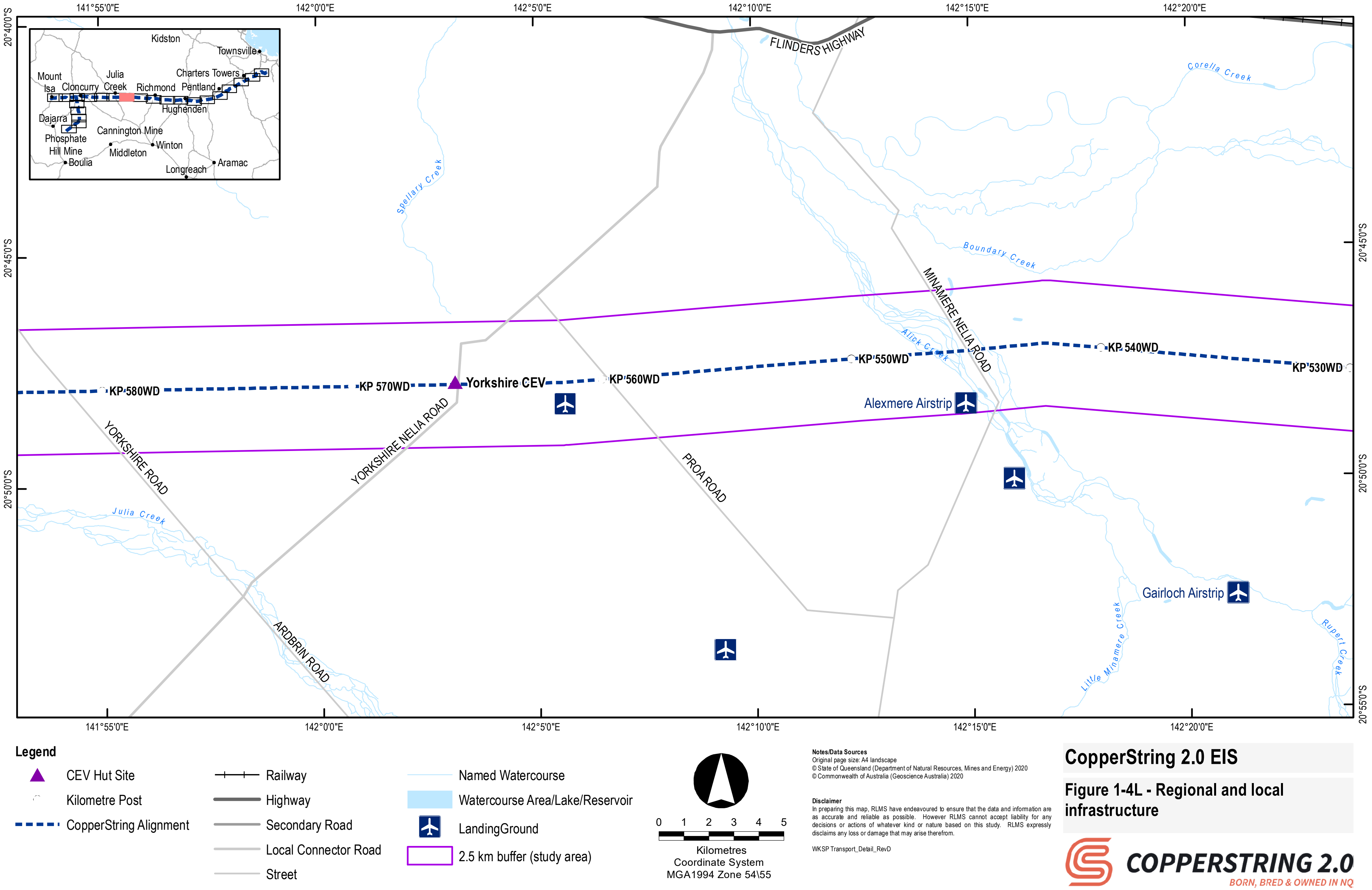
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4K - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



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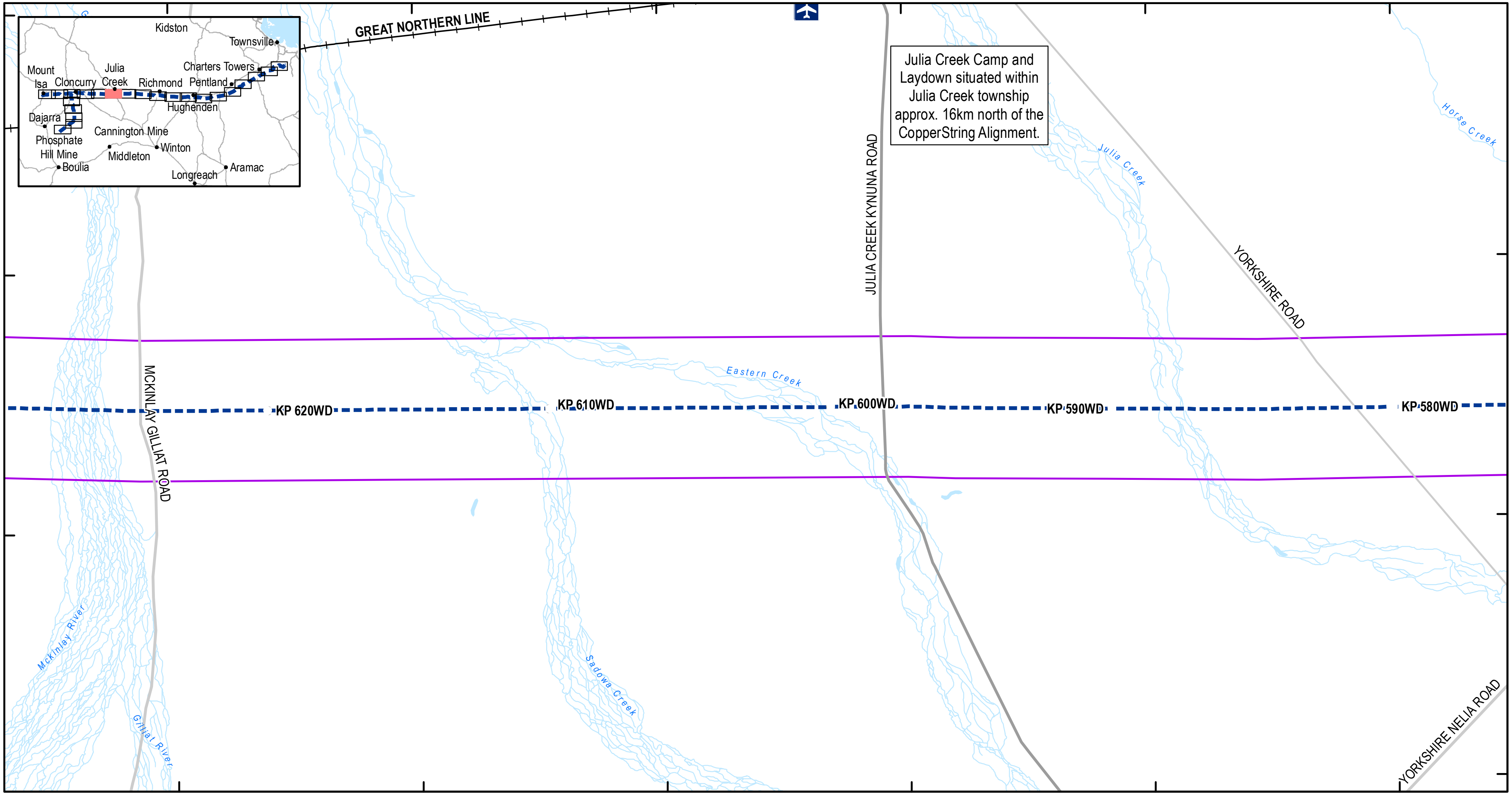
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4L - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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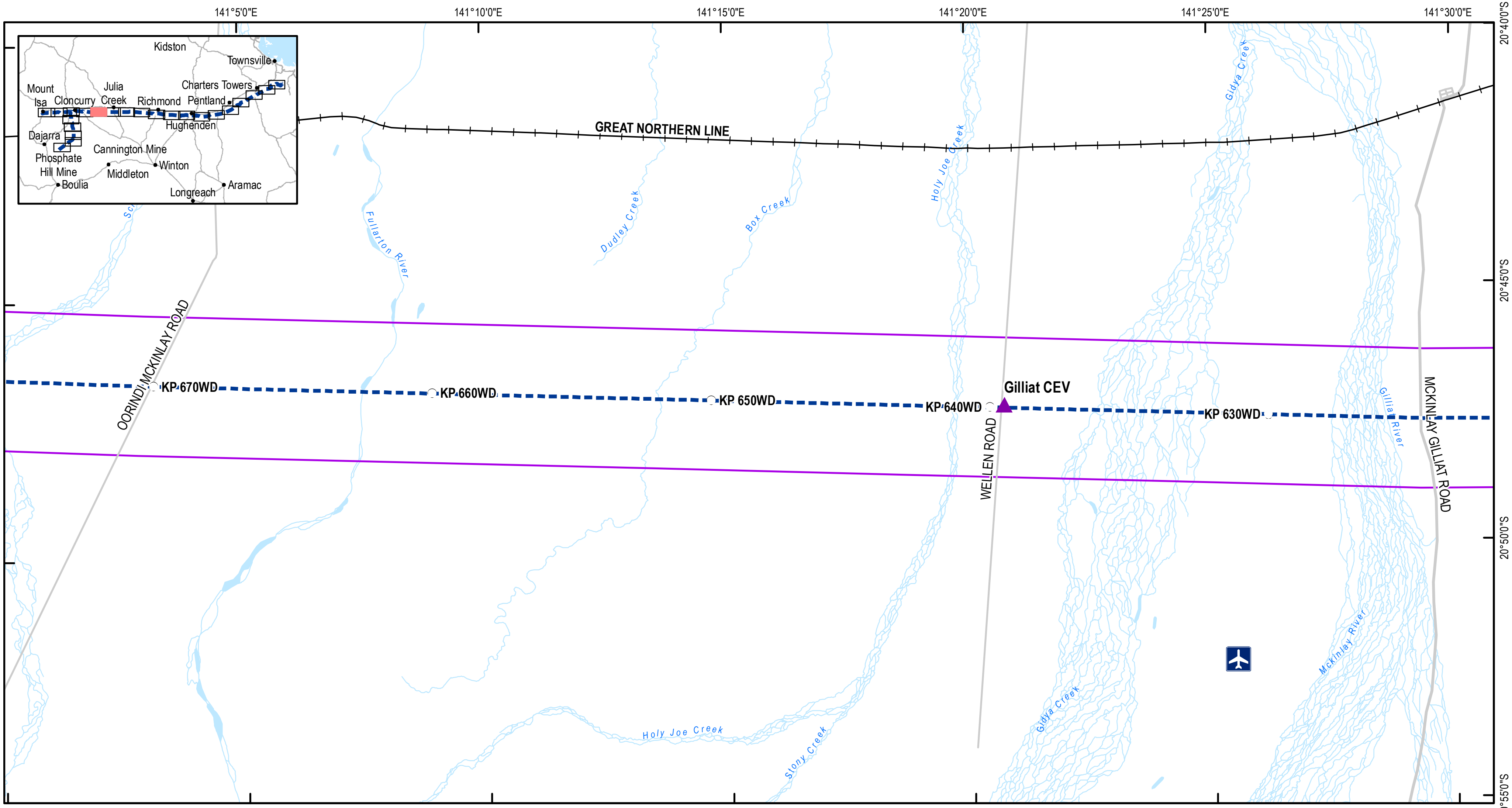
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4M - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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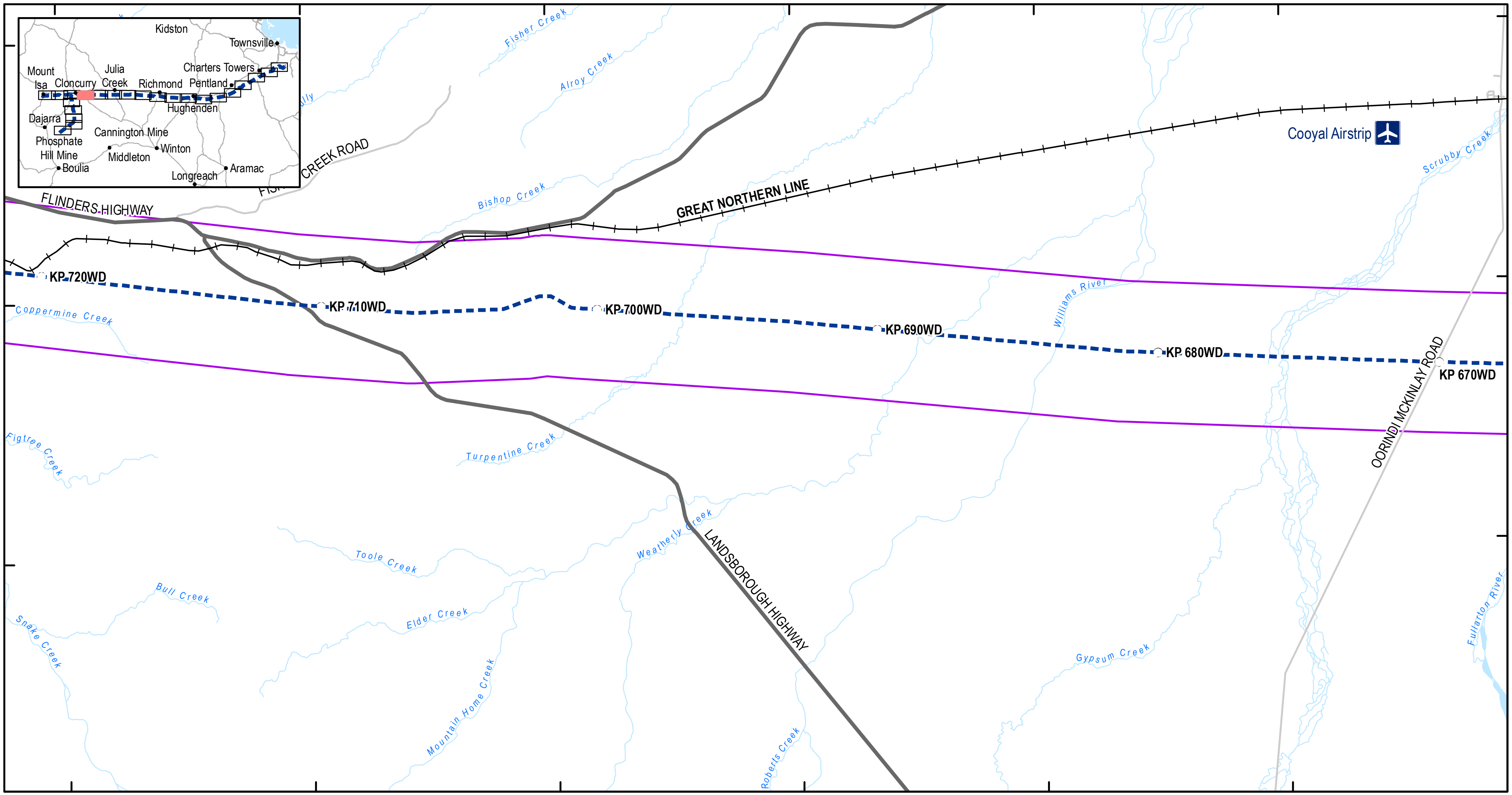
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4N - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
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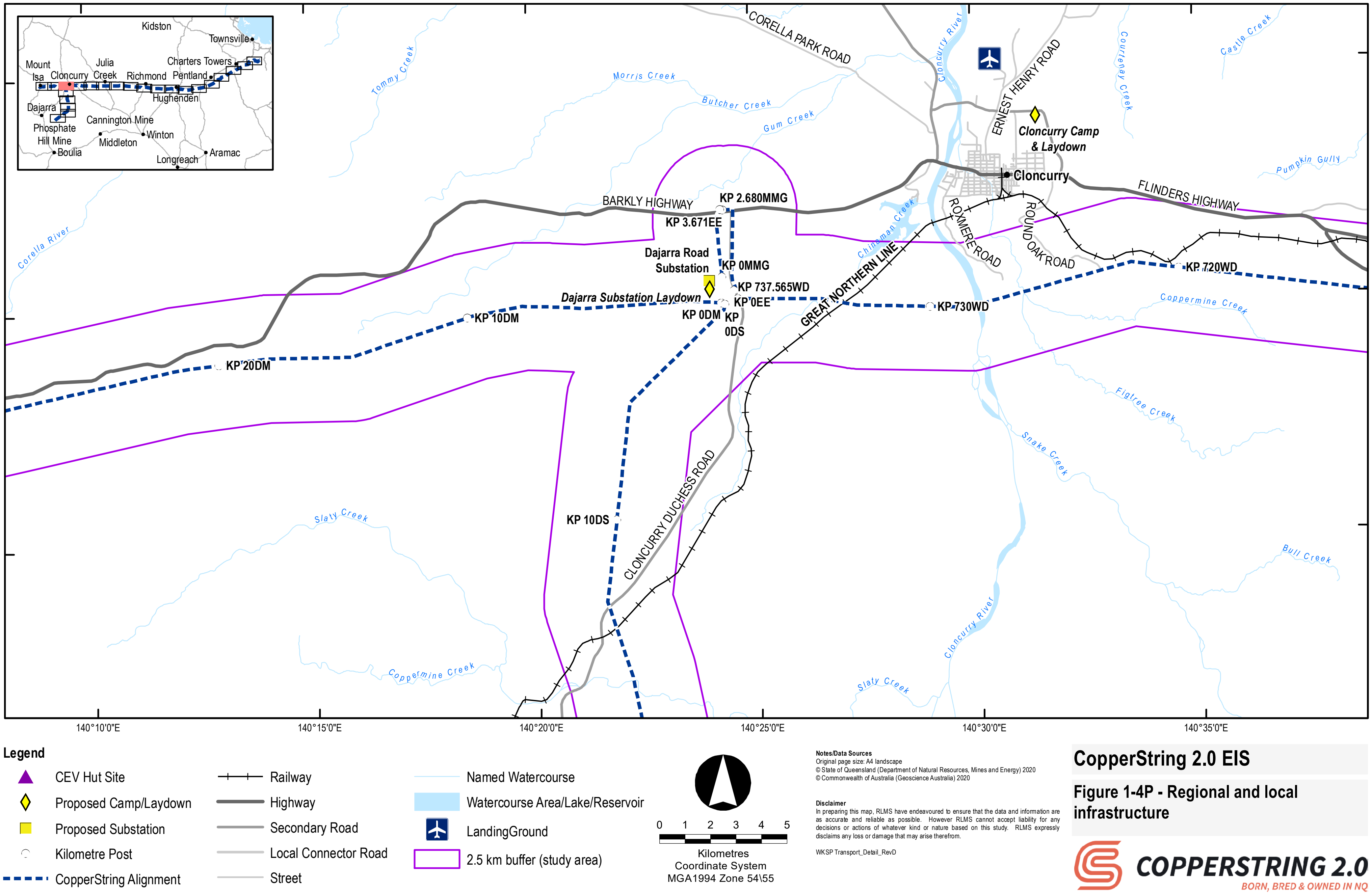
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-40 - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



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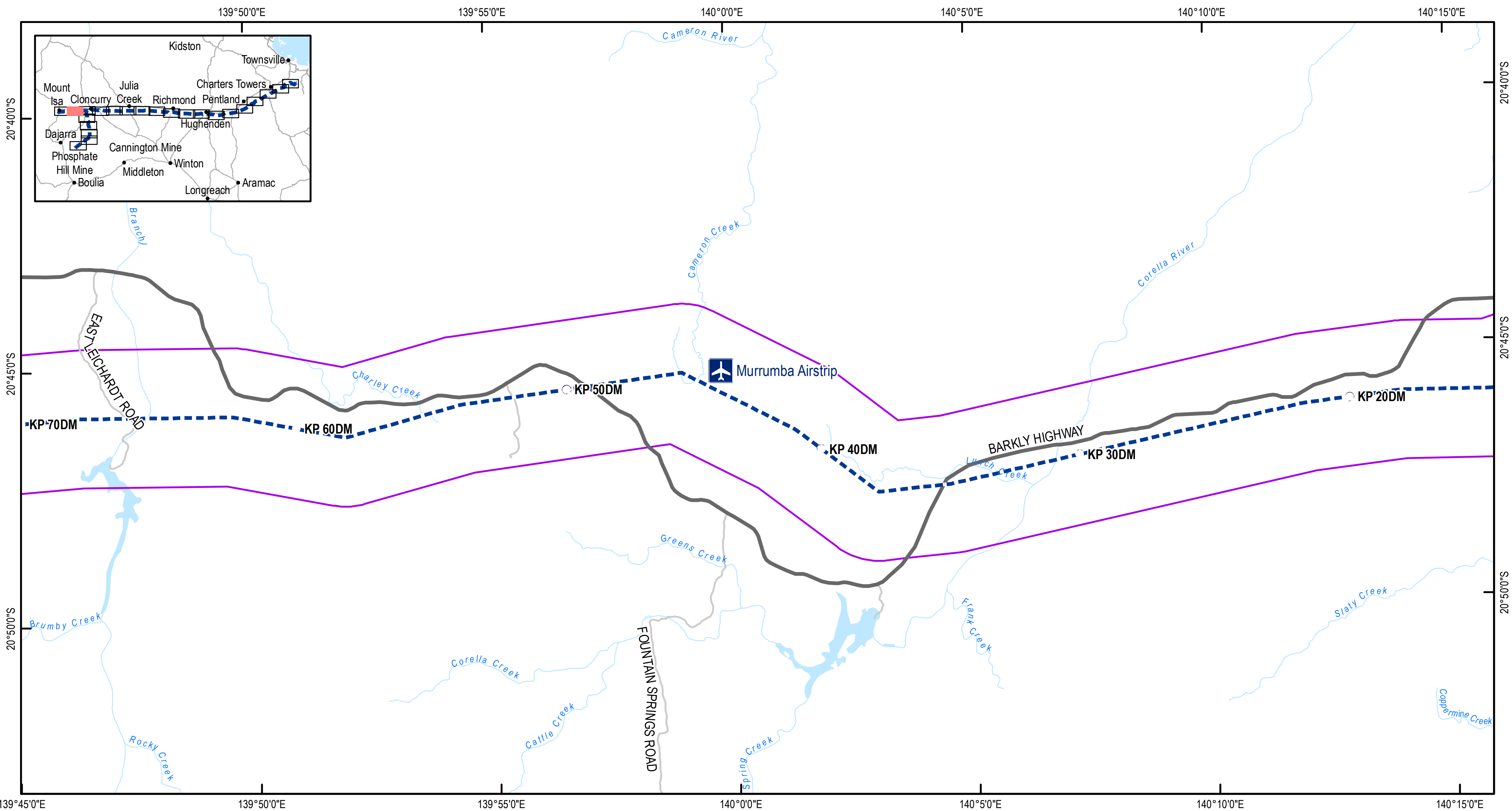
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4P - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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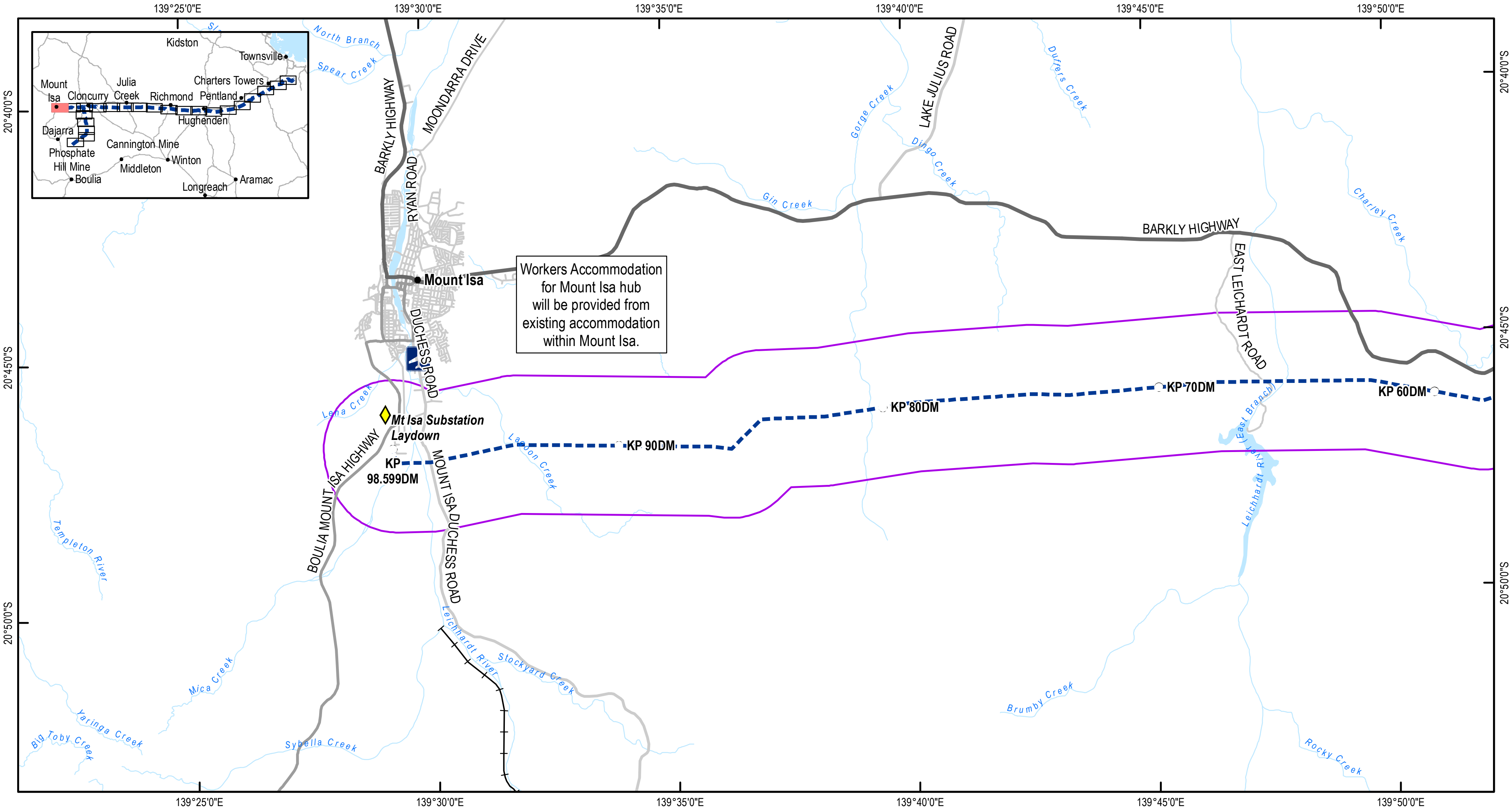
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4Q - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Proposed Camp/Laydown
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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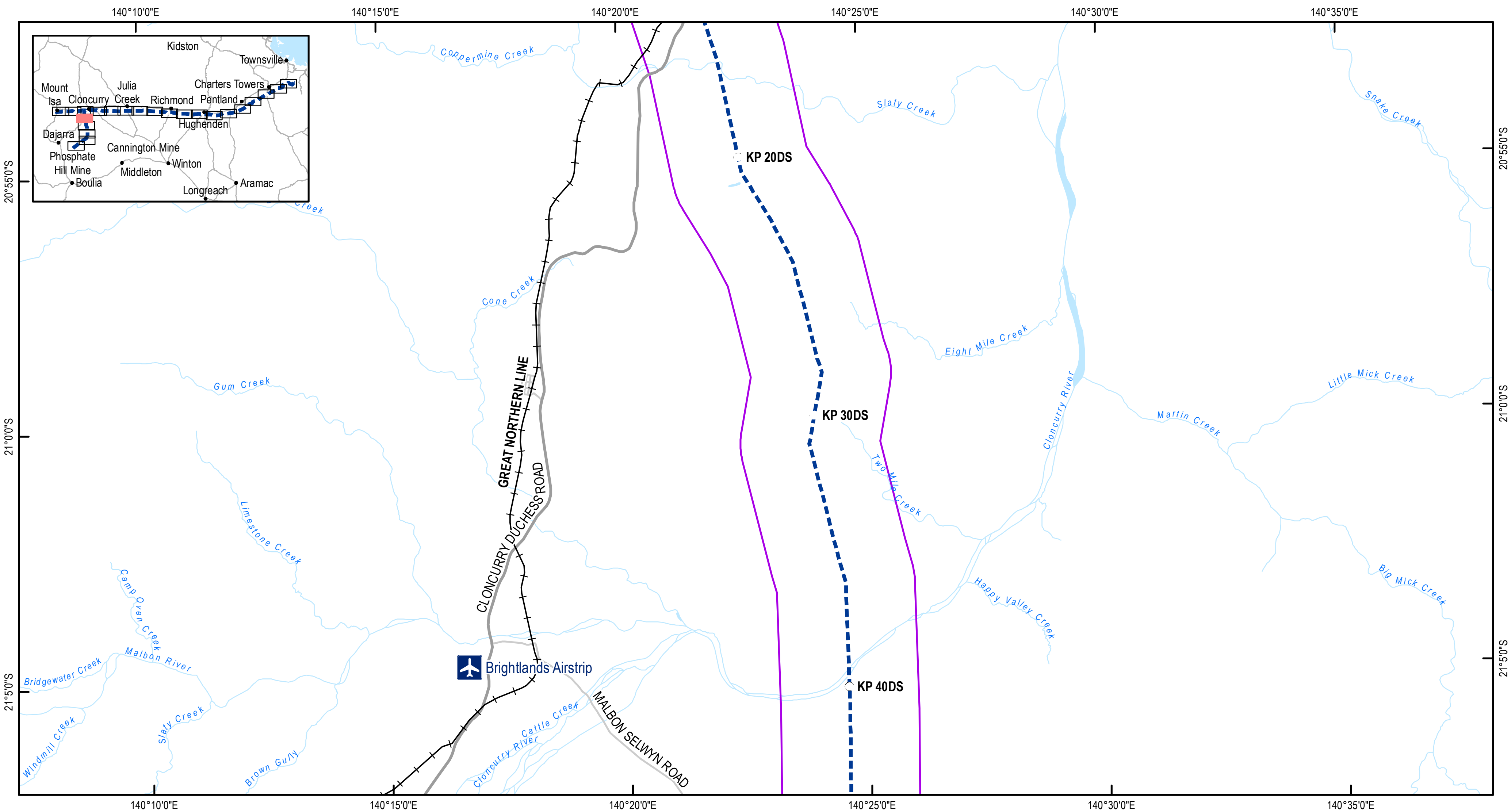
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4R - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5

Kilometres
Coordinate System
MGA1994 Zone 54\55

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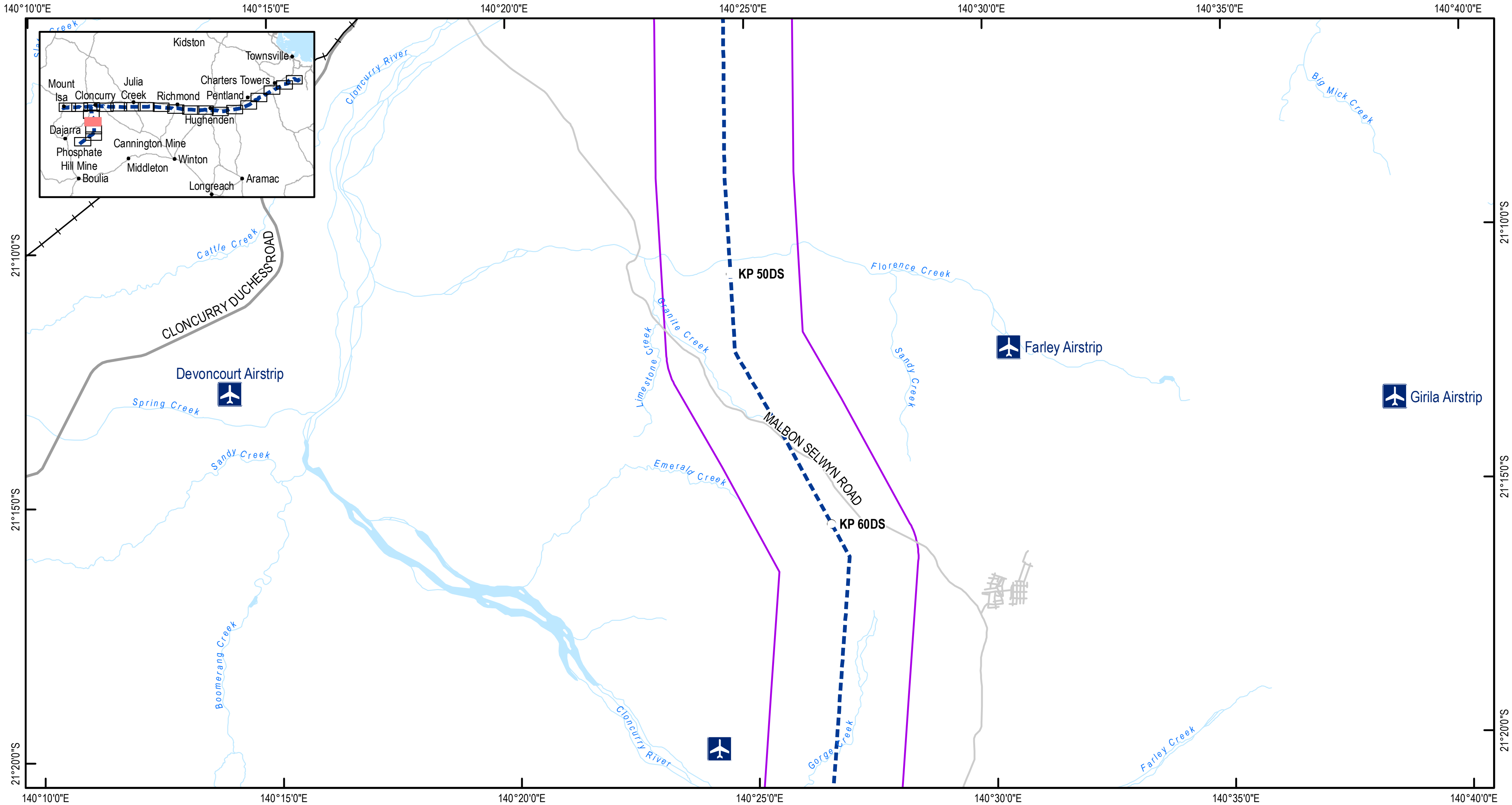
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4S - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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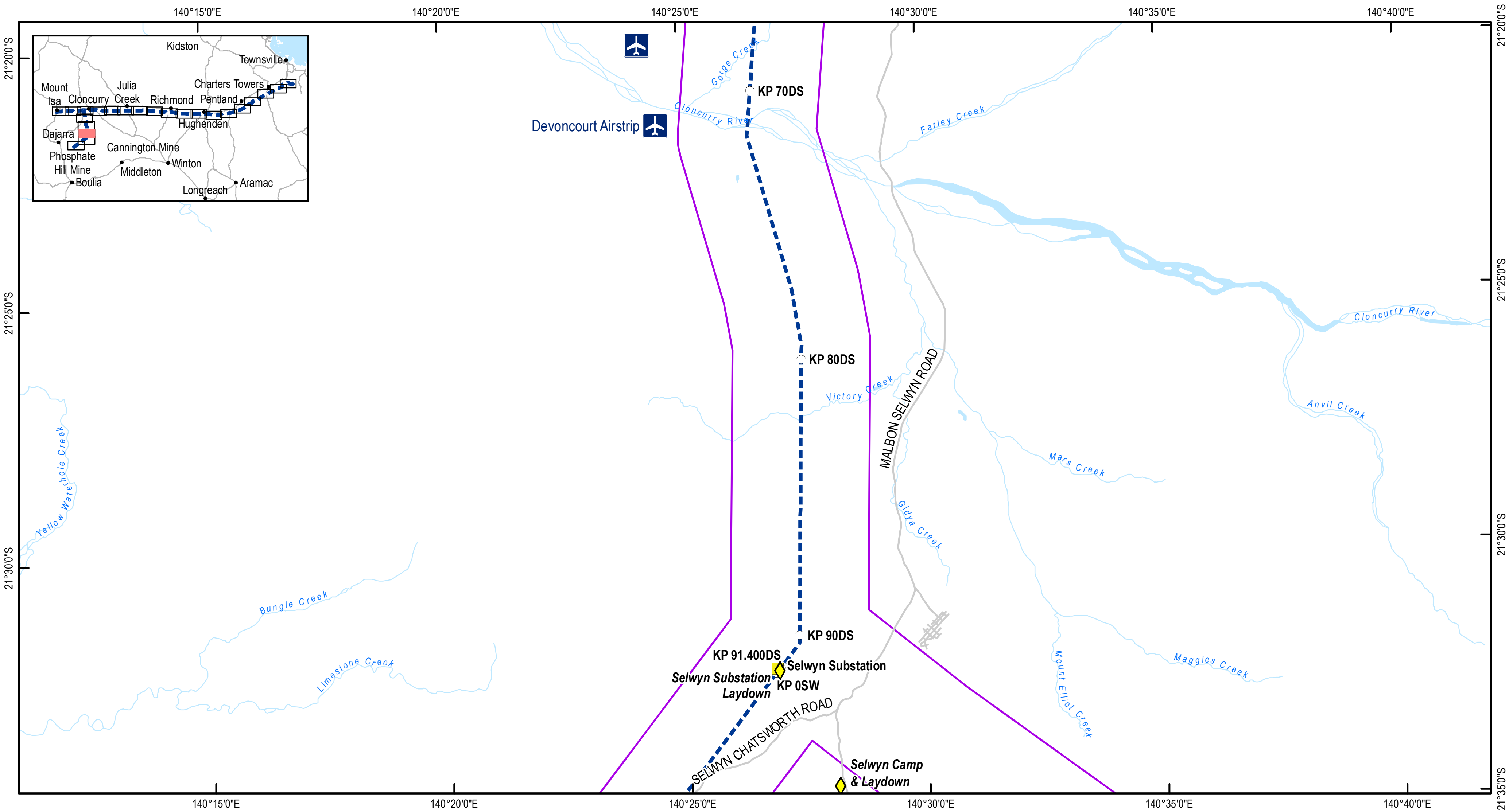
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4T - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Proposed Camp/Laydown
- Proposed Substation
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

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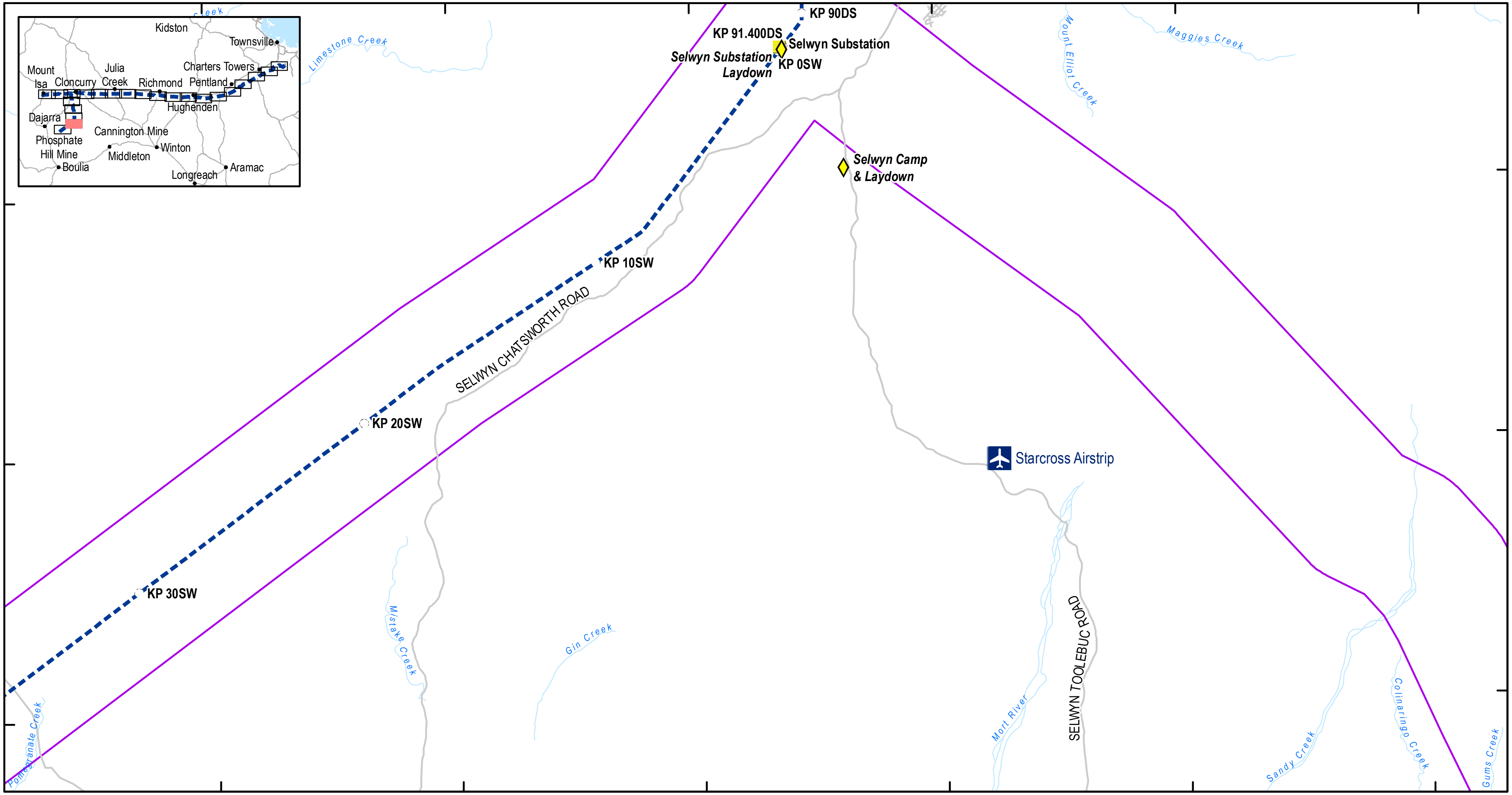
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4U - Regional and local infrastructure

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

CEV Hut Site	Railway	Named Watercourse
Proposed Camp/Laydown	Highway	Watercourse Area/Lake/Reservoir
Proposed Substation	Secondary Road	LandingGround
Kilometre Post	Local Connector Road	2.5 km buffer (study area)
CopperString Alignment	Street	

0 1 2 3 4 5

Kilometres

Coordinate System

MGA1994 Zone 54\55

Notes/Data Sources

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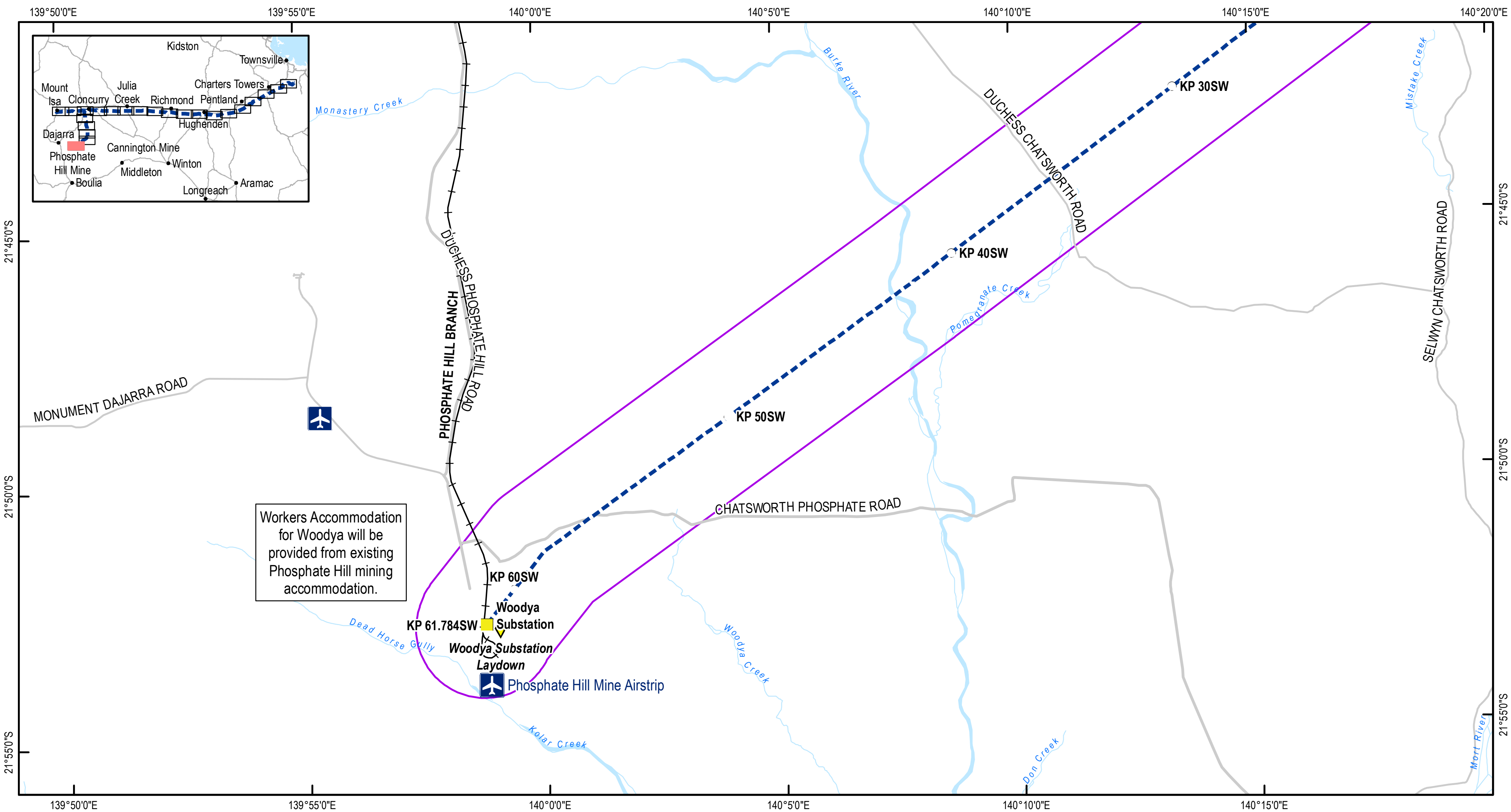
WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4V - Regional and local infrastructure

COPPERSTRING 2.0

BORN, BRED & OWNED IN NQ



Legend

- CEV Hut Site
- Proposed Camp/Laydown
- Proposed Substation
- Kilometre Post
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Named Watercourse
- Watercourse Area/Lake/Reservoir
- LandingGround
- 2.5 km buffer (study area)

0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
Original page size: A4 landscape

WKSP Transport_Detail_RevD

CopperString 2.0 EIS

Figure 1-4W - Regional and local infrastructure

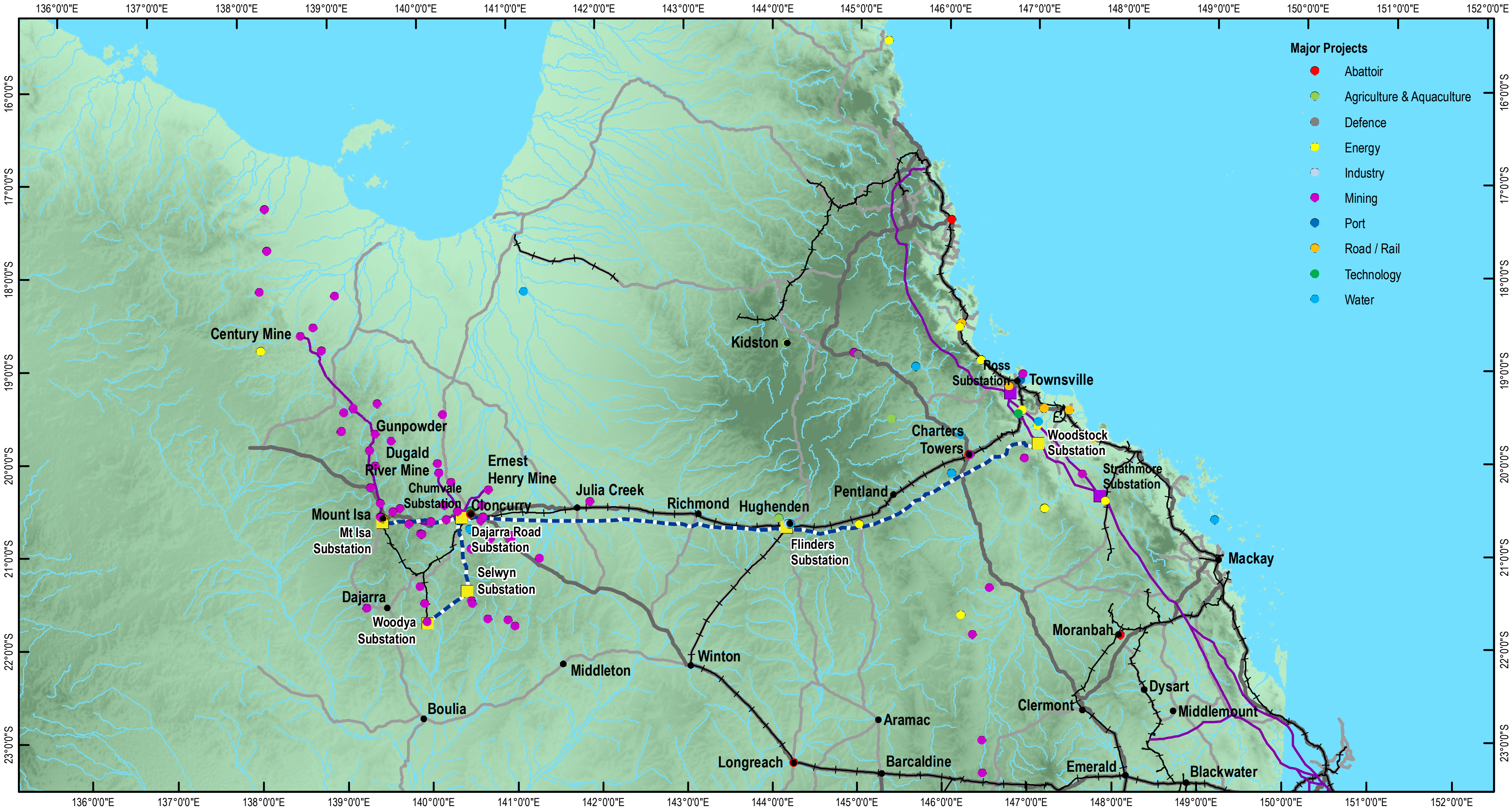
COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

2.4 Relationship to other projects

The Project is a stand-alone project. It provides an opportunity to stimulate macro-economic growth by reducing electricity prices in the region, a significant component in the cost of mining and minerals processing in the NWMP and facilitating market access to renewable energy resources along the corridor selection.

It is anticipated that the Project will precipitate the commencement of other projects such as the proposed Mount James Wind Farm and renewed mining investments in the NWMP.

Several coordinated projects, prescribed projects and local projects in the regions traversed by the Project have been identified (Figure 2-4) and are described in Volume 2 Chapter 20 Cumulative impacts.



Legend

- Town/City
- Proposed Substation
- Existing Substation
- CopperString Corridor
- Existing Transmission Line (>= 220kV)
- Railway
- Highway
- Secondary Road
- Major Watercourse

0 50 100 150
Kilometres
Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
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WKSP Major_Projects_RevD

CopperString 2.0 EIS

Figure 2-5 - Other major projects

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

2.5 Basis of design

The transmission system will be designed to deliver 400 MVA of electricity to the CopperString Core with a reliability equal to, or better than, that already experienced by electricity consumers connected to the NWPS. The Project will be capable of exporting power into the state electricity grid from generators on the existing islanded systems and future generators such as the proposed Mount James Wind Farm.

The Project includes the development of the transmission line, substations, laydown areas, construction camps, communication huts, access tracks, and vegetation management.

2.5.1 Corridor selection

A Corridor Selection Report has been prepared, identifying the corridor from Mulgrave through to Mount Isa and from Cloncurry south to the Selwyn Substation and connection points to Mount Dore Mine and Phosphate Hill Mine.

The Corridor Selection Report, based on the original report dated August 2010, has been updated to capture change requests because of new constraint information and landholder requests.

The corridor selection is based on the final corridor from 2010. Some changes were made based on a range of matters including:

- Current farm infrastructure that may be intersected by the corridor.
- Environmental constraints including revisions to 'of concern' ecosystems.
- Identified cultural heritage places and any buffers around these places.

For further detail refer to Volume 3 Appendix D Corridor selection report.

The sections of the corridor selection are summarised in Table 2-2.

Table 2-2 Transmission line easement description

Transmission Line Section	Approximate Distance (km)	Voltage (kV)	Easement width (m)	Corresponding kilometre points (KP)
Mulgrave cut-in (North) Mulgrave cut-in (South)	0.98 1.07	275 275	60 60	0 – 0.980MN 0 – 1.066MS
Renewable Energy Hub	342	330	120	0 - 342.4WD
CopperString Core	395	330	120	342.4–737.5WD
Dajarra Road Connection for connection to the Ernest Henry and Chumvale Substation	4	220	60	0 - 3.67 EE
Dajarra Road Connection for the connection to the Dugald River	3	220	80	0 - 2.68MMG
Mount Isa Augmentation	99	220	60	0 - 98.6DM
Southern Connection	90	220	60	0 – 91.40DS
Woodya Connection	61	132	60	0 - 61.78SW

The 120 m wide easement from Woodstock Substation to Dajarra Road Substation (Renewable Energy Hub and CopperString Core) accounts for a potential future duplication of these sections of the transmission line. Construction will only occur on the southern 60 m side of the 120 m easement, leaving the northern side for an expansion in the future, if required.

Connection to the existing NWPS near Chumvale Substation will be achieved by cutting in to the existing 220 kV transmission lines connecting Chumvale Substation to the Ernest Henry Mine and Dugald River Mine. These cut-ins will connect the Dajarra Road Substation to the Chumvale Substation and transfer connection of the two mines' 220 kV transmission lines to the Dajarra Road Substation. A 60 m wide easement is required for the single circuit line connecting Dajarra Road Substation to the Chumvale Substation and to extend Ergon's Ernest Henry 220 kV line to the Dajarra Road Substation. An 80 m wide easement (matching the width of the Dugald River mine access lease) is required to extend MMG's Dugald River 220 kV line to the Dajarra Road Substation.

The remaining sections (Mount Isa Augmentation, Southern Connection, and Woodya Connection) will have 60 m wide easements, with the transmission line being constructed in the centre of the easements.

2.5.2 Transmission towers

Although the conceptual design is based on self-supporting steel lattice transmission towers, alternative structures such as guyed towers or monopoles may be considered, where appropriate.

The Mulgrave Substation cut-in (north and south) will have double circuit 275 kV transmission lines.

The Renewable Energy Hub and CopperString Core will have double circuit 330 kV transmission lines. Typical structures are shown in Plate 2-1. Each transmission tower will support a single circuit on each side of the tower.

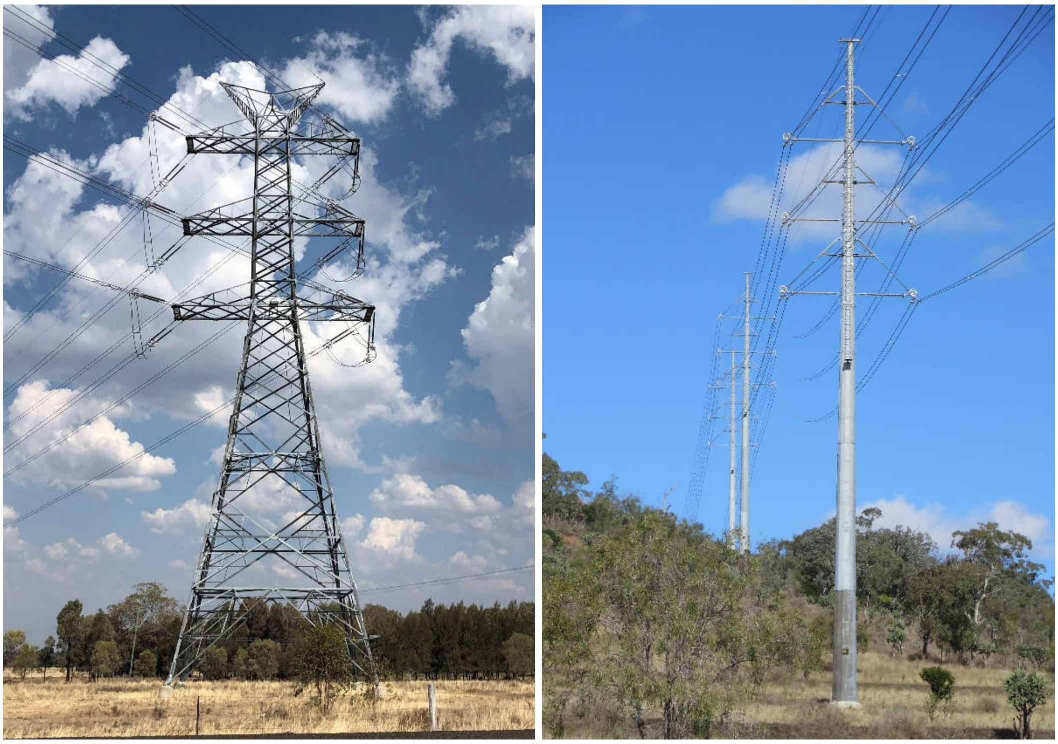


Plate 2-1 Typical 330kV double circuit self-supporting steel lattice transmission tower (left) and typical 330 kV double circuit monopole (right)

The Mount Isa Augmentation and the Southern Connection will each have a double circuit 220 kV transmission line. Each double circuit transmission structure will support a single circuit on each side of the tower (Plate 2-2).

The Woodya Connection will have a double circuit 220 kV transmission line, energised at 132 kV.

The connections between Dajarra Road Substation and the Chumvale Substation area will have three 220 kV single circuit transmission lines.

Each transmission line circuit consists of three phase conductors (or groups of sub-conductors) and an optical ground wire (OPGW). Each individual phase conductor is attached to the transmission tower with an insulator and a cross arm. The OPGW consists of a fibre optic cable shielded by a conductor so it functions as both lightning protection and communications media.

Plate 2-2 Typical 220 kV single circuit lattice transmission tower (left) and typical 220 kV single circuit monopole structure (right)

Transmission towers will be designed to maintain a clearance of the transmission line above local terrain in compliance with Queensland legislation. Nominal transmission tower heights and distances between transmission towers are described in Table 2-3. Transmission tower heights will vary from location to location depending on the topography of each specific location.

Table 2-3 Transmission tower physical description

Transmission line route	Minimum height (m)	Maximum height (m)	Typical spacing (m)
Mulgrave cut-in	45	65	500-600
Renewable Energy Hub	50	75	500-600
CopperString Core	50	75	500-600
Mount Isa Augmentation	45	65	500-600
Southern Connection	45	65	500-600
Phosphate Hill Connection	45	65	500-600

The distance between transmission towers will typically be in the range of 500-600m. This may vary (and in special circumstances exceed 600 m) depending on the topography and conductor clearance required areas of the easement. Drawings showing indicative placement of transmission towers are included in Volume 3 Appendix H Tower siting plans.

The concept transmission tower sites have been selected after careful consideration of all physical constraints such as sensitive environmental areas, rock/soil types, significant waterways /

watercourse infrastructure crossings, existing land use and amenity. The transmission towers will be sited to make the best use of available terrain providing both sound foundations whilst minimising impacts to the environment and adjacent land uses.

Transmission towers and associated construction materials will be located outside of active watercourses and wetlands. Where the corridor selection crosses large braided ephemeral systems, some of which are more than 1 km wide, tower sites have been individually selected to avoid existing channels and the tower design will be sufficient to withstand seasonal flows or larger flooding events.

Foundations

The type of foundation for the transmission towers is largely dependent on the site and soil condition. Although the conceptual design is based on cast in-situ steel reinforced concrete piles, alternative foundation types such as driven steel reinforced concrete piles, driven steel piles or steel screw piles may be considered, where appropriate. Transmission tower sites that may be subject to inundation from flooding and large rainfall events will be engineered to protect the structure and site from erosion or degradation.

Detailed geotechnical studies will be conducted during the detailed design of the Project to finalise foundation types and will likely constitute a range of footing types and designs that will vary, depending on the final transmission tower size, transmission tower type and site conditions for each location. Transmission tower foundations will be mostly bored concrete piers. Depending on ground conditions, alternative foundation design such as rock anchors or concrete raft foundations may be required. Further site testing will be conducted during construction to enable selection of a standard design for each site.

Where monopoles are used there will be a single foundation, rather than four separate footings. In certain installation conditions, monopoles may require the fitment of guy wires, which will have additional anchoring foundations.

Where guyed lattice monomast towers are used there will be a foundation under the mast plus separate footings for each guy.

2.5.3 Infrastructure and watercourse crossings

Consultation with the relevant government agencies, such as Department of Transport and Main Roads (DTMR) and Queensland Rail will be required to develop specific management plans for potential impacts to existing road and rail infrastructure. The project transmission infrastructure will cross state-controlled roads in 13 locations and local roads in 35 locations. There will be 3 crossings of the Mount Isa railway line (refer Table 2-4).

Major roads and local roads (where suitable) are an important means of access to the transmission line easement for construction and maintenance. They are also a constraint to cross when constructing a transmission line because of the need to maintain the use of the road and to protect the users of the road during construction.

No new rail crossings are proposed for vehicle access to the corridor. Where access tracks are required to cross a railway line, existing operational crossings will be utilised. A detailed register of all rail and road corridor crossings is provided in Volume 3 Appendix G Intersecting Road and Rail Infrastructure Crossings.

The transmission lines will also have to cross other existing distribution line infrastructure in 46 locations.

The watercourses in Table 2-4 are named watercourses identified on Geoscience Australia (2006) 1:250,000 Topographic data.

Table 2-4 Infrastructure and watercourse crossings

Infrastructure	Number of crossings
Road crossings	
State-controlled roads	13
Local government roads	35
Railway crossings	
Railway crossings	3
Transmission line crossings	
220 kV	3
66 kV	7
33 kV	5
19.1 kV	29
11 kV	2
Watercourse crossing*	
Named water features crossings	60
Major water feature course crossings	25

*table denotes number of times watercourses are crossed, some watercourses are crossed multiple times

Major watercourse crossings are defined as crossings where the corridor selection traverses significant floodplain extents greater than 0.5 km in width, which accounts for more than 90 percent of the floodplain crossing extents. A summary of watercourse crossings is included in Table 9-3 of Volume 2 Chapter 9 Water resources and water quality.

Watercourses may be defined as waterways for waterway barrier works, under the Queensland *Fisheries Act 1994*. Most waterways along the proposed route flow intermittently or are ephemeral. As works in these areas are generally programmed for the dry season, it is expected most waterways will be dry when crossed. Where this is not the case, and for larger waterway crossings, the access to transmission tower sites will use either existing crossings or a new temporary waterway crossing will be constructed (unless for safety reasons). A summary of watercourse crossings is included in Table 9-3 of Volume 2 Chapter 9 Water resources and water quality.

There are no components of the Project that are defined as waterway barrier works. Towers will not be constructed within any waterways. Conductors and earth wire pull cables will be strung over the waterways using helicopters where riparian zones contain vegetation that is at risk of significant disturbance from manual line stringing. Vehicle access across waterways is likely be in the form of a bed level crossings which can be established in accordance with the Department of Agriculture and Fisheries' Accepted development requirements for operational work that is constructing or raising waterway barrier works. Any bed level crossings of watercourses will also be established in accordance with the Department of Regional Development, Manufacturing and Water's riverine protection permit exemption requirements or a riverine protection permit will be obtained under the Water Act 2000.

The major river crossings are:

- Burdekin River
- Campaspe River
- Cape River
- Gilliat River
- Fullarton River
- Williams River
- Cloncurry River
- Corella River
- Leichhardt River
- Burke River.

Where civil works are required to upgrade an existing waterway crossing or establish a new waterway crossing for construction, an assessment of the temporary design and duration the infrastructure will be required within the waterway, will be undertaken. A development permit for waterway barrier works will be obtained prior to commencement of construction of these civil works where compliance with the accepted development requirements cannot be achieved. A list of all Department of Agriculture and Fisheries' waterways crossed by the transmission lines is included in Table 9-5 of Volume 2 Chapter 9 Water resources and water quality.

2.5.4 Substation locations

New substations will be required at Mulgrave, Hughenden, Cloncurry, Mount Isa, Selwyn and Woodya (refer to Figure 2-1).

Substations are required to perform switching, transform voltage, control stability through reactive and system strength support, and to connect to the customer or Powerlink systems.

Indicative plans of the substation locations are included in Volume 3 Appendix I Indicative infrastructure layout and cross-section drawings.

Mulgrave

The Woodstock Substation will connect the CopperString transmission network to the Powerlink 275 kV transmission network. The connection to the existing Powerlink 275 kV transmission network consists of the Mulgrave Substation and two sections of 275 kV double circuit transmission line for a cut-in to the Strathmore to Ross transmission line, each about 1 km long. The Mulgrave Substation will be contiguous with the north-eastern boundary of the Woodstock Substation.

The Woodstock Substation will be the interface for conductors, communications, and protection between the Powerlink and CopperString transmission networks.

The Woodstock Substation will be located approximately 25 km south-west of the township of Clare adjacent to the Ayr Ravenswood Road.

The Woodstock Substation will transform voltage between the 275 kV and 330 kV networks. Reactive plant such as line reactors, capacitor banks and harmonic filters will be required.

Hughenden

The Flinders Substation located approximately 5 km south-west of Hughenden, will form part of the Renewable Energy Hub.

Reactive plant such as reactors, capacitor banks and static synchronous compensator (STATCOM) will be required.

Cloncurry

The Chumvale Substation is an existing substation, owned by Ergon Energy, located approximately 9 km west of Cloncurry.

The Dajarra Road Substation is approximately 3 km south of the existing Chumvale substation, located adjacent to the Cloncurry Duchess Road. The Dajarra Road Substation will transform voltage between the 330 kV and 220 kV networks, interconnect with the NWPS 220 kV network at Chumvale, and connect to transmission lines radiating out to 220 kV bulk supply customers.

Reactive plant such as reactors, STATCOMs and capacitor banks will be required.

The existing 220 kV transmission line connecting Chumvale Substation to Dugald River Mine will be cut at a location near the Chumvale Substation. The section of the transmission line connected to Dugald River Mine will be joined to a short section of transmission line connecting it to the Dajarra Road Substation. The remaining section of the Dugald River Mine transmission line will be disconnected from the Chumvale Substation.

The existing 220 kV transmission line connecting Chumvale Substation to Ernest Henry Mine will be cut at a location near the Chumvale Substation. The remaining section of the Ernest Henry Mine transmission line will be joined to a short section of transmission line to connect it to the Dajarra Road Substation. The remaining section of Ernest Henry Mine transmission line connected to the Chumvale Substation will similarly be joined to a short section of the transmission line connecting it to Dajarra Road Substation. In this way, brownfield work on the primary systems at the Chumvale Substation can be minimised.

It will be necessary to integrate protection and communication systems at the Chumvale Substation.

Mount Isa

The Mount Isa Substation will be located north of the existing Mica Creek power station at Mount Isa. The Mount Isa Substation will transform voltage between the 220 kV and 132 kV networks, interconnect with the Mica Creek D Substation, and connect to transmission lines radiating out to 220 kV and 132 kV customers.

Reactive plant such as capacitor banks and harmonic filters will be required.

Selwyn

The Selwyn Substation will be located approximately 6 km west of the abandoned mining township of Selwyn. Selwyn Substation will be a transmission node with two 220/132 kV transformers and a 132 kV bus supplying the Woodya Connection and providing a connection point for energy consumers such as Mount Dore Mine.

Phosphate Hill Mine

The Woodya Substation is located near the Phosphate Hill Mine. The Woodya Substation will be a transmission node comprising a 132kV switching station.

2.5.5 Substation equipment

Fencing

Security fences with locked gates will be installed around the substation sites to restrict unauthorised access to the site in accordance with regulatory standards. The site will be unattended unless maintenance of the substation is being carried out.

A security fence will define the overall boundary of the substation site and the balance of the land acquired will provide a buffer zone.

Civil works

A gravel access road and space for parking will be provided at each substation site to allow maintenance staff access to the site under all weather conditions. The substations will be positioned with access to a public road. Access roads will be approximately 6 m wide and the substation sites will provide enough space for maintenance and emergency vehicles that may need to access the site. The grade of access roads will be kept to a minimum to allow the potential transport of heavy machinery and to minimise water erosion.

Roads into and around the substation sites and hard standing and pavement areas will be constructed, suitable for anticipated weight of plant, vehicles and equipment and amount of traffic anticipated over the life of the substation.

Drainage

Substation platform surface runoff will flow through sediment control systems. Oil and water separators will be installed as part of drainage. A first flush diversion system will be installed to mitigate the risk of releasing sediments and contaminants from the area. Automated oil detection and separation systems may be utilised.

The need for drainage works shall be kept to the minimum and care taken also to minimise damage to natural drainage channels and soil erosion. The drainage system will be largely influenced by the final substation platform level relative to the surrounding natural ground surfaces and associated grades.

Major electrical equipment and switchgear

Specific design parameters of each of the substations are outlined in Table 2-5. The main power transformers to be installed will be large oil filled static units, with a delivery weight without oil in the order of 65 to 200 t, with oil volumes up to 150 kL for the larger transformers. Transformer installations are designed with oil containment bunds and oil interception systems to minimise the risk of an oil spill escaping into the environment. Biodegradable oils may be used where technically feasible to mitigate environmental risks.

Table 2-5 Technical description of substation sites

Substation	Technical description of major electrical equipment
Woodstock	• 3 x 275/330 kV transformers • 2 x 330 kV line shunt reactors • 1 x 330 kV shunt reactor • 1 x 330 kV shunt capacitor • 2 x 330 kV filters
Flinders	• 2 x 330 kV STATCOMs including transformers

Substation	Technical description of major electrical equipment
	• 3 x 330 kV shunt reactors • 4 x 330 kV line reactors
Dajarra Road	• 3 x 330/220 kV transformers • 2 x 220 kV STATCOMs including transformers • 2 x 330 kV line reactors • 2 x 220 kV shunt capacitors
Mount Isa	• 2 x 220/132 kV transformers • 3 x 132 kV shunt capacitors • 2 x 132 kV filters
Woodya	• 1 x 220/132 kV transformers
Selwyn	• 2 x 220/132 kV transformers

Fire protection system

Fire protection in equipment rooms will be principally through passive protection, such as fire-retardant cabling, dispersal of equipment, and fireproof cabinets.

The installation of transformers and other equipment will be designed where possible to eliminate the requirement for fire water deluge systems. Where technically feasible, fire resistant transformer oil will be used to prevent the escalation of transformer faults into fire.

Gaseous fire suppression will be considered during the safety in design risk assessment processes and only installed if warranted.

Other Facilities

Substation sites will have an allowance for a small maintenance facility that will consist of a dust-free building with an internal cubicle that includes amenities, an office and a hardstand for the loading and unloading of storage.

The Woodstock, Flinders and Dajarra Road substation sites will incorporate an unsealed helicopter landing area.

Additional areas may be required for hazardous substance enclosures or fuel storage areas or tanks.

Any storage shed will typically be a 'slab on ground' portal frame design with Colorbond® type walls.

2.5.6 Protection, control, and communications systems

Control systems

The transmission system, including the necessary power quality control and protection schemes, will meet the requirements of the NER.

The substations will house the supervisory control and data acquisition (SCADA) system in a separate control and communications building at each substation site. The SCADA system will communicate with the control centre for interface with a human operator. This automated system ensures real-time 24-hour monitoring of the network.

The control and communications buildings will be of a transportable prefabricated building design with fire resilient Colorbond® walls and roofing. They will be delivered complete to site and installed on their foundations using a mobile crane.

Voltage and reactive power control

The transmission system will maintain voltage at the relevant connection points within the requirements of the NER. The system will effectively and efficiently control voltage and reactive power to achieve efficient, stable, and safe power transfer.

Islanding capability

The transmission system will include an emergency frequency control scheme meeting the requirements of the NER. The scheme will include appropriate controls for scenarios such as separation from the state grid and separation of portions of the network.

Protection and load shedding

The control system will include necessary plant self-protection systems and load shedding regimes consistent with the NER.

The existing NWPS currently incorporates local load shedding regimes, which may be incorporated into the CopperString transmission network system following a review of the compliance of these regimes with the NER.

Dynamic rating

The transmission system will be capable of calculating the dynamic rating of critical sections of the transmission line in real time and communicating this to the National Electricity Market Dispatch Engine (NEMDE) for use in constraint equations.

Local generation

As the Project will be connecting the NWPS to the state electricity grid, to enable participation in the NEM, all existing local generators connected to the NWPS, and generators connecting directly to the Project, will need to register under the appropriate categories to participate in the NEM. The system will connect each scheduled and semi-scheduled generator to the NEMDE. The NEMDE will manage constraints and dispatch local generation.

Communications system

Fibre optic cables incorporated into the OPGW will provide communication links across the system.

Communications will be by two OPGW for the double circuit transmission lines.

Spare capacity in the OPGW system will be offered to telecommunications carriers willing to pass the benefit of this spare capacity on to communities along the Project corridor selection.

OPGW repeater stations

In addition to the communication infrastructure at each substation, OPGW repeater stations will be required at sites along the transmission network to boost the optical signal. Repeater stations will be located at a spacing of 80 to 120 km, close to the transmission line.

The main component of the repeater stations will be a hut housing the Controlled Environmental Vault (CEV). The CEV huts will be unmanned. Equipment within the CEV huts will be battery powered, charged by mains electricity, where available, or solar power. Proposed locations of CEV huts are outlined in Table 2-6 and indicative locations and site plans are included in Volume 3 Appendix I Indicative infrastructure layout and cross-section drawings.

Table 2-6 Proposed CEV hut locations

CEV hut	Chainage	Location
Charters Towers South CEV	Between KP 110WD and KP 111WD	Approximately 23 km south-west of Charters Towers, adjacent to the Gregory Developmental Road
Pentland South CEV	Between KP 181WD and KP 182WD	Approximately 24 km south-east of Pentland, adjacent to Longton Road
Warreah South CEV	Between KP 278WD and KP 279WD	Approximately 9.8 km south-west of Warreah railway station, adjacent to Cotonvale Penrice Road
Barabon CEV	Between KP 419WD and KP 420WD	Approximately 4.5 km south of the Barabon railway station, adjacent to Barabon Terranburby Road
Nonda CEV	Between KP 498WD and KP 499WD	Approximately 12 km south of the Maxwelton railway station, adjacent to Maxwelton Kynuna Road
Yorkshire CEV	Between KP 565WD and KP566WD	Approximately 17.5 km south-east of Quarrells railway station, adjacent to Yorkshire Nelia Road
Gilliat CEV	Between KP 639WD and KP 640WD	Approximately 10.5 km south-east of Tibarri railway station, adjacent to Wellen Road

Site works will comprise installation of an earth grid, conduits for power, control and communications cables, security fence, weed mats and a gravel surface. Where grid connected power supply is not available, solar array frames will supply power requirements. These solar array frames will be mounted on strip footings and will be rated for local wind or cyclone conditions. An example of a typical CEV hut (non-solar) is provided in Plate 2-3.

The CEV huts will be prefabricated and mounted on concrete piers or slab footings inside a fenced area, that will also contain the ground mounted solar panels, where required. The CEV huts will be on the northern side of the corridor, outside but abutting the easement. An area of approximately between 21 x 16 m will be fenced; however, to ensure that vegetation management is maintained an area of approximately 71 x 66 m (approximately 0.5 ha) is required to maintain fire security.

Plate 2-3 Typical communications hut

Network control centre

The transmission system will require a control centre. The system will be operated by a third-party network service provider from their relevant existing operations centre. CuString is currently engaged in discussions with Powerlink regarding the scope of these services. If a dedicated control room is required, it will be established in the region.

If required, a dedicated, stand-alone backup control centre will be located at the Dajarra Road substation. This system will include sufficient human-machine interfaces and operator facilities, including parking and service vehicles to allow operation of the system from the Dajarra Road control centre. The Dajarra Road control centre will be capable of operation of the entire system in isolation from the main control centre for sustained periods of time.

2.6 Project workforce

2.6.1 Workforce numbers

The EIS will detail the workforce requirements for the Project based on the proposed construction methodologies outlined in Section 2.13. The Project will provide direct employment opportunities during construction and operation. It is anticipated that 757 people will be employed during the peak of construction of the Project and 30 people will be required to operate and maintain the infrastructure. Indirect employment opportunities will occur as a result of the construction and commissioning of the Project by means of further regional development and an expansion to the exploration, mining and resources processing of the region due to the provision of competitive and reliable electricity.

Detailed information about the construction workforce is included in Section 2.17.

2.6.2 Workforce accommodation

CuString acknowledges the potential impact of a large workforce on local infrastructure and services of areas with small existing populations and housing availability. For this reason, it is planned that temporary construction camps will house most of the construction workforce.

The Project corridor selection will be segmented into nine construction hubs (refer Section 2.13.2), each serviced by a central camp (or within proximity to existing establish accommodation) and project office. All hubs will support transmission line construction activities; some will also support substation construction activities (refer Figure 2-6). Construction of the Project within the required timeframes will require concurrent activities across most of the construction hubs.

Where possible, the construction camps will be located near major towns of the region, to make best use of existing services, including water supply, electricity, sewage, and air transport. This will also enable local industry participation for services such as catering and cleaning and will avoid negative impacts on existing accommodation resources in the region while providing benefit to local supply services. Indicative locations of construction camps are included in Volume 4 Attachment D Revised concept infrastructure plans.

Accommodation will be provided for all non-local personnel employed on the Project, except the workforce crew that are planned to install and decommission the construction camps.

A local point of hire will be made available to local workers at each camp that is co-located with a town.

The temporary construction camps will be designed to provide a high level of accommodation to industry standards and will comply with all relevant legislation and regulations, including the required building codes, occupational health and safety guidelines and local planning laws. Potential camp locations are currently being investigated in consultation with local authorities and communities to ensure minimal impacts to host communities during the construction phase. Further information about workforce accommodation is included in Section 2.6.2.

2.7 Transport

2.7.1 General

The Project will pass through remote regions of north and north-west Queensland, typified by long distances and sparse populations, with limited local logistical support.

The Renewable Energy Hub and CopperString Core sections of the easement generally run parallel with the Kennedy and Barkly highways, facilitating access to the easement during construction. Distances are vast, impacting daily productivity if logistics are not efficient, particularly transportation of personnel between camp and work sites.

The Southern Connection is remote and in a region with almost no services. Work crews operating in this region will need to be self-sufficient.

The wet season will impact the ability to access constructions sites due to boggy conditions, particularly in the regions between Hughenden and Cloncurry. Flooding may impact construction transportation during the wet season. Heavy vehicle transport along the Kennedy and Barkly highways may also be restricted during this period.

2.7.2 Major towns

The major towns along the Renewable Energy Hub and CopperString Core corridor are:

- Charters Towers
- Hughenden
- Richmond
- Julia Creek
- Cloncurry
- Mount Isa.

A summary of the facilities in each of the population centres is included in Section 14.3.2 of Volume 2 Chapter 14 Social. All population centres, other than the city of Mount Isa are rural communities with basic facilities supporting the agricultural industry.

There are no population centres along the Southern Connection, other than Cloncurry at its northern most end. Very limited services are available at Dajarra Roadhouse, some 100 km west of the connection and Middleton, some 150 km southeast of the transmission line corridor. In an emergency, or by agreement, customer facilities at Phosphate Hill Mine may be available.

2.7.3 Air services

Virgin Australia and Qantas airlines service Mount Isa, Cloncurry and Townsville from Brisbane daily. Qantas operates daily services between Townsville, Cloncurry and Mount Isa. Rex Airlines operates a SAAB 340 (30-36 seat) hop service from Townsville to Mount Isa (and return) through Hughenden, Richmond and Julia Creek every Monday, Wednesday and Friday.

Incitec Pivot operates a Fokker 100 charter service between Townsville and The Monument Airport at Phosphate Hill Mine, and offer spare seats to related contractors, neighbouring mines and the local community on an 'as available' basis.

There are no hire car facilities at the southern mines or any towns along the corridor other than Mount Isa and Townsville.

A range of general aviation charter services are available out of Townsville and Mount Isa. Townsville hosts a small range of helicopter charter services, including at least one company with a line stringing capability.

Charter air services will be utilised to operate the fly-in fly-out (FIFO) operations. Townsville will be used as the FIFO hub and regular flights will be operated to service the camps at Hughenden, Richmond, Julia Creek, Cloncurry, Mount Isa and Selwyn Substation.

Helicopter charters may also be used for crew transfers in more remote or difficult to access regions.

2.7.4 Rail

Queensland Rail operates the Mount Isa Line system (including the Phosphate Hill branch), which is rated to 20 tonne axle loads. A passenger service (The Inlander) between Townsville and Mount Isa operates twice weekly.

Mount Isa and Cloncurry both have container handling facilities associated with the rail depots. All towns along the corridor have basic rail sidings and small freight yards. Townsville Port operates an intermodal freight terminal.

A limited amount of general freight is delivered by rail typically as additional wagons attached to trains delivering bulk mining product. Use of the rail system (and co-location of laydown areas with rail sidings) to minimise truck haulage on the road network will be explored with freight agents and Queensland Rail.

2.7.5 Port facilities

The Port of Townsville is the nearest major seaport to the Project. The Port of Townsville's facilities include eight operational berths with a uniformly distributed load capacity of up to 5.0 t/m^2 and container handling. The Port of Townsville maintains a channel depth of at least 11.7 m and berth pocket depths to 12.5 m (Berth 8). Mariana Lines operates a fortnightly service to Townsville from Chinese seaports through Indonesia, Darwin and Port Moresby.

The Port of Brisbane receives more frequent scheduled services from Europe, Asia and the Americas.

It is expected that the bulk of the materials and equipment will be imported through the Port of Townsville. Where access to more regular shipping schedules or direct access from Europe or America is required, the Port of Brisbane and the East Coast Rail Line will be utilised. Private charter services, if required, will unload at the Port of Townsville.

2.8 Road infrastructure

The Flinders and Barkly Highways run parallel to the Renewable Energy Hub, CopperString Core and Mount Isa Augmentation. These roads are dual lane, sealed and meet interstate highway standards.

Type 2 road train (to 53.5 m) access is available (by the approved route) from the Port of Townsville and then generally permissible (subject to local restrictions) on most roads west of the Townsville City and Burdekin Regional Councils.

A review of road restrictions did not reveal any height restrictions on the route between the Port of Townsville and Mount Isa other than a rail bridge passing over the Flinders Highway with 5.5 m clearance at Charters Towers, conveyor infrastructure within the port and Ergon Energy distribution assets.

Access to the Southern Connection is by a combination of gravel and single lane sealed roads.

There are limited services south of Cloncurry, meaning that work crews will need to be self-sufficient and set up for remote operation (including emergency management).

Greyhound Australia operates a weekly coach service between Townsville and Tennant Creek in the Northern Territory, stopping at all major towns along the Project corridor.

CuString will consult with transport agencies and local council authorities at the earliest possible instance regarding the use of local roads, loads requiring transportation, transport types, construction schedule and other relevant transport information.

The regional transport network is illustrated in Figure 2-3.

The proposed freight transport road corridor provides links with other corridors to facilitate the movement of freight through north-west Queensland, including the Bruce, Barkly and Landsborough Highways and the Burke, Wills, Kennedy, and Gregory Development Roads.

2.8.1 Local road network

The roads that may be used during construction of the Project fall under the control of the following local government areas:

- Townsville City Council
- Burdekin Regional Council
- Charters Towers Regional Council
- Flinders Shire Council
- Richmond Shire Council
- McKinlay Shire Council
- Cloncurry Shire Council
- Mount Isa City Council.

Many of the roads that have been identified as being likely to be utilised to access the sites for construction are local government owned and maintained gravel roads. They are graded in the dry season only and are generally 8 m wide formation. They can take heavy vehicles provided load limits are not exceeded. In practice, they are generally trafficable by road trains in the dry season. Most of the identified local council operated roads have creek crossings that will result in road closures in the wet season.

2.8.2 Seasonal factors

The summer wet season, generally December to March, has the potential to disrupt and delay construction. This applies especially to the black soil/Mitchell Grass plains areas stretching from east of Hughenden to west of Julia Creek.

While flooding can occur in the areas from Woodstock through to east of Pentland generally, drainage and soil conditions are such that delays during the wet season are likely to be relatively short and work may continue during that period. Similarly, delays over this period may be experienced in the areas around Cloncurry to Mount Isa and south to Cannington and Phosphate Hill. Although the access road into Cannington is via black soil country around McKinlay, the road to McKinlay and into Cannington is sealed.

Wet season flooding events can be severe, causing damage to the structure and foundations of the Flinders Highway, resulting in road closure, especially for heavy vehicles.

The construction program is structured so that where possible peak construction activities in areas susceptible to flooding are programmed to occur outside of the wet weather period. In addition, the transport management plan will need to address wet weather aspects associated with the use of unsealed access tracks, such as communication paths and procedures for road use in wet weather, stop work conditions, transport agency consultation on weather events and road use conditions, and formalised wet weather access arrangements with private landholders.

2.8.3 Road use management plan

A road use management plan (RUMP) will be developed by the Construction Contractor for the Project and will include consultation with the relevant transport authorities, such as DTMR, Queensland Rail and local councils. The main purpose of the RUMP is to outline the framework for work practices, procedures, and management controls to minimise traffic impacts and address the safety of all road users.

2.9 Transport of construction materials

2.9.1 General

The estimated tonnage of transmission tower steel and components will be 56,610 tonnes with each transmission tower weighing approximately 30 tonnes (based on steel lattice transmission tower design).

From Townsville, it is envisaged that movement to construction lay-down areas will be generally transported in Type 2 road trains along the Flinders or Barkly Highways or by rail along the Mount Isa Rail Line.

Table 2-7 summarises the anticipated numbers of road trains in relation to the transport of construction materials. This estimate assumes the highest possible number of vehicle movements.

Transportation to the Woodstock construction zone will also utilise local roads, some of which will require an upgrade.

If rail is used, it is anticipated that there will be substantially fewer long-distance truck movements.

Table 2-7 Summary of road train movements for transmission tower construction materials

Construction Zone	Road train movements (one way only)	Period (weeks)	Average weekly movements (one way)
Woodstock	57	6.0	10
Charters Towers	131	14.0	10
Pentland	251	33.0	8
Hughenden (east)	162	13.0	13
Hughenden (west)	95	9.0	11
Richmond	243	19.0	13
Julia Creek	266	19.0	14
Cloncurry (east)	124	17.0	8
Cloncurry (west)	97	13.0	8
Mount Isa	97	9.0	11
Cloncurry (south)	158	16.0	10
Selwyn (to Woodya)	100	8.0	13

2.9.2 Load limits and over dimensional loads

It is anticipated that several over mass and over dimension loads will be required to deliver specialised equipment such as transformers, SVCs, line reactors, capacitor banks, switch rooms, camp buildings and other equipment. Construction machinery such as large cranes may also require over mass and/or over dimension permits.

The logistics contractor responsible for the delivery of the equipment will lodge the appropriate applications and prepare RUMPs.

Transportation of the above materials falls into the over dimensional load category and will be transported from the Port of Townsville direct on low loaders requiring permit approvals and escort vehicles.

Table 2-8 indicates the total number of movements over each section for delivery of transformers. These movements will be spread over the construction period phased by an install and delivery schedule.

As a guide the dimensions from preliminary layout diagrams are as follows:

- 500 MVA transformers – 200 t – 9.60 m (L) x 6.03 m (W) x 7.31 m (H)
- 60 MVA transformers – 68 t – 5.10 m (L) x 3.24 m (W) x 4.22 m (H).

Table 2-8 Over dimensional load movements of transformers

Construction zone (transport from Townsville)	Vehicle movements (one way)	Aggregate movements over construction zone (one way)
Via the Flinders Highway		
Woodstock	6	20
Hughenden	7	14
Cloncurry	3	7
Via the Flinders Highway and Barkly Highway		
Mount Isa	2	4
Via the Flinders Highway, Barkly Highway, Cloncurry Duchess Road, Malbon Selwyn Road and Selwyn Toolebuc Road		
Selwyn	2	2
Via the Flinders Highway, Barkly Highway, Cloncurry Duchess Road and Chatsworth Phosphate Road		
Woodya	0	0

2.9.3 Concrete

Concrete will be supplied to the construction sites for each construction zone from several existing or mobile concrete batching plants. This concrete will be utilised in the transmission tower and substation foundations. More details on resources for operation of the batch plants can be found in Section 2.18.3.

The requirements of concrete transportation are summarised below in Table 2-9, based on transport by concrete agitator trucks with 5.6 m^3 capacity.

Table 2-9 Truck movements for concrete transportation

Construction zone	Concrete requirement (m^3)	Total truck movements (one way only)	Period (weeks)[1]	Local road average weekly movements (one way)	DTMR road average weekly movements (one way)
Woodstock	13052	2331	8	291	13052
Charters Towers	3264	583	13	45	3264
Pentland	4224	754	32	24	4224
Hughenden	13628	2434	13	187	13628
Richmond	7253	1295	18	72	7253
Julia Creek	7617	1360	19	72	7617
Cloncurry	15282	2729	17	161	15282
Mount Isa	7034	1256	8	157	7034
Selwyn and Woodya	6022	1075	11	98	6022

[1] Transmission tower construction only

2.9.4 Construction facilities

Construction camp facilities will comprise of demountable units which will require the transport of construction materials during assembly, operation, and demobilisation of these facilities.

It is estimated that each 350-person camp will require 220 semi-trailer movements (110 loaded and 110 unloaded) for the assembly and demobilisation of each camp facility. The worst-case scenario has been assumed to calculate the expected input and output volumes, with the transportation of the temporary camp facilities to and from Townsville. If efficiencies in construction can be achieved, it may be possible to reuse camp infrastructure for multiple construction hubs.

2.10 Workforce movements

The movement of workforce personnel can be categorised into the transport of the workforce to and from the construction camps and the local movement between the construction camps and the construction sites.

2.10.1 Transport to and from camps

It is envisaged that the Project will operate a combination of FIFO and bus-in bus-out (BIBO) deployment of workforce, with Townsville as the FIFO/BIBO hub servicing the camps at Woodstock, Charters Towers and Pentland, via chartered buses and the camps at Hughenden, Richmond, Julia Creek, Cloncurry, Mount Isa and Selwyn Substation via chartered flights.

2.10.2 Transport to and from worksites

The movement of workforce personnel will occur in each construction hubs to and from the local accommodation. The workforce will travel to their construction worksites spread over each section of active construction of approximately 105 km centred around the local accommodation. A mixed fleet of 4WD vehicles, buses or other transport modes will be used to transport personnel between the construction zone and local accommodation.

The Project will provide transport for construction workers. Unless there is an overwhelming need, construction workers' private vehicles will not be permitted to access the transmission line easement. This will reduce the traffic volume on local roads and help to manage biosecurity as well as dust, noise and driving risks. Additionally, the restriction of construction workers' private vehicles from the easement means fewer parking areas will be required, thus reducing congestion and the impact on road safety.

Vehicles will move along the safest and most efficient route to their relevant worksite, which will be dependent on the final location of access tracks and the location of work sites. For Project construction in the vicinity of the construction camp area, the road pattern is such that workers will move straight out along a transmission line easement access road avoiding the need to use the highway. Those accessing the transmission line easement further out will use the highway, fanning out in both directions (east and west), before accessing the easement.

2.11 Infrastructure requirements

2.11.1 Overview

Infrastructure required for the construction of the Project includes the following:

- Temporary construction camps to accommodate the construction workforce (see Section 2.17.4)
- Temporary workshops and site offices to coordinate construction activities (see Section 2.18)
- Temporary construction laydown/delivery areas for the preparation of building materials and assembly of the transmission line components (see Section 2.18.1)
- Access tracks, which will also be used for ongoing maintenance of the transmission line (see Section 2.11.3)
- The use of local and state-controlled roads to allow the safe transportation of construction materials (see Section 2.8)
- Temporary concrete batching plants for production of concrete for foundations (see Section 2.18.3)
- Water supply for construction activities and camps (see Section 2.22.1)
- Power supply for construction activities and camps (see Section 2.23).

The potential locations of the associated infrastructure will be finalised during the detailed design of the Project. The finalisation of these sites will be achieved through ongoing negotiations with landholders and relevant government agencies as appropriate (e.g. local councils, DTMR and the Department of Community Safety). Indicative locations of these infrastructure requirements are detailed in the following sections.

2.11.2 Disturbance assumptions

The percentage of each landscape type which occurs within each corridor section has been calculated and is detailed in Table 2-10. Table 2-10 also details the percentage of vegetation above 3.5 m found within each landscape type and corridor section. This percentage of vegetation over 3.5 m has been considered in the calculation of disturbance associated with the transmission line conductor clearance zone (blow-out) at the mid span. Table 2-11 outlines the approximate project disturbance footprints for infrastructure required for the construction and operation of the Project. These footprints have been used to calculate the total disturbance requirements of the Project across defined landscape types.

Table 2-10 Landscape types per corridor section

Corridor Section	Landscape type					
	Riparian	Open forest	Low open woodland	Mixed low woodland	Tussock	Previously cleared
Percentage of landscape type per corridor section						
Chumvale Connections (4 Km)	13.86	0.00	83.96	2.19	0.00	0.00
CopperString Core (395 Km)	13.85	0.00	9.06	2.67	73.09	1.33
Mount Isa Augmentation (99 Km)	31.05	0.00	64.17	0.00	4.59	0.20
Woodya Connection (61 Km)	11.65	0.00	35.02	8.76	44.43	0.15
Renewable Energy Hub (342 Km)	14.67	70.06	0.12	1.52	4.04	9.59
Southern Connection (91 Km)	14.82	0.00	81.80	1.05	2.33	0.00
Percentage of vegetation over 3.5 m in each landscape type and corridor section						
Chumvale Connections	7.89	0.00	2.57	7.01	0.00	0.00
CopperString Core	4.19	0.00	3.32	8.71	0.19	0.90
Mount Isa Augmentation	7.69	0.00	4.41	0.00	4.89	11.74
Woodya Connection	6.25	0.00	3.16	1.48	0.60	3.47
Renewable Energy Hub	22.64	18.74	32.37	25.48	1.36	3.38
Southern Connection	9.32	0.00	5.18	17.19	2.98	0.00

Table 2-11 Infrastructure disturbance footprint

Activity	Approximate Footprint
Access tracks	• Construction 6 m wide. • Chumvale Connections (2.7km + 3.7km) 3.84 ha (2.9 ha excluding tower areas) • CopperString Core (395 km) Line 2: 237.0 ha (200.4 ha excluding tower areas) • Mount Isa Augmentation (99 km) Line 3: 56.4 ha (40.2 ha excluding tower areas)

<table>
<tr><th>Activity</th><th>Approximate Footprint</th></tr>
<tr><td></td><td>

Renewable Energy Hub (342 km) Line 1: 205.2 ha (172.5 ha excluding tower areas)
Southern Connection (91 km) Line 4: 54.6 ha (49.4 ha excluding tower areas)
Woodya Connection (61 Km) Line 5: 36.6 ha (32.1 ha excluding tower areas)
Operation 3 m wide.

</td></tr>
<tr><td>Brake and winch</td><td>

2,400 m2 (40 m x 60)
1,600 m2 (40 m x 40).
Number calculated per Corridor section as below:

Renewable Energy Hub. 16 ha
CopperString Core 16.96 ha
Dajarra Road Connection to Dugald River 1.92 ha
Dajarra Road Connection to Ernest Henry and Chumvale 1.2 ha
Mt Isa Augmentation 7.04 ha
Southern Connection (Dajarra Rd to Selwyn) 6.08 ha
Woodya Connection 2.72 ha

</td></tr>
<tr><td>Towers / Transmission lines</td><td>
330 kv Renewable Energy Hub and CopperString Core
<table>
<tr><th rowspan="2">Tower Type</th><th rowspan="2">Crossarm width (m)</th><th colspan="2">Base Width</th></tr>
<tr><th>Min ext.</th><th>Max ext.</th></tr>
<tr><td>D3S2</td><td>15.6</td><td>8.0 [-6m]</td><td>13.5 [+18m]</td></tr>
<tr><td>D3T40</td><td>17.2</td><td>9.5 [-6m]</td><td>14.7 [+12m]</td></tr>
<tr><td>D3TT70</td><td>19.2</td><td>13.1 [-6m]</td><td>20.1 [+12m]</td></tr>
<tr><td>AD3S0</td><td>15.4</td><td>8.0 [-6m]</td><td>13.5 [+18m]</td></tr>
<tr><td>AD3T20</td><td>16.2</td><td>8.9 [-6m]</td><td>13.9 [+12m]</td></tr>
</table>
220 kv Mount Isa Augmentation and Southern Connection
<table>
<tr><th rowspan="2">Tower Type</th><th rowspan="2">Crossarm width (m)</th><th colspan="2">Base Width</th></tr>
<tr><th>Min ext.</th><th>Max ext.</th></tr>
<tr><td>D2S0</td><td>9.3</td><td>7.0 [-6m]</td><td>10.9 [+18m]</td></tr>
<tr><td>D2T20</td><td>12.4</td><td>8.9 [-6m]</td><td>14.1 [+12m]</td></tr>
<tr><td>D2T40</td><td>13.0</td><td>9.3 [-6m]</td><td>14.6 [+12m]</td></tr>
<tr><td>D2TT70</td><td>14.6</td><td>12.1 [-6m]</td><td>18.9 [+12m]</td></tr>
<tr><td>S2S0</td><td>9.7</td><td>6.6 [-6m]</td><td>10.3 [+18m]</td></tr>
<tr><td>S2T40</td><td>10.8</td><td>7.8 [-6m]</td><td>12.1 [+12m]</td></tr>
<tr><td>S2TT70</td><td>11.4</td><td>9.5 [-6m]</td><td>15.2 [+12m]</td></tr>
</table>
132 kv Woodya Connection
<table>
<tr><th rowspan="2">Tower Type</th><th rowspan="2">Crossarm width (m)</th><th colspan="2">Base Width</th></tr>
<tr><th>Min ext.</th><th>Max ext.</th></tr>
<tr><td>S2S0</td><td>9.7</td><td>6.6 [-6m]</td><td>10.3 [+18m]</td></tr>
<tr><td>S2T40</td><td>10.8</td><td>7.8 [-6m]</td><td>12.1 [+12m]</td></tr>
<tr><td>S2TT70</td><td>11.4</td><td>9.5 [-6m]</td><td>15.2 [+12m]</td></tr>
</table>

Tower assembly area 3,364 m^2 (58 m x 58 m)
Tower pad (operational) 841 m^2 (29 m x 29 m)

Renewable Energy Hub - 649 towers
CopperString Core (395 km) - 713 towers
Dajarra Rd Connection Dugald River – 14 towers
</td></tr>
</table>

Activity	Approximate Footprint
	Chumvale Connection – 12 towers Mt Isa Augmentation – 203 towers Southern Connection Dajarra Rd to Selwyn – 173 towers Woodya Connection – 115 towers • Transmission line clearing (line of sight – to ground) construction 6 m wide. • Transmission line clearing (conductor clearance zone – above 3.5m) variable.
CEV	• Barabon CEV – 0.5 ha • Charters Towers South CEV – 0.49 ha construction area • Gilliat CEV – 0.48 ha construction area • Nonda CEV – 0.55 ha construction area • Pentland South CEV – 0.7 ha • Warreah South CEV – 0.56 ha • Yorkshire CEV – 0.49 ha
CEV access	• Barabon CEV– 0.15 ha • Charters Towers South CEV– 0.15 ha • Gilliat CEV – 0.14 ha • Nonda CEV – 0.19 ha • Pentland South CEV – 0.35 ha • Warreah South CEV – 16.82 ha • Yorkshire CEV – 0.13 ha
Substation	• Dajarra Road Substation – 32 ha construction footprint (site area approx. 82 ha) (infrastructure footprint 15 ha) • Flinders Substation – 32.1 ha construction footprint (site area approx. 86 ha) (infrastructure footprint 10 ha) • Mount Isa Substation – 7.0 ha construction footprint (site area 7.0 ha) (infrastructure footprint 5 ha) • Selwyn Substation – 5.0 ha construction footprint (site area 5.0 ha) access Easement 3.3 ha • Woodstock Substation – 40 ha construction footprint (site area 40 ha) (infrastructure footprint 15 ha) access easement 0.9 ha • Woodya Substation – 1.0 ha construction footprint (site area 1 ha) (infrastructure footprint 0.6 ha) access easement 1.5 ha
Camps/laydowns	• Dajarra Road substation laydown area 2 ha • Charters Towers Camp and laydown 5.5 ha (construction footprint) (infrastructure footprint 4.75 ha) • Cloncurry camp and laydown7.0 ha (construction footprint) (infrastructure footprint 6.1 ha) • Flinders Substation laydown area 2 ha • Hughenden camp and laydown 5.5 ha (construction footprint) (infrastructure footprint 4.75 ha) • Julia Creek Camp and laydown 5.5 ha (construction footprint) (infrastructure footprint 4.75 ha) • Mount Isa camp (utilise existing accommodation) • Mount Isa substation laydown 2 ha • Pentland camp and laydown 5.5 ha (construction footprint) (infrastructure footprint 4.75 ha) • Richmond camp and laydown 5.5 ha (construction footprint) (infrastructure footprint 4.75 ha) • Selwyn camp and laydown 5.5 ha (construction footprint) (infrastructure footprint 4.75 ha) • Selwyn substation laydown areas 2 ha

Activity	Approximate Footprint
	• Woodstock substation laydown areas 2 ha • Woodya substation laydown area 2 ha • Woodya camp (utilise existing mining accommodation)

Table 2-12 provides a calculation of how the disturbance assumptions outlined in Table 2-11 contribute to the overall Project disturbance footprint. Disturbance has been calculated across six landscape types. The landscape types in Table 2-12 are identified as follows:

1. Low open woodland with spinifex or other grasses (eucalypt or acacia dominated)
2. Mixed low woodland with grasses (gidgee, mulga, or eucalypt dominated)
3. Open forest to open woodland on plains
4. Previously cleared/grazing land with scattered trees
5. Riparian zone and fringing vegetation along ephemeral channels/watercourses/channelised floodplains
6. Tussock/hummock grassland (Mitchell grass/spinifex).

Table 2-12 Project infrastructure disturbance

Section Name	Landscape type						Total (ha)
	1	2	3	4	5	6	
Barabon CEV & BCZ	0.00	0.00	0.00	0.00	0.00	0.50	**0.50**
Barabon CEV Access Easement	0.00	0.00	0.00	0.00	0.00	0.15	**0.15**
Charters Towers Camp	0.00	0.00	0.00	5.50	0.00	0.00	**5.50**
Charters Towers South CEV & BCZ	0.00	0.00	0.49	0.00	0.00	0.00	**0.49**
Charters Towers South CEV Access Easement	0.00	0.00	0.15	0.00	0.00	0.00	**0.15**
Chumvale Ernest Henry Connection Easement	6.68	0.20	0.00	0.00	1.84	0.00	**8.72**
Access Track	1.56	0.04	0.00	0.00	0.50	0.00	**2.10**
Transmission Wire (line of sight clearing)	1.51	0.04	0.00	0.00	0.52	0.00	**2.07**
Brake and Winch buffer (including line of sight)	1.20	0.00	0.00	0.00	0.00	0.00	**1.20**
Tower Assembly Areas	2.97	0.00	0.00	0.00	0.96	0.00	**3.93**
*Conductor clearance zone**	-	-	-	-	-	-	-
Cloncurry Camp & laydown	0.00	0.00	0.00	7.00	0.00	0.00	**7.00**
Dugald River Connection Easement	12.68	0.45	0.00	0.00	3.58	0.00	**16.71**
Access Track	1.74	0.04	0.00	0.00	0.35	0.00	**2.13**
Transmission Wire (line of sight clearing)	1.10	0.04	0.00	0.00	0.37	0.00	**1.51**
Brake and Winch buffer (including line of sight)	1.92	0.00	0.00	0.00	0.00	0.00	**1.92**
Tower Assembly Areas	2.68	0.25	0.00	0.00	0.35	0.00	**3.28**
*Conductor clearance zone**	-	-	-	-	-	-	-
CopperString Core Easement – Line 2	202.39	64.88	0.00	27.71	383.34	1695.08	**2373.4**

Section Name	Landscape type						Total (ha)
	1	2	3	4	5	6	
Access Track	14.16	4.76	0.00	2.12	31.63	147.74	**200.41**
Transmission Wire (line of sight clearing)	17.92	5.85	0.00	2.50	34.83	151.27	**212.37**
Brake and Winch buffer (including line of sight)	2.08	0.00	0.00	0.32	3.33	12.40	**18.13**
Towers Assembly Areas	21.94	6.48	0.00	2.57	29.13	170.84	**230.96**
*Conductor clearance zone**	-	-	-	-	-	-	-
Dajarra Road Substation Laydown	2.00	0.00	0.00	0.00	0.00	0.00	**2.00**
Dajarra Road Substation	32.00	0.00	0.00	0.00	0.00	0.00	**32.00**
Flinders Substation Laydown	0.00	0.00	0.00	0.00	0.00	2.0	**2.00**
Flinders Substation	0.00	0.00	0.00	0.00	0.00	32.10	**32.10**
Gilliat CEV & BCZ	0.00	0.00	0.00	0.00	0.00	0.48	**0.48**
Gilliat CEV Access Easement	0.00	0.00	0.00	0.00	0.00	0.14	**0.14**
Hughenden Camp	0.00	0.00	0.00	5.50	0.00	0.00	**5.50**
Julia Creek Camp	0.00	0.00	0.00	5.50	0.00	0.00	**5.50**
Mount Isa Augmentation Easement – Line 3	418.98	0.00	0.00	0.55	144.19	26.10	**589.82**
Access Track	29.32	0.00	0.00	0.18	8.29	2.44	**40.23**
Transmission Wire (line of sight clearing)	33.79	0.00	0.00	0.04	12.47	2.29	**48.59**
Brake and Winch Buffer (including line of sight)	4.79	0.00	0.00	0.55	1.65	0.53	**7.52**
Towers Assembly Areas	51.70	0.00	0.00	0.33	10.67	2.80	**65.50**
*Conductor clearance zone**	-	-	-	-	-	-	-
Mount Isa Substation Laydown	2.00	0.00	0.00	0.00	0.00	0.00	**2.00**
Mount Isa Substation	0.00	0.00	0.00	7.00	0.00	0.00	**7.00**
Nonda CEV & BCZ	0.00	0.00	0.00	0.00	0.00	0.55	**0.55**
Nonda CEV Access Easement	0.00	0.00	0.00	0.00	0.00	0.19	**0.19**
Pentland Camp and Laydown	0.00	0.00	5.50	0.00	0.00	0.00	**5.50**
Pentland South CEV & BCZ	0.00	0.00	0.47	0.00	0.00	0.00	**0.47**
Pentland South CEV Access Easement	0.00	0.00	0.35	0.00	0.00	0.00	**0.35**
Renewable Energy Hub Easement – Line 1	2.39	31.02	1421.77	182.02	325.47	79.83	**2042.50**
Access Track	0.17	2.60	120.28	14.93	27.79	6.71	**172.48**
Transmission Wire (line of sight clearing)	0.17	2.78	126.48	16.25	29.63	7.42	**182.73**
Brake and Winch Buffer (including line of sight)	0.00	0.00	11.62	2.05	3.61	0.54	**17.82**
Towers Assembly Areas	0.66	3.12	151.97	18.95	28.94	7.12	**210.76**
*Conductor clearance zone**	-	-	-	-	-	-	-
Richmond Camp and Laydown	0.00	0.00	0.00	5.50	0.00	0.00	**5.50**
Selwyn Camp and Laydown	5.50	0.00	0.00	0.00	0.00	0.00	**5.50**
Selwyn Substation and Access	8.30	0.00	0.00	0.00	0.00	0.00	**8.30**
Selwyn Substation Laydown	2.00	0.00	0.00	0.00	0.00	0.00	**2.00**
Southern Connection Easement – Line 4	420.00	6.19	0.00	0.00	100.88	14.35	**541.42**
Access Track	38.09	0.50	0.00	0.00	9.23	1.59	**49.41**

Section Name	Landscape type						Total (ha)
	1	2	3	4	5	6	
Transmission Wire (line of sight clearing)	34.70	0.52	0.00	0.00	8.55	1.23	**45.00**
Brake and Winch Buffer (including line of sight)	4.79	0.00	0.00	0.55	1.65	0.53	**7.52**
Tower Assembly Areas	46.62	0.66	0.00	0.00	8.30	0.98	**56.56**
*Conductor clearance zone**	-	-	-	-	-	-	-
Warreah South CEV & BCZ	0.00	0.00	0.56	0.00	0.00	0.00	**0.56**
Warreah South CEV Access Easement	0.00	0.00	0.00	16.82	0.00	0.00	**16.82**
Woodstock Substation Laydown	2.00	0.00	0.00	0.00	0.00	0.00	**2.00**
Woodstock Substation and Access	0.00	0.00	40.90	0.00	0.00	0.00	**40.90**
Woodya Connection Easement – Line 5	173.26	38.00	0.00	0.55	45.58	121.57	**378.96**
Access Track	14.76	3.15	0.00	0.05	4.12	10.05	**32.13**
Transmission Wire (line of sight clearing)	14.25	3.14	0.00	0.05	3.93	10.06	**31.44**
Brake and Winch Buffer (including line of sight)	0.72	0.32	0.00	0.23	0.27	1.31	**2.85**
Towers Assembly Areas	17.94	3.93	0.00	0.00	3.73	11.74	**37.34**
*Conductor clearance zone**	-	-	-	-	-	-	-
Woodya Substation and Access	1.05	0.00	0.00	0.15	0.30	1.00	**2.50**
Yorkshire CEV & BCZ	0.00	0.00	0.00	0.00	0.00	0.49	**0.49**
Yorkshire CEV Access Easement	0.00	0.00	0.00	0.00	0.13	0.00	**0.13**
Grand Total (excluding easement)	**418.10**	**38.22**	**458.77**	**114.64**	**265.23**	**587.19**	**1882.15**

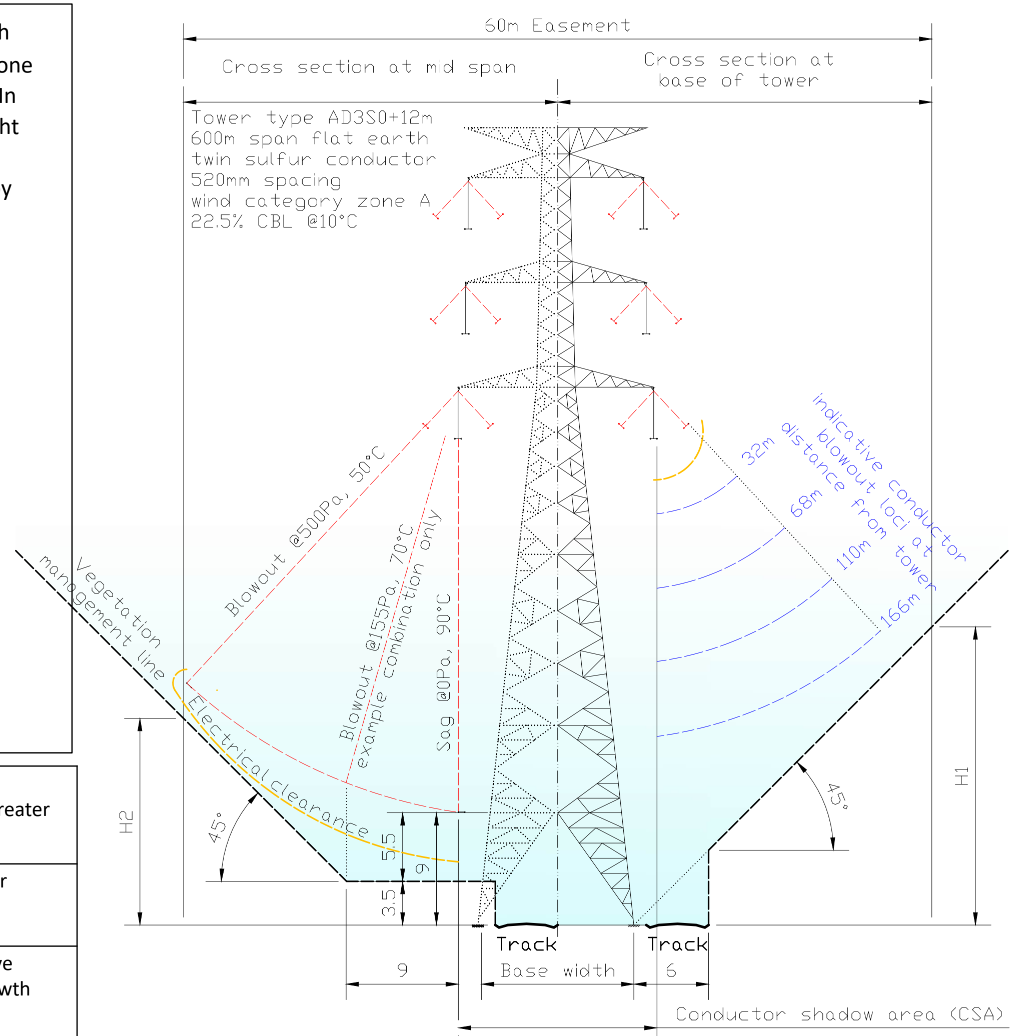
* Transmission line clearing for conductor clearance zone is variable and has not been quantified in this disturbance footprint table. Quantification of the impacts to conservation significant species and riparian RE for conductor clearance has been included within Volume 4 Attachment E Revised Matters of National Environmental Significance (Chapter 18).

Disturbance to vegetation and within conservation significant habitats for towers and transmission lines will be variable, as it will be dependant on the tower size and height. Tower designs differ along the corridor selection and within different landscapes and the regional topographic relief. Figure 2-5 provides a description of how towers will impact vegetation across the different landscape types.

Open woodland with grassy ground layer - typically sparse to very sparse canopy, with trees between 10-20m in height. Lidar indicates some patches along the Conductor Clearance Zone with a maximum vegetation canopy height of over 30m and these areas border Riparian zones. In addition, examination of Lidar also indicates that several patches with up to 60% of canopy height above 3.5m highlighting the high variability along the majority of the alignment. *Eucalyptus* (ironbarks and gum barks) or *Corymbia* (bloodwoods) species are generally the dominant canopy tree types. Shrubs are very sparse and the ground layer is composed of native grasses.

330kV line construction hubs dominated by this landscape type include:

- Woodstock
- Charters Towers
- Pentland
- east of Hughenden



1. Tower Pad	Extends 6m in all directions around the tower base. (incorporates the track within one side)	Vegetation cleared to ground level. Topsoil stripped, pad cut/fill earth works (If slope greater than 3%) and earth graded and rolled.
2. Tower Fall-in Zone[2,4,5]	H1 varies with base width and topography in vicinity to the tower.	Vegetation cut-back at 45° angle from tower footing extending beyond easement.
3. Conductor Shadow Area (CSA)	Crossarm width plus sub-conductor spacing. (varies dependent on tower type (see tower types adjacent))	Vegetation cleared to a height of 3.5m above ground level. Low level Grasses with no growth potential may remain.
4. Conductor Clearance Zone[1,3]	Maximum of 9m each side of CSA where max. blowout and max. sag are co-incident.	Vegetation cleared to a height of 3.5m above ground level.
5. Conductor Fall-in Zone[2,3,4,5]	H2 varies with crossarm width, topography and blowout locus at location along the line.	Vegetation cut-back at 45° angle from conductor clearance zone extending beyond easement.

Tower types occurring in this landscape type	Crossarm Width (m)	Base Width [ext.] (m)	
		min ext.	max ext.
D3S2	15.6	8.0 [-6]	13.5 [+18]
D3T40	17.2	9.5 [-6]	14.7 [+12]
D3TT70	19.2	13.1 [-6]	20.1 [+12]
AD3S0	15.4	8.0 [-6]	13.5 [+18]
AD3T20	16.2	8.9 [-6]	13.9 [+12]

Notes:

1. Maximum conductor blowout occurs mid-span. The location of maximum sag is related to length of span and difference in height between the attachment points at each end of span.
2. The 45° cut-back angle is indicative for flat earth.
3. Conductor sag and blow-out reduces closer to the towers so the width of the Conductor Clearance Zone can be reduced and the maximum allowable vegetation height increased, on the proviso that electrical clearances are maintained. Highlighted as indicative blow out at 32,68,110 and 166 from the tower
4. Vegetation clearing will be maximized for bushfire prone areas of the easement classified as very high or high potential intensity.
5. The selection of tower type and height depends upon design aspects such as topography, changes in direction and requirements associated with shared land use along the alignment.

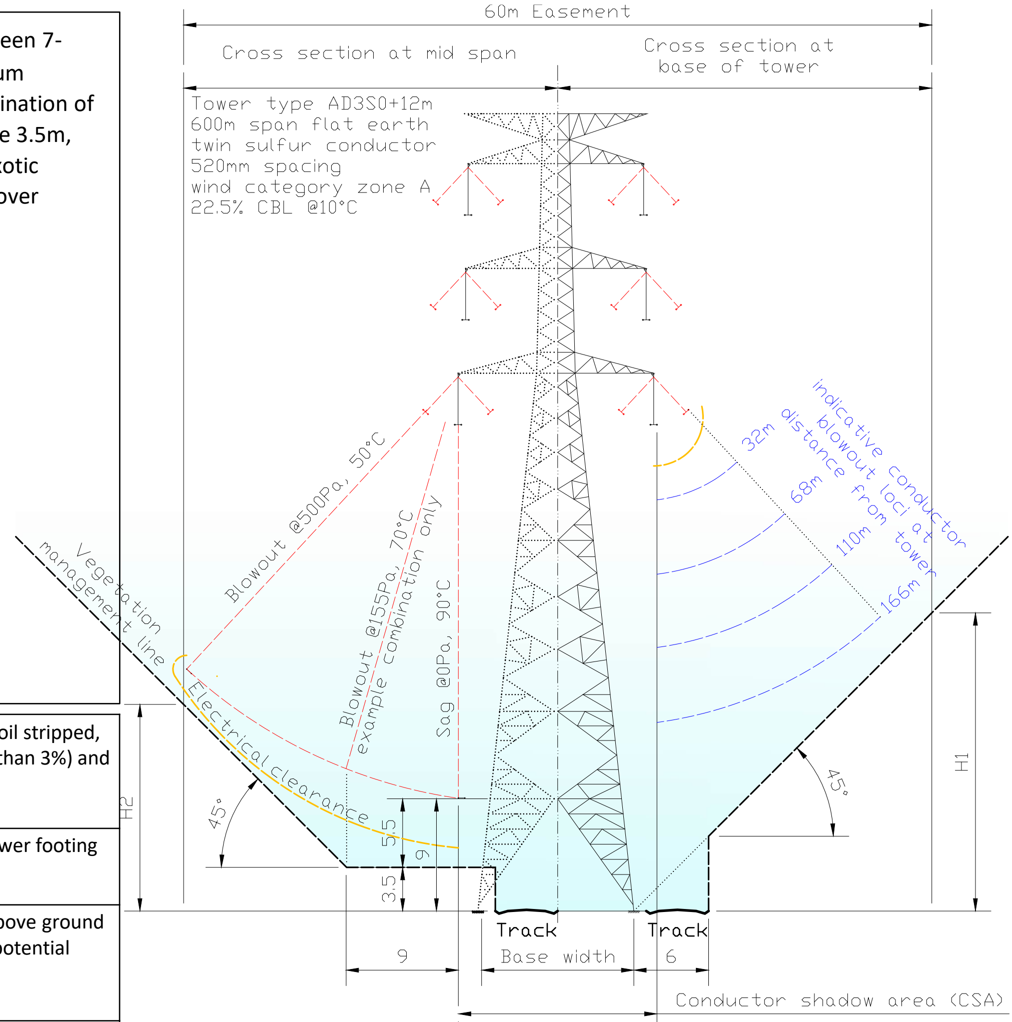
Figure 2-5A

Mitchell Grasslands - typically very sparse canopy, with trees often absent or if occur between 7-10m in height. Lidar indicates some patches along the Conductor Clearance Zone with a maximum vegetation canopy height of over 15m and these areas border Riparian zones. In addition, examination of Lidar also indicates that several patches contain vegetation with 20% of the canopy height above 3.5m, suggesting the majority of vegetation along this portion of the alignment will be below 3.5m. Exotic shrubs (prickly acacia) are often the dominant woody canopy structure. Soils are cracking clays over native and exotic grasses.

330kV line construction hubs with dominated by this landscape type include :

- west of Hughenden
- Richmond
- Julia Creek
- east of Cloncurry

1. Tower Pad	Extends 6m in all directions around the tower base. (incorporates the track within one side)	Vegetation cleared to ground level. Topsoil stripped, pad cut/fill earth works (If slope greater than 3%) and earth graded and rolled.
2. Tower Fall-in Zone[2,4,5]	H1 varies with base width and topography in vicinity to the tower.	Vegetation cut-back at 45° angle from tower footing extending beyond easement.
3. Conductor Shadow Area (CSA)	Crossarm width plus sub-conductor spacing. (varies dependent on tower type (see tower types adjacent))	Vegetation cleared to a height of 3.5m above ground level. Low level Grasses with no growth potential may remain.
4. Conductor Clearance Zone[1,3]	Maximum of 9m each side of CSA where max. blowout and max. sag are co-incident.	Vegetation cleared to a height of 3.5m above ground level.
5. Conductor Fall-in Zone[2,3,4,5]	H2 varies with crossarm width, topography and blowout locus at location along the line.	Vegetation cut-back at 45° angle from conductor clearance zone extending beyond easement.



Tower types occurring in this landscape type	Crossarm Width (m)	Base Width [ext.] (m)	
		min ext.	max ext.
D3S2	15.6	8.0 [-6]	13.5 [+18]
D3T40	17.2	9.5 [-6]	14.7 [+12]
D3TT70	19.2	13.1 [-6]	20.1 [+12]
AD3S0	15.4	8.0 [-6]	13.5 [+18]
AD3T20	16.2	8.9 [-6]	13.9 [+12]

Notes:

1. Maximum conductor blowout occurs mid-span. The location of maximum sag is related to length of span and difference in height between the attachment points at each end of span.
2. The 45° cut-back angle is indicative for flat earth.
3. Conductor sag and blow-out reduces closer to the towers so the width of the Conductor Clearance Zone can be reduced and the maximum allowable vegetation height increased, on the proviso that electrical clearances are maintained. Highlighted as indicative blow out at 32,68,110 and 166 from the tower
4. Vegetation clearing will be maximized for bushfire prone areas of the easement classified as very high or high potential intensity.
5. The selection of tower type and height depends upon design aspects such as topography, changes in direction and requirements associated with shared land use along the alignment.

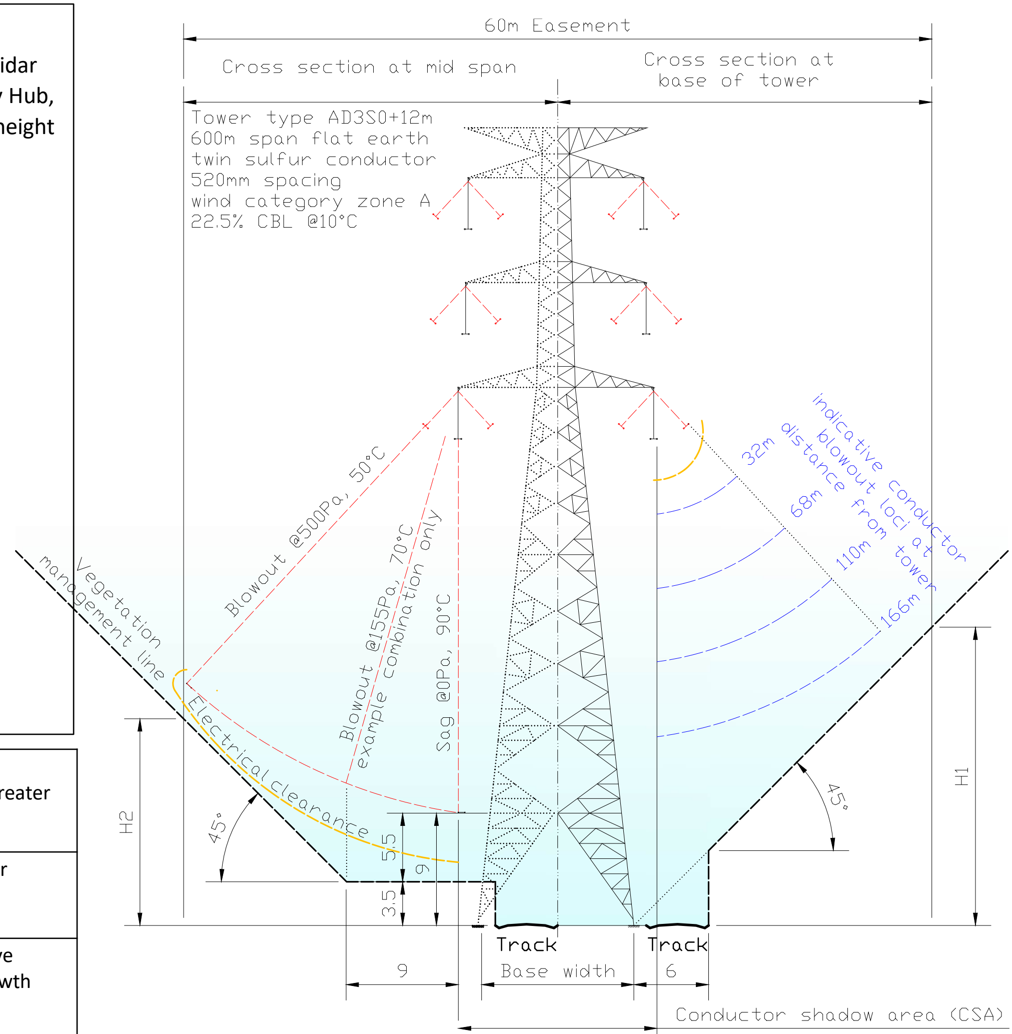
Figure 2-5B

Riparian zones (330kV lines) - tree density is highly variable as are tree heights. In the renewable energy hub, tree heights are often up to 25-30m with mid-dense canopy coverage. Lidar indicates some patches along the Conductor Clearance Zone, particularly the Renewable Energy Hub, with a maximum vegetation canopy height of over 30m and others with almost 65% of canopy height above 3.5m. Within the Copperstring Core (predominately Mitchell grass downs) riparian tree heights are considerably lower often 10-15m and frequently sparse in canopy cover, although density is often locally higher. Heavy stock grazing common in the riparian zones.

330kV line construction hubs with these landscapes include:

- Woodstock
- Charters Towers
- Pentland
- East of Hughenden
- West of Hughenden
- Richmond
- Julia Creek
- East of Cloncurry

1. Tower Pad	Extends 6m in all directions around the tower base. (incorporates the track within one side)	Vegetation cleared to ground level. Topsoil stripped, pad cut/fill earth works (If slope greater than 3%) and earth graded and rolled.
2. Tower Fall-in Zone[2,4,5]	H1 varies with base width and topography in vicinity to the tower.	Vegetation cut-back at 45° angle from tower footing extending beyond easement.
3. Conductor Shadow Area (CSA)	Crossarm width plus sub-conductor spacing. (varies dependent on tower type (see tower types adjacent))	Vegetation cleared to a height of 3.5m above ground level. Low level Grasses with no growth potential may remain.
4. Conductor Clearance Zone[1,3]	Maximum of 9m each side of CSA where max. blowout and max. sag are co-incident.	Vegetation cleared to a height of 3.5m above ground level.
5. Conductor Fall-in Zone[2,3,4,5]	H2 varies with crossarm width, topography and blowout locus at location along the line.	Vegetation cut-back at 45° angle from conductor clearance zone extending beyond easement.



Tower types occurring in this landscape type	Crossarm Width (m)	Base Width [ext.] (m)	
		min ext.	max ext.
D3S2	15.6	8.0 [-6]	13.5 [+18]
D3T40	17.2	9.5 [-6]	14.7 [+12]
D3TT70	19.2	13.1 [-6]	20.1 [+12]
AD3S0	15.4	8.0 [-6]	13.5 [+18]
AD3T20	16.2	8.9 [-6]	13.9 [+12]

Notes:

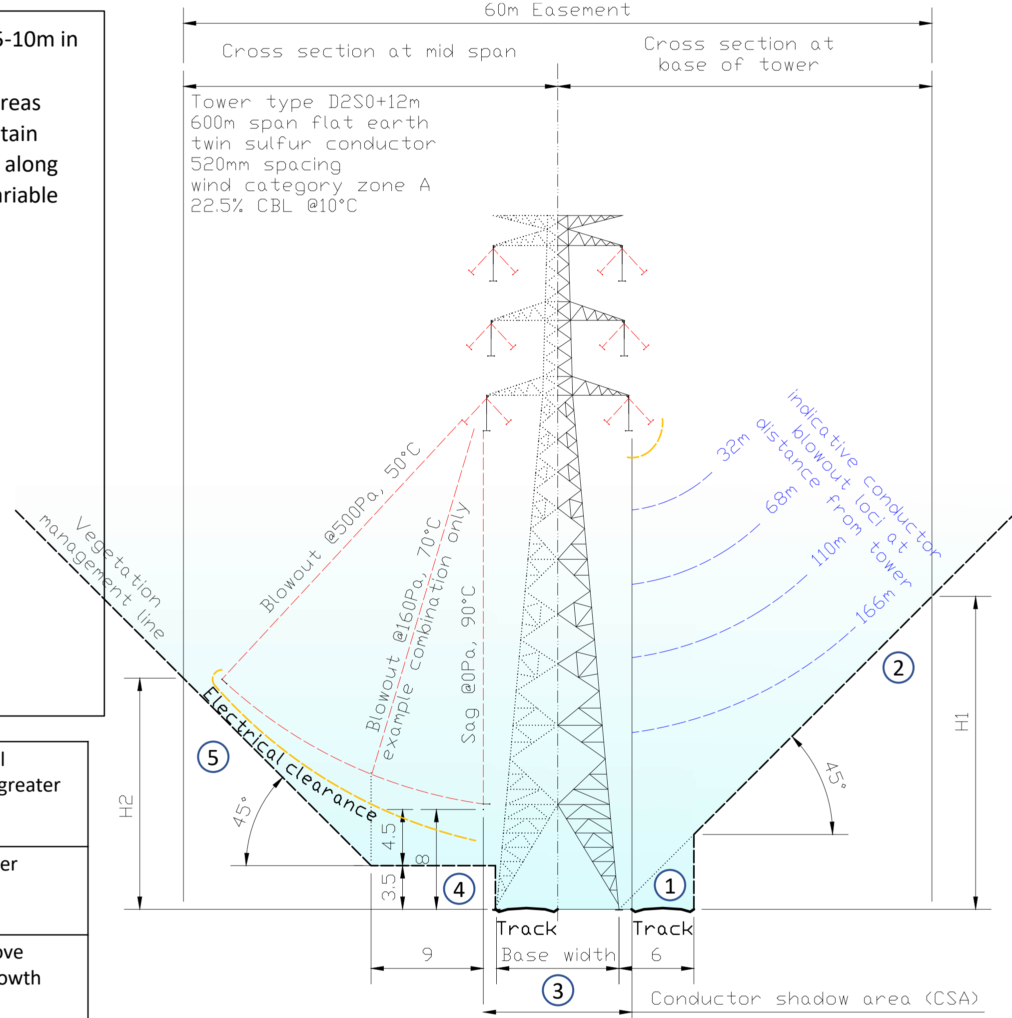
1. Maximum conductor blowout occurs mid-span. The location of maximum sag is related to length of span and difference in height between the attachment points at each end of span.
2. The 45° cut-back angle is indicative for flat earth.
3. Conductor sag and blow-out reduces closer to the towers so the width of the Conductor Clearance Zone can be reduced and the maximum allowable vegetation height increased, on the proviso that electrical clearances are maintained. Highlighted as indicative blow out at 32,68,110 and 166 from the tower
4. Vegetation clearing will be maximized for bushfire prone areas of the easement classified as very high or high potential intensity.
5. The selection of tower type and height depends upon design aspects such as topography, changes in direction and requirements associated with shared land use along the alignment.

Figure 2-6c

Eucalypt Low open woodland with spinifex - very sparse to sparse canopy typically 5-10m in height dominated by Eucalyptus and or Acacia species. Lidar indicates some patches along the Conductor Clearance Zone with a maximum vegetation canopy height of over 20m and these areas border Riparian zones. In addition, examination of Lidar also indicates that several patches contain vegetation within 20% of the canopy height above 3.5m, suggesting the majority of vegetation along this potion of the alignment will be 3.5m. Shrubs sparse over a ground layer dominated by a variable coverage of native grasses (spinifex) or introduced pasture grass species

220kV line construction hubs with these landscapes Include:

- Mt Isa
- Cloncurry
- Selwyn
- Woodya



1. Tower Pad	Extends 6m in all directions around the tower base. (incorporates the track within one side)	Vegetation cleared to ground level. Topsoil stripped, pad cut/fill earth works (If slope greater than 3%) and earth graded and rolled.
2. Tower Fall-in Zone[2,4,5]	H1 varies with base width and topography in vicinity to the tower.	Vegetation cut-back at 45° angle from tower footing extending beyond easement.
3. Conductor Shadow Area (CSA)	Crossarm width plus sub-conductor spacing. (varies dependent on tower type (see tower types adjacent))	Vegetation cleared to a height of 3.5m above ground level. Low level Grasses with no growth potential may remain.
4. Conductor Clearance Zone[1,3]	Maximum of 9m each side of CSA where max. blowout and max. sag are co-incident.	Vegetation cleared to a height of 3.5m above ground level.
5. Conductor Fall-in Zone[2,3,4,5]	H2 varies with crossarm width, topography and blowout locus at location along the line.	Vegetation cut-back at 45° angle from conductor clearance zone extending beyond easement.

Tower types occurring in this landscape type	Crossarm Width (m)	Base Width [ext] (m)	
		min ext.	max ext.
D2S0	9.3	7.0 [-6]	10.9 [+18]
D2T20	12.4	8.9 [-6]	14.1 [+12]
D2T40	13.0	9.3 [-6]	14.6 [+12]
D2TT70	14.6	12.1 [-6]	18.9 [+12]
S2S0	9.7	6.6 [-6]	10.3 [+18]
S2T40	10.8	7.8 [-6]	12.1 [+12]
S2TT70	11.4	9.5 [-6]	15.2 [+12]

Notes:

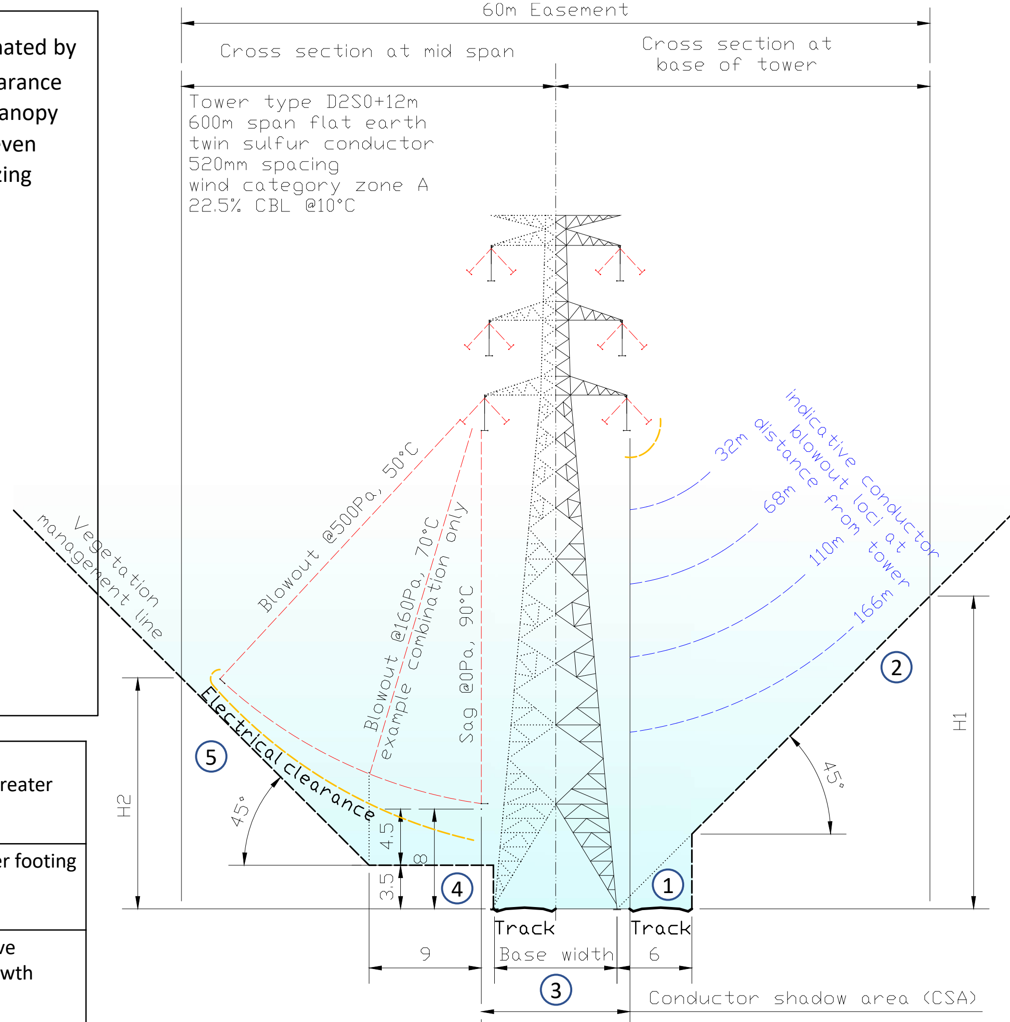
1. Maximum conductor blowout occurs mid-span. The location of maximum sag is related to length of span and difference in height between the attachment points at each end of span.
2. The 45° cut-back angle is indicative for flat earth.
3. Conductor sag and blow-out reduces closer to the towers so the width of the Conductor Clearance Zone can be reduced and the maximum allowable vegetation height increased, on the proviso that electrical clearances are maintained. Highlighted as indicative blow out at 32,68,110 and 166 from the tower
4. Vegetation clearing will be maximized for bushfire prone areas of the easement classified as very high or high potential intensity.
5. The selection of tower type and height depends upon design aspects such as topography, changes in direction and requirements associated with shared land use along the alignment.

Figure 2-5D

<u>Riparian zones (220kV zones)</u> - typically sparse to mid dense (up to 20m) in height dominated by river red gum (*Eucalyptus camaldulensis*). Lidar indicates some patches along the Conductor Clearance Zone with a maximum vegetation canopy height of almost 30m and others with almost 35% of canopy height above 3.5m, indicating high variability in canopy height. Shrubs sparse to very sparse or even absent. Grassy ground layer commonly dominated by introduced grass species. Heavy stock grazing common in the riparian zone.

220kV line construction hubs with these landscapes Include:

- Mt Isa
- Cloncurry
- Selwyn
- Woodya



1. Tower Pad	Extends 6m in all directions around the tower base. (incorporates the track within one side)	Vegetation cleared to ground level. Topsoil stripped, pad cut/fill earth works (If slope greater than 3%) and earth graded and rolled.
2. Tower Fall-in Zone[2,4,5]	H1 varies with base width and topography in vicinity to the tower.	Vegetation cut-back at 45° angle from tower footing extending beyond easement.
3. Conductor Shadow Area (CSA)	Crossarm width plus sub-conductor spacing. (varies dependent on tower type (see tower types adjacent))	Vegetation cleared to a height of 3.5m above ground level. Low level Grasses with no growth potential may remain.
4. Conductor Clearance Zone[1,3]	Maximum of 9m each side of CSA where max. blowout and max. sag are co-incident.	Vegetation cleared to a height of 3.5m above ground level.
5. Conductor Fall-in Zone[2,3,4,5]	H2 varies with crossarm width, topography and blowout locus at location along the line.	Vegetation cut-back at 45° angle from conductor clearance zone extending beyond easement.

Tower types occurring in this landscape type	Crossarm Width (m)	Base Width [ext] (m)	
		min ext.	max ext.
D2S0	9.3	7.0 [-6]	10.9 [+18]
D2T20	12.4	8.9 [-6]	14.1 [+12]
D2T40	13.0	9.3 [-6]	14.6 [+12]
D2TT70	14.6	12.1 [-6]	18.9 [+12]
S2S0	9.7	6.6 [-6]	10.3 [+18]
S2T40	10.8	7.8 [-6]	12.1 [+12]
S2TT70	11.4	9.5 [-6]	15.2 [+12]

Notes:

1. Maximum conductor blowout occurs mid-span. The location of maximum sag is related to length of span and difference in height between the attachment points at each end of span.
2. The 45° cut-back angle is indicative for flat earth.
3. Conductor sag and blow-out reduces closer to the towers so the width of the Conductor Clearance Zone can be reduced and the maximum allowable vegetation height increased, on the proviso that electrical clearances are maintained. Highlighted as indicative blow out at 32,68,110 and 166 from the tower
4. Vegetation clearing will be maximized for bushfire prone areas of the easement classified as very high or high potential intensity.
5. The selection of tower type and height depends upon design aspects such as topography, changes in direction and requirements associated with shared land use along the alignment.

Figure 2-5E

Disturbance within the easement includes temporary and permanent disturbance footprints. Temporary disturbance activities include the brake and winch sites and the tower assembly areas. Permanent disturbance includes tower pads, substations, CEV huts and clearing loss for the transmission line clearance to canopy. As described in Table 2-12 the permanent loss of vegetation across the corridor will vary depending on the corridor section.

2.11.3 Access tracks

Access to the transmission line will be required for both the construction (6m wide) and ongoing maintenance (3m wide) of the transmission line. Access will be required to each transmission tower site.

The tracks will generally be contained within the transmission line easement however where terrain, environmentally or culturally sensitive areas and water crossings do not permit this, the access track may be located outside of the easement (access will follow topography to maintain safe vehicle access grades), with spur tracks linking the main access track to each transmission tower site.

In vegetated areas or sites with steep grades, existing cleared paths will be utilised where possible so that clearing by the Project is kept to a minimum.

It is intended to utilise the existing road network and private access tracks, though some new tracks will be required to provide access for construction and maintenance teams.

The access tracks for the Project construction phase will be developed to a standard suitable for dry weather use for a range of vehicles (e.g. 4WD, drill rigs and water trucks) and will remain in place (post construction) as a low speed 4WD track for operational access.

Where tracks are to be constructed as part of the Project, they will generally be unsealed tracks that follow the natural ground contours. Access constraints may require some landform re-shaping to construct a safe access track.

Access tracks will be of a suitable width to allow the safe movement, including turning, of construction and maintenance equipment and vehicles.

Typically, where formed access tracks are constructed, they will be 6m wide tracks to allow the safe movement of construction and maintenance equipment and vehicles.

Where appropriate (and with the agreement of landholders), gates will be installed at fenced property lines to restrict general vehicular access to or from the easement.

Suitable weed control measures will be implemented for the construction and operation of the Project. The Project will support biosecurity management programs and will consult with local council weed and pest management officers and landholder eradication activities. Weed and pest management procedures are provided in Volume 3 Appendix U Concept biosecurity plan. The location of the access tracks will be detailed in the Project GIS database.

2.11.4 Waste disposal

Project waste streams can broadly be classified as one of the following three types:

- Commercial and domestic waste from construction camps, including food and wastewater
- Construction waste, including waste concrete
- Waste generated at laydown/delivery areas.

The Project will develop a waste management strategy based on recyclable, non-recyclable, intractable and other waste streams. Details about waste management is included in Volume 2

Chapter 12 Waste management.

2.12 Pre-construction activities

2.12.1 Introduction

The following pre-construction activities are similar in nature to other linear infrastructure projects and will need to occur for the Project to proceed. Pre-construction activities will include:

- Finalisation of the detailed design of the Project
- Geotechnical, property and other surveys for the easement, transmission tower and substation foundations and earthing systems
- Townsville logistics yard (detailed in Section 2.18.4)
- Land acquisition for the easement, CEV huts and substations including re-subdivision of the lots as necessary
- Acquiring development approvals, licences, permits and native title/cultural heritage clearances
- Commissioning of the temporary construction camps and site offices (described in Section 2.17.4)
- Workforce sourcing and induction (described in Section 2.17.2)
- Construction team mobilisation (50 project personnel)
- Control set out and survey of substation and transmission line land
- Procurement of construction materials that require a long lead-time (described in Section 2.20)
- Transportation of materials.

Once formal approvals have been received for the Project, the timing of these early pre-construction activities will be dependent on the construction schedule of the given construction zone. The following sections detail the pre-construction activities mentioned above, not covered in other sections.

2.12.2 Detailed design

The Project has undergone preliminary design to determine land requirements. The detailed design phase will use information from comprehensive geotechnical surveys and precise topographical and vegetation mapping to inform the transmission tower site selection.

Regulatory requirements

The transmission system will be designed to allow the Project to comply with the requirements of the NER.

Additionally, the system will comply with the requirements of all relevant legislation including, but not limited to:

- *Electricity Act 1994*
- *Electrical Safety Act 2002*
- *Electricity – National Scheme (Queensland) Act 1997*
- *Professional Engineers Act 2002*
- *Work Health and Safety Act 2011*.

The system will also comply with relevant Australian Standards.

Safety in design

Modern, effective safety in design practices will be used in the Project. Specifications will require the contractor and/or designer to facilitate appropriate practices, such as HAZOP/HAZAN, and to ensure that risk studies and assessments, and constructability studies are undertaken.

As required by the Queensland *Professional Engineers Act 2002,* all engineering services, including design, related to the project will be undertaken, supervised or certified by a Registered Professional Engineer of Queensland of the appropriate discipline.

2.12.3 Land acquisition

Prior to the construction of the transmission network, the easements required for the Project will require acquisition by CuString. Several land parcels and property owners are likely to be affected by the Project. These have been identified in Section 5.3.1 of Volume 2 Chapter 5 Land and Volume 3 Appendix F Real property descriptions of impacted land parcels.

2.12.4 Approvals, permits and cultural heritage clearance

The regulatory licences, permits and approvals required for the Project to proceed are described in Volume 1 Chapter 4 Legislation and approvals and Volume 3 Appendix L Regulatory approvals plan. CuString will commence the post-draft EIS development approvals with the relevant regulatory agencies after the finalisation of the Coordinator-General's report and once approval of the Project is given from the Commonwealth Minister for the Environment in accordance with the requirements of the EPBC Act.

Indigenous cultural heritage clearance for the Project will be managed in accordance with the Cultural Heritage Management Plan being developed for the Project. Further information on Indigenous cultural heritage and the Cultural Heritage Management Plan is provided in Volume 2 Chapter 15 Cultural heritage.

2.13 Construction activities

2.13.1 General

The construction scheduling will consider the linear nature of the Project, its remote location and the prevalent weather patterns applicable to the region. Following the four-month pre-construction activities mentioned above, construction is expected to take approximately 31 months to complete.

The proposed construction staging is outlined in Table 2-13.

Table 2-13 Proposed construction staging

Project milestone	Proposed Dates
Preliminary design via early contractor involvement	Q1 2021
Completion of the EIS Process	Q3 2021
Financial close/notice to proceed for construction phase	Q4 2021
Detailed Design	Q1 2022
Commissioning of connection to the Renewable Energy Hub and CopperString Core	Q4 2024
Commissioning of Mount Isa Augmentation	Q2 2024
Commissioning of Southern Connection	Q1 2025

While the Project is a major infrastructure project, the construction methodology is not technically complex, and the sequence of tasks is repetitive for both the transmission line and substation construction processes. Consequently, material supply, logistics and resource availability are the key drivers of the construction solution.

The construction staging schedule has been developed with reference to the seasonal rainfall anticipated during the summer months.

Areas at high risk of flooding and erosion will be targeted for construction during the dry months. For example construction activities in the Mitchell Grass Downs areas stretching from east of Hughenden to west of Julia Creek will be limited during December-March (refer Section 2.8.2).

2.13.2 Construction hubs

Due to the linear nature of the infrastructure, the Project will be segmented into nine construction hubs (refer to Figure 2-6).

It is envisaged that transmission line construction will be undertaken using up to two work fronts, moving from one construction zone to another upon completion of the required works. Each work front will consist of several small teams, each focusing on a specific activity – clearing and access, foundations, steelwork, stringing or rehabilitation. For example, once the clearing and access teams of a particular work front have completed a construction zone, they will move onto the next construction zone, while other teams, such as foundation teams continue their activities. This accounts for the overlap of activities occurring within individual construction hubs. Depending on the activity one team could be up to 30 to 70 km in front of the following team. Each team may comprise several crews working across one or more transmission tower sites.

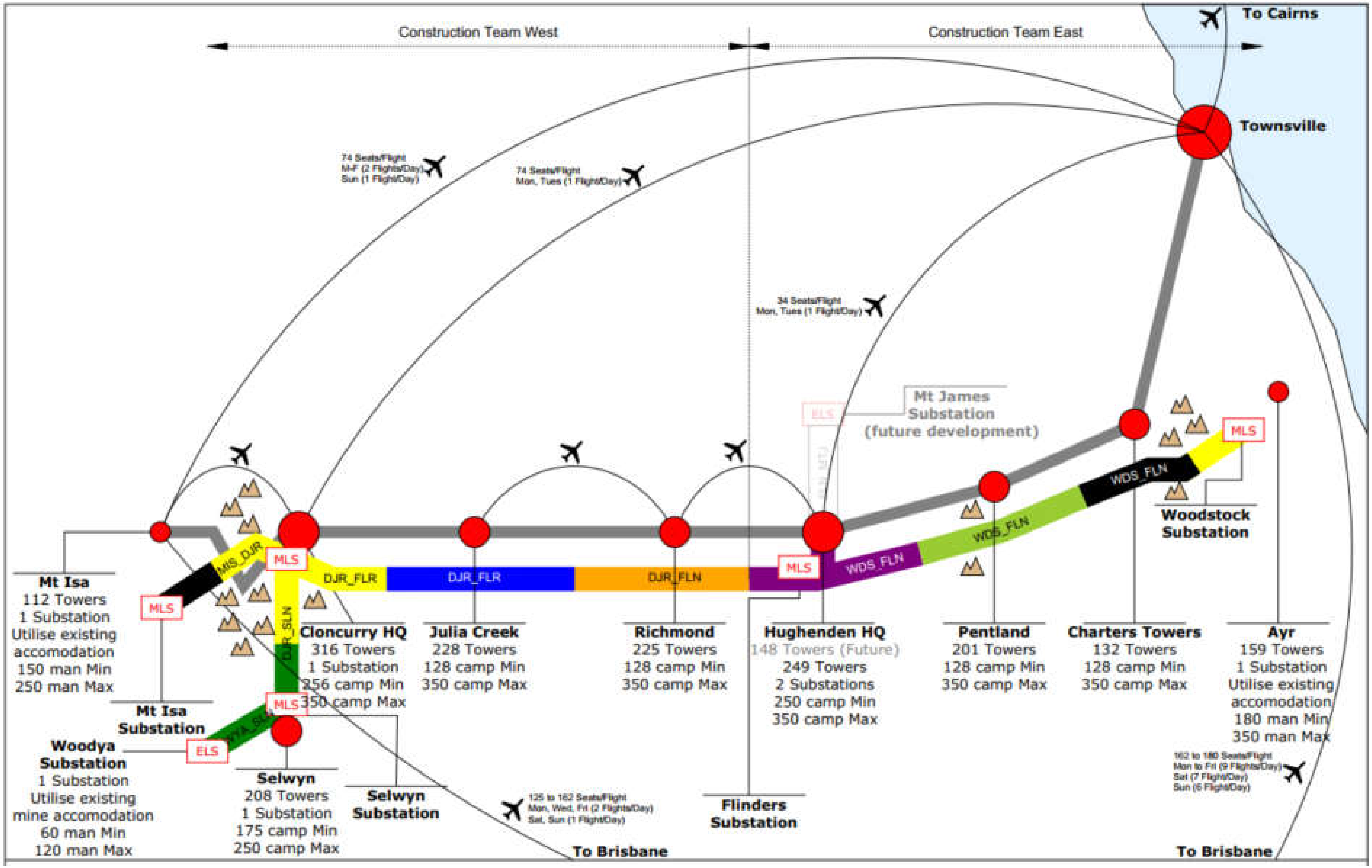


Figure 2-6 Construction hubs

2.13.3 Hours of operation

Where work is proposed to be conducted in proximity to a sensitive receptor the timing of construction will be considerate of the noise, dust, vibration and light impacts of the construction process and of access issues. Where this is planned, consultation with the affected residents will ensure that suitable mitigation measures are in place to minimise the disturbance and that the affected residents are fully aware of the times, duration and nature of the planned construction activities.

During hotter months, the working day may be staggered to commence earlier in the morning to avoid the heat of the afternoon.

At laydown/delivery areas along the transmission line, deliveries will occur in a manner to ensure that audible noise is not clearly heard by an individual who is an occupier of a building outside of the hours of 6.30 am to 6.30 pm Monday to Saturday. A complaint handling process, including a complaint register, will be developed as part of the Stakeholder and Community Engagement Plan, which will include regular reviews and reporting procedures.

This does not mean that the hours will be limited to within 6.30 am to 6.30 pm at laydown areas along the transmission line, just that audible noise will not be heard by an individual who is an occupier of a building outside of this time frame. To meet noise requirements in some areas, no loud activities will occur between 6.30 pm and 6.30 am.

Some specific activities, such as vehicle refuelling and maintenance, will occur outside of designated construction work hours. Head office and administrative staff will work the same hours as the crews they support.

The roster for the direct workforce will be selected by the contractors; it is anticipated that the roster will be 10 days on and 4 days off for the crews conducting civil works and 21 days on and 7 days off for the towers and stringing crews (Monday to Sunday).

Potential competition from other projects in the industry and the local region are factors that could drive rosters and attract suitable staff. These factors and their drivers change over time, and may change during the Project, requiring rosters to be reassessed.

2.14 Transmission lines

2.14.1 General

Construction of the transmission line broadly involves the following series of activities:

- Vegetation clearing
- Upgrade and construction of access tracks
- Foundation installation
- Construction of transmission towers (structure erection)
- Conductor and earth wire/OPGW stringing
- Transmission tower completion and rehabilitation.

The width of the easements required for the transmission routes in the Project are described in Figure 2-2.

2.14.2 Vegetation clearing

The area of land that will require vegetation management will be dependent on the transmission line design, terrain, vegetation types, and to some extent landholder requirements.

Vegetation clearance requirements fall into the following three main categories:

- Vegetation within the operational clearance boundary of the transmission line
- Vegetation along access tracks
- Vegetation on sites disturbed for construction proposes (such as temporary construction access roads and earthen pads for various construction activities).

For a large portion of the corridor selection these requirements will overlap. Note that although the transmission line will always be on the easement, other infrastructure, such as the tracks required for operation and maintenance and the temporary construction tracks and pads, may not be able to be constructed on the easement.

Management of vegetation for the operational clearance boundary of the transmission line and the operation and maintenance access tracks will be required for the life of the asset.

Volume 3 Appendix R Field development plan provides guidance to the design and field preparation teams regarding areas for avoidance or limited disturbance.

Areas disturbed for temporary construction access tracks and the pads for various construction activities will be rehabilitated whether they are on or off the easement.

The operational clearance boundary of the transmission lines will be defined once tower locations and conductor heights are finalised in the detailed design of the Project. Any vegetation within the operational clearance boundary that may hinder the safe operation of the transmission line requires clearing. This includes vegetation that is identified as potentially impacting on the operations when it reaches mature height. Low growing vegetation that poses no threat to the reliability and safety of the transmission line will not be removed, except to provide maintenance access, or to reduce the potential for bushfires and bushfire induced flashover by removing fuel build up.

The Construction Contractor will develop a Vegetation Management Plan that will include a permit to disturb land and vegetation, establishment of no go zones for significant flora and fauna habitat and preclearance surveys to be completed, before the commencement of site preparation works. Appropriate measures to be incorporated in the plan include the presence of qualified fauna spotter/catcher(s), during clearing, to allow the safe movement of fauna species, hand trimming of vegetation (for conductor clearance) and leaving rootstock in place (near waterways). Specific environmental management plans will be developed for the control of vegetation in areas with identified important vegetation.

Most vegetation clearing will typically be conducted by bulldozers and broad acre mulchers. More refined hand or mechanical clearing methods will be employed for smaller clearing (such as conductor clearance zones and line of sight for line stringing) operations in environmentally sensitive areas and riparian zones. Any timber felled near watercourses will not be allowed to impact on the flow of water.

Where timber of commercial value is to be felled, the Project will consult landholders and other stakeholders on appropriate uses for this resource. Non-saleable timber will be laid flat or windrowed within the easement to provide shelter for fauna. In areas of steep terrain, it may be appropriate to allow felled trees to decompose naturally along the contour of the landscape. Timber felled near watercourses may be aligned to provide bank protection and riparian habitat.

Further discussion on vegetation clearing and management is contained in Section 7.4 and Section 7.5 in Volume 2 Chapter 7 Flora and fauna.

2.14.3 Construction of access tracks

A concept erosion and sediment control plan (CESCP) has been developed for the Project and will be implemented during the construction and maintenance phases of the Project. All work will minimise disturbance to the natural ground cover to reduce the potential for erosion. The CESCP is included in Volume 3 Appendix S Concept erosion and sediment control plan.

Where major or high risk DAF waterways run parallel or intersect directly with the proposed access track between towers, the access track shall be offset from the waterway to minimise disruption to the waterway creek bed and banks. Vegetation clearing along the alignment, where it intersects with waterways will be required to undertake construction and operation of the transmission line.

Watering of access roads near homesteads and sensitive receptors during construction periods will minimise dust and nuisance air emissions from vehicular movement. Speed restrictions will also be enforced on access tracks.

The number of access tracks will be minimised as far as practicable to ensure the integrity of the land and to minimise the impact to the environment.

2.14.4 Foundation installation

The installation of foundations will occur in a process of excavation or boring, forming, pouring of concrete and removal of formwork. In steep terrain, transmission tower sites may require benching to prepare the site for foundation installation. On flat or gently sloping sites, site preparation may only involve slashing the area or running a blade across the surface. The foundation preparation and installation process can occur directly after access is gained and vegetation is removed from the easement.

During construction the transmission tower work sites and voids created by excavation will be surrounded by mechanical barriers to prevent the intrusion and potential injury of animals, including livestock and native fauna species.

A small crew will bench sites in preparation for foundations and other activities requiring a level hardstand area in the vicinity of the transmission tower sites.

The foundations are positioned to align with the base of the transmission tower legs. Stubs, held in place with reinforcing steel cages, will be set into the foundations and will protrude from the concrete to allow the transmission tower to then be attached to the stub.

The foundation process will start with the boring of four holes for each transmission tower. The holes will be bored using truck-mounted rigs or excavator mounted augers. Foundations will extend above the ground line.

Blasting is not anticipated to be required for the construction of the foundations. In the unlikely event that it is required, a licenced contractor will be required to manage all health and safety risks and blasting will not occur unless these conditions can be met without resulting in any medium to long term disruption or impacts.

Where alternative transmission line support structures, other than lattice steel towers, are used the foundations will be of a different design. For example, monopoles will have a single foundation of different size, shape and quantities of reinforcing and concrete.

Following excavation of the foundations, reinforcing steel cages will be installed and concrete will be set. The reinforcing steel cages will be assembled at laydown yards and delivered to each structure location by flatbed truck.

The reinforcing steel cages are supplemented with temporary formwork to ensure that when the concrete is poured the structure maintains its integrity and alignment with the required transmission tower structure.

Concrete for the foundation process is transported by concrete trucks from the concrete batching plants. The concrete is placed in accordance with normal construction procedures and after an appropriate curing time the formwork is removed.

The foundation installation process for each transmission tower site will take approximately two to five days from excavation to removal of the formwork. Up to four boring rigs will operate in each work front, completing up to three bores per day per rig for standard foundations, with four persons per rig.

A small crew will form one standard transmission tower foundation per day or two non-standard transmission tower foundations per week.

The Construction Contractor will develop a management plan for handling and temporary storage of topsoil and spoil during construction activities at the transmission tower sites. This will be incorporated in the Construction Environmental Management Plan. Spoil not suitable for reuse on-site will be disposed of appropriately.

Each foundation will be required to cure for a period of up to four weeks prior to erection of the transmission tower structure.

Alternative foundation types may not require excavations or concrete.

2.14.5 Construction of transmission towers (structure erection)

Transmission tower construction for each work front will be undertaken as follows:

- Materials will be removed from containers or vehicles at each transmission tower site and arranged in a logical way to assist rapid assembly of the structure.
- Assembly crews will use smaller cranes to piece together sections of the structure and attach relevant transmission line hardware at ground level.
- A larger crane will lift and secure together the sections in place from the ground up.
- Finishing elements will be installed.

Where monopoles, or guyed monomasts, are utilised, the logistics will be different and erection timeframes will be shorter.

2.14.6 Stringing

Stringing of the conductors and earth wires is the process of installing the conductors and earth wires to the transmission towers.

Temporary clearance structures (or hurdles), typically consisting of vertical wood poles with cross arms, will need to be installed at road and rail crossings and at crossings of energized existing overhead electric lines to prevent conductors or draw lines from sagging onto existing infrastructure during the stringing operation. Once the conductors have been fixed to the transmission towers the hurdles will be removed.

At no point does the CopperString transmission line cross existing electricity distribution infrastructure with a higher voltage than the proposed transmission lines. At any such intersections, lines of higher voltage will cross above the line of lower voltage.

Some electricity infrastructure that the Project crosses may be required to be de-energised for a short period of time to allow for the safe construction of the Project transmission infrastructure.

Consultation will be required with the owners of any other electricity infrastructure that the Project may interfere with to arrange any planned outages and to detail the transmission line crossing, once the detailed design and staging of the Project is finalised.

Brake and winch sites for tensioning the transmission lines will be required approximately every 5 to 10 km along the line route. To the greatest extent practical, brake and winch sites will be located within the transmission line easement. However, some brake and winch sites may occur outside the easement.. The sites are needed to set up the winches and brakes with the conductor drums. Depending on topography, some incidental grading may be required at pulling and tensioning sites to create level pads for equipment.

Helicopters will be employed as the primary means of installing insulator strings, conductor draw lines and overhead earth wires.

Stringing between pulling and tensioning sites will be undertaken as follows:

- For the section to be strung a helicopter or elevated work platform will be used to fit the insulator strings and sheaves to the transmission tower structure to ensure when the lines are being strung that there is no damage to the conductor and earth wires.
- For each stringing section a helicopter will thread the draw line that will be used to pull the conductor.
- The draw line will be pulled by the helicopter and tensioned using a braking device to ensure the transmission line does not contact obstructions or the ground. A smaller ground crew will conduct visual inspections during stringing to monitor the work and ensure the draw line does not become obstructed.
- The draw line is then detached from the helicopter and attached to the conductor to be strung. When pulling twin conductor circuits, a headboard is used to connect the conductors, and the headboard is connected to the draw line. The conductor(s) are then drawn into place.
- A large work crew will follow the stringing operations and detach the conductor from the sheave blocks and attach it to the transmission tower ensuring the correct amount of sag in accordance with the transmission line design. Where spacers and dampers are required along the transmission line, they will be installed at this stage of the stringing operation.
- After stringing of the conductors, a similar process will be conducted for the OPGW, where a helicopter will be utilised to pull the OPGW. An optical fibre jointing crew will follow and complete the jointing from the ground. This last activity in the line stringing will occur at a rate of approximately 10 km per day.
- The stringing crew will consist of a total of 50 people, completing from 3 km/week over rough terrain, to 7 km/week on flat terrain, with an average of 5 km/week over variable terrain.
- Helicopter stringing activities will be undertaken essentially within the easement, which is, as discussed previously, well separated from buildings and other sensitive receptors.

2.14.7 Transmission tower completion

After stringing, a completion crew will attend to each structure site to conclude the construction program by completing the following:

- Installation of warning and informational signage
- Construction of wildlife-friendly anti-climbing devices.

A separate crew will conduct any required final rehabilitation of temporary disturbance at tower sites. At the conclusion of construction, the easement will also be cleaned of packing crates, hardware, and all construction debris.

Rehabilitation of construction sites will occur progressively as the construction process advances. Disturbed areas not required for access roads and maintenance areas around structures will be restored as soon as practicable. These sites may be heavily trafficked, with ground disturbance in construction material laydown areas, footing drill pads, crane pads, mobile crib room pads, and truck turning areas. The sites will be ripped to break up any compacted soil.

2.14.8 Transmission line identification markers

Where the transmission line crosses any area that is used for aviation purposes, transmission line identification markers will be installed to indicate the position and/or direction of the transmission line. This does not include heli-mustering areas unless the landowners specifically apply for identification markers.

Bird scarers will be installed on transmission lines crossing areas where they are a hazard to bird species, such as cranes on wetlands.

2.14.9 Helicopter use

In addition to conductor stringing activities, there may be a requirement for helicopters to be used to support some of the other construction activities. Project construction activities potentially facilitated by helicopters may include delivery of construction workforce, equipment, and materials to structure sites, structure placement (e.g. sky crane services), and hardware installation.

Use of a helicopter for structure erection may be driven by various factors, including access to the transmission tower sites, environmental or other access constraints, construction schedule, and/or construction economics. When helicopter construction methods are employed, helicopter construction activities will be based at or near tower assembly areas which are also utilised as delivery/laydown areas.

Prior to installation, each transmission tower structure will be assembled in multiple sections at the tower assembly area. Transmission tower sections or components will be assembled by weight based on the lifting capacity of the helicopter in use. The lift capacity of helicopters is dependent on the transmission tower site and the intervening terrain.

After assembly, the transmission tower sections will be attached by cables from the helicopter crane to the top four corners of the structure section and airlifted to the transmission tower site. Upon arrival at the transmission tower sites, the section will be placed directly on to the foundation or atop the previous transmission tower section. Guide brackets attached on top of each section will assist in aligning the stacked sections. Once aligned correctly, line crews will access the transmission towers to bolt the sections together permanently.

2.15 Substations

2.15.1 General

The construction of substation sites occurs over a relatively short period and the overall construction program is dependent on the procurement of the major substation equipment, such as transformers and SVCs. On average construction of an individual substation will require approximately 12 to 18 months.

Construction of the substations, and other infrastructure such as the communications CEV huts, broadly involves the following series of activities:

- Site preparation
- Vegetation clearing
- Site fencing
- Civil works
- Earth grid installation
- Drainage
- Foundations
- Equipment installation
- Rehabilitation.

2.15.2 Site preparation

Appropriate measures will be taken to minimise disturbance and loss of topsoil from the site and to rehabilitate disturbed areas in the substation vicinity because of the construction works. Excess material onsite will be disposed of in an appropriate manner.

2.15.3 Vegetation clearing

Substation sites have generally been selected in pre-disturbed areas where minimal vegetation clearing is required. Where vegetation clearing is required, the methodology described in Section 2.14.2 will be employed.

2.15.4 Site fencing

Security fences with locked gates will be installed around the substation sites to restrict unauthorised access to the site. The site will be unattended unless maintenance of the substation is being carried out.

A boundary fence will define the overall boundary of the substation site and the balance of the land acquired will provide a buffer zone.

Due precautions will be taken to minimise potential for loss or injury to persons or livestock during the construction phase.

2.15.5 Civil works

Foundations for the substation equipment will be excavated and an earth grid will be installed under the substation site.

2.15.6 Drainage

Drainage work consists of the installation of all drains, pits, and culverts necessary to control the flow of stormwater from the substation footprint.

2.15.7 Foundations

It is expected that structure foundations within the substation will be excavated or bored cast in-situ steel reinforced concrete, driven steel or steel reinforced concrete piles or steel screw piles. Bored concrete foundations will be used if the site conditions are favourable for drilling. Driven steel piles or pre-cast steel reinforced concrete piles and steel screw piles may be used if the site conditions are favourable. Excavated or rock anchor foundations will be used when the ground conditions are not suitable for the excavated, bored, driven or screwed type (e.g. in hard rock). Pile caps and headstocks will be constructed from concrete or steel as appropriate. Isolated plinths and foundations will then be constructed to support the site infrastructure.

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. Concrete for the foundations, transformer bund walls and cable trenches will be transported from the concrete batching plants, which are further discussed in Section 2.18.3.

2.15.8 Major electrical equipment and switchgear

Equipment will be mounted on individual steel support structures in distinct bays for each separate circuit, such as incoming and outgoing transmission lines.

The steel for the lattice and tubular structures will be fabricated, galvanised (where required), 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 member into several sections and subsequent erection by a mobile crane.

Once all gantry and support structures have been erected, the busbars and high voltage electrical equipment (disconnectors, earth switches, instrument transformers, circuit breakers, reactors, capacitors, power transformers etc.) will be installed and electrical connections made. Cables that carry the control and protection signals from equipment in the yard to the control equipment building/s will be laid and all connections made.

Purpose built equipment such as large power transformers will undergo project specific testing and functional systems will be subject to detailed acceptance tests during the commissioning of the Project.

2.15.9 Rehabilitation

Rehabilitation at the substation site will include clean up and final trim of exposed soils, removal of construction waste, landscaping (grass seeding), and commissioning of environmental management equipment such as oil/water monitoring systems, and first flush diversion valves. Planting of native species and other landscaping measures will supplement the screening of the site from public viewpoints.

2.16 Commissioning

The transmission network will be subject to a detailed testing and commissioning plan and several performance trials to verify the integrity of the transmission lines and substation infrastructure.

Coordination of transmission line and substation construction work is required to deliver the network sections, as described in Section 2.1.2, for the commissioning plan. The Renewable Energy Hub and CopperString Core, including the connections to the Chumvale Substation and the Dugald River and Ernest Henry transmission lines, will be commissioned together, as one portion. The Southern Connection will be commissioned together with the Phosphate Hill Connection, as another portion. The Mount Isa Augmentation will be commissioned as a separate portion.

Equipment will undergo a series of individual, modular and full system testing and commissioning tests supervised by an independent testing engineer. All electrical equipment supplied will be provided with type test certificates.

For each network portion, the substation equipment will first be tested at the equipment and functional level, followed by a complete substation testing.

Once all substation sites for a commissioning portion have been tested individually, overall end system tests will be performed to confirm the correct operation of all protection, control, communications, and SCADA systems.

The transmission lines will undergo final inspection, testing and all temporary earths will be removed prior to the energisation of the line. The network portion will then be progressively energised from end to end, allowing time for transformers and other systems to be 'soak tested' at full voltage.

A series of system tests will be conducted to ensure power quality performance and any required Australian Energy Market Operator testing.

The commissioning process for each network portion is anticipated to take two months from the finalisation of construction and the individual component testing at substation sites is likely to begin before the finalisation of construction on the complete network. No additional infrastructure will be required for the commissioning of the Project.

2.17 Construction resourcing

2.17.1 Project workforce

2.17.2 Workforce sourcing and induction

A workforce attraction and retention strategy will be used to assist in establishing and stabilising the workforce for the construction of the Project.

The current construction schedule is based on resources becoming available in realistic timeframes.

2.17.3 Local workforce participation (local and Indigenous)

CuString expects that the transmission line construction industry in Australia will be resource constrained over the construction period. Where possible and competitive, the Project will employ and subcontract locally and regionally however specialist roles may be sourced from elsewhere in Queensland or Australia.

While Townsville will be the main point of employment, the Project will also operate points of employment at Charters Towers, Pentland, Hughenden, Richmond, Julia Creek, Cloncurry and Mount Isa to allow residents living along the route an opportunity to be employed by the Project.

CuString will work with councils, education and training providers, and labour force suppliers to develop a local training, education and employment program that develop measures to:

- Maximise local participation and employment (including work readiness if appropriate)
- Maximise Indigenous participation and employment
- Employ apprentices and trainees (including work readiness if appropriate).

CuString and the Project Construction team has developed a Local Industry Participation Plan for the potential businesses wishing to be involved in the project. This information will be made available to organisations tendering for the major contractor roles.

In all instances, the Project will strive for an inclusive workforce in respect to Indigenous employees, people with a disability and other groups that enhance the diversity of employees.

All workers will undertake site and project inductions, and these will include training in safety systems, cultural awareness, environmental compliance, controls and procedures, landholder dealings and land management.

2.17.4 Workforce accommodation

Capacity

Figure 2-7 provides an indication of how work fronts will move between construction hubs, including an approach to managing the variation in wet season access restrictions between hubs.

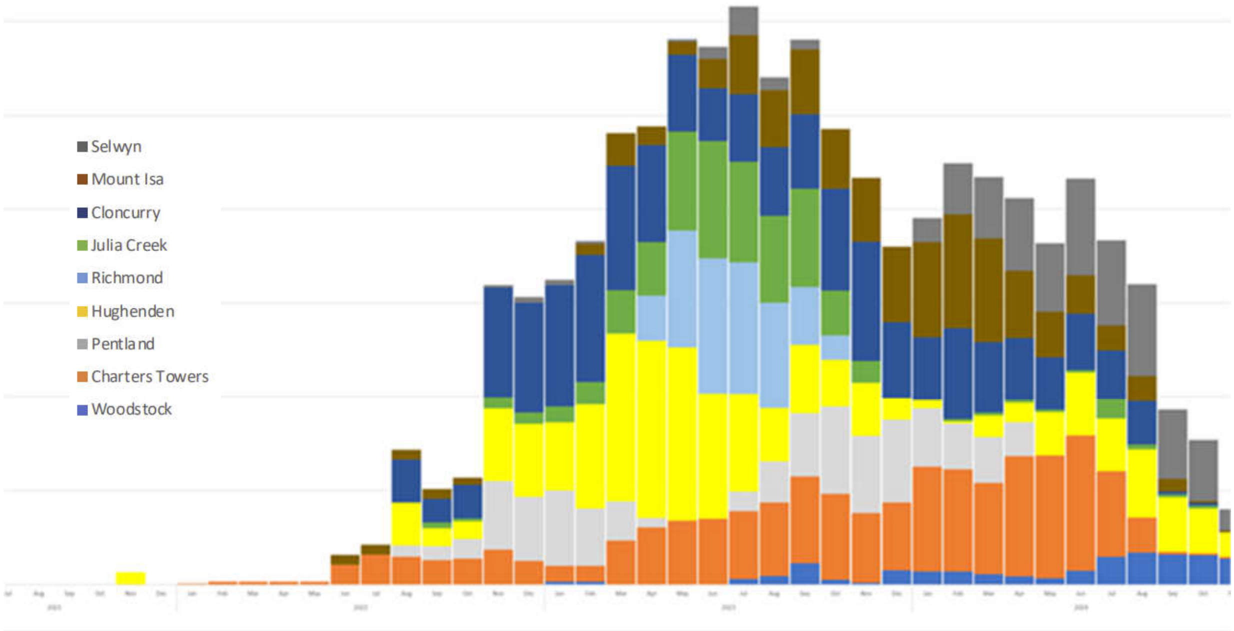


Figure 2-7 Indicative construction workforce histogram showing transitions between camps

Due to the scale of the Project the construction activities for the transmission line and the substations will be managed almost as independent projects that have shared logistics. Most of the workforce will be involved in transmission line construction activities.

The substation construction workforce will use the same camps as the transmission line workforce. However due to the longer duration of substation construction the size of the workforce at the camps will vary during the project as the transmission workforce comes and goes from each camp.

Table 2-14 provides an indication of the peak occupational grouping for each transmission line construction hubs.

Table 2-14 Indicative peak occupational groupings for each transmission line construction hub work front

Role	Estimated peak personnel requirements
Construction Manager	2
Area Manager – Civil	4
Area Manager – Structural	4
Commissioning Engineers	4
Area Engineers	8
Compliance Officers	8
Administration, Human Relations and Community Relations staff	10
Surveyors	6
CH Monitors	4

Role	Estimated peak personnel requirements
Logistics	6
Planners, contractors, finance, procurement	10
Camp staff	10
Sub-total	**76**
Riggers	150
Plant Operators	40
Fitters	6
Labourers	50
Sub-total	**246**
Total	**322 (~350)**

The workforce associated with the construction of the substation infrastructure is significantly smaller than the workforce constructing the transmission line infrastructure. A peak of 40 to 50 construction personnel (refer to Table 2-15) will be required at each substation site, with an average of 10 personnel on site each day of the construction period. The peak at each substation site is anticipated for approximately a two-month period during the overlap of civil and electrical works and peak workloads during commissioning. Figure 2-8 presents the typical staging that will occur for transmission substation construction.

Table 2-15 Indicative occupational groupings for each substation peak construction hub work front

Role	Estimated Peak Personnel Requirements	
	Mainline Substations	Mining Substations
Substation Manager	1	1
Surveyors	2	1
Clearing Contractors	4	-
Civil Manager	1	-
Civil Team	8	3
Fencing Contractor Team	4	2
Heavy Construction Crew	12	4
Electricians	8	2
Apprentices	4	1
Labourers	3	2
Commissioning Engineers	6	2
Total	**53 (≈ 50)**	**18 (≈ 20)**

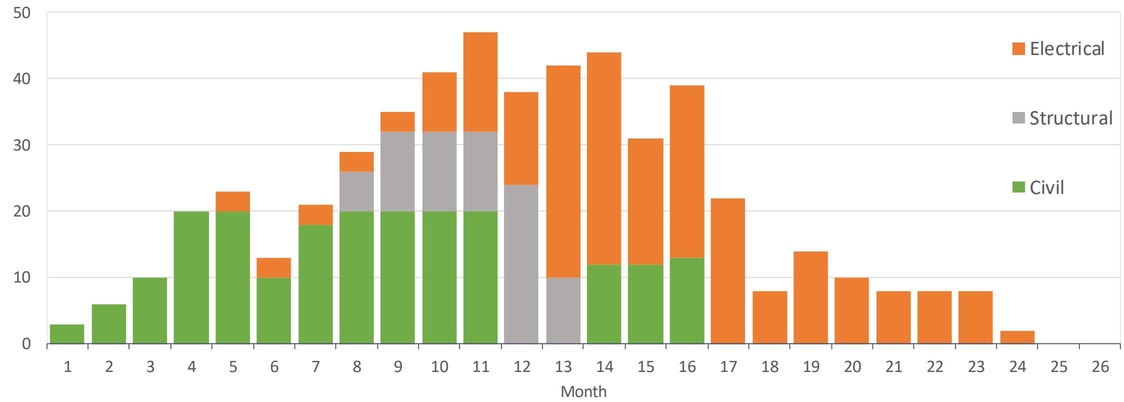


Figure 2-8 Typical transmission substation construction hub work periods

The mine site substations, which are end-user substations are considerably smaller than the mainline transmission substations and require a shorter construction period, with a construction workforce of 20 to 25 personnel, but have a similar resource profile. It may be possible to utilise CuString's customer's mine camps for the construction of these substations.

The estimated capacity is based on a requirement to have a surplus of 50 beds at each camp to accommodate any unanticipated additional staffing requirements. These accommodation numbers represent a nominal maximum and there will be parts of the project period in each section where the workforce is substantially less (refer to Table 2-15).

Location

Preliminary camp locations have been identified as detailed in Table 2-16 and indicative locations and plans are included in a revised Volume 4 Appendix D Revised concept infrastructure plans.

Where appropriate workers' accommodation facilities already exist, workers may be accommodated in these facilities.

Table 2-16 Indicative workforce accommodation for the construction hubs

<table>
<tr><th>Transmission Network Section</th><th>Construction hubs</th><th>Length (km)</th><th>Location of accommodation</th><th>Capacity beds (minimum to maximum)</th></tr>
<tr><td>Woodstock Substation</td><td>Woodstock</td><td>n/a</td><td>Options under consideration within the Townsville City and Burdekin LGAs (within 1 hour of travel to the Woodstock Substation)</td><td>180 -350</td></tr>
<tr><td rowspan="4">Renewable Energy Hub</td><td>Woodstock</td><td>31</td><td>As above</td><td>Incl. above</td></tr>
<tr><td>Charters Towers</td><td>72</td><td>Charters Towers</td><td>128 - 350</td></tr>
<tr><td>Pentland</td><td>139</td><td>Pentland</td><td>128 -350</td></tr>
<tr><td rowspan="2">Hughenden</td><td>94</td><td rowspan="2">Hughenden</td><td rowspan="2">250 -350</td></tr>
<tr><td rowspan="4">CopperString Core</td><td>47</td></tr>
<tr><td>Richmond</td><td>134</td><td>Richmond</td><td>128 -350</td></tr>
<tr><td>Julia Creek</td><td>147</td><td>Julia Creek</td><td>128 -350</td></tr>
<tr><td rowspan="2">Cloncurry</td><td>118</td><td rowspan="2">Cloncurry</td><td rowspan="2">256 -350</td></tr>
<tr><td></td><td>50</td></tr>
</table>

Transmission Network Section	Construction hubs	Length (km)	Location of accommodation	Capacity beds (minimum to maximum)
Mount Isa Augmentation	Mount Isa	50	Mount Isa (utilise existing accommodation	150 -250
Southern Connection	Cloncurry	50	Cloncurry	Incl. above
	Selwyn	40	Selwyn Substation	175 -250
Woodya Connection	Selwyn	60	Woodya Substation	

Duration

Construction camps installed by the Project will only be utilised for the construction period of the Project and will be decommissioned at the end of the construction program.

The operational period of each of the construction camps varies in accordance with the construction schedule. The assumed construction staging described in Table 2-13 is presented in Table 2-17.

Table 2-17 Camp construction and camp operation schedule

Month	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Duration Months
Mt Isa							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							27
Selwyn													■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		26
Cloncurry										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					26
Julia Creek										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			28
Richmond																	■	■	■	■	■	■	■	■	■	■														10
Hughenden	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								32
Pentland										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					26
Charters			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						32
Woodstock												■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				25

Design

Finalisation of the construction camps will be completed by specialist contractors (or sub-contractors) that will construct and operate the camps. The contractors will be responsible for ensuring the facilities meet all applicable occupational health and safety requirements, including those relating to food preparation and storage, ablutions and water quality, vector and vermin control and safety and emergency services. All camps will be of a similar structure and will be built to current industry standards and the requirements of local laws and approval conditions.

The camps will be designed to provide accommodation and essential services for single persons only. This includes incorporating single person sleeping quarters and services to cater for male and female personnel based on the facilities listed in Table 2-18.

Table 2-18 Typical construction camp facilities

Facility	Details
Kitchen	• Adjoining dining hall • Food preparation capacity for the anticipated peak tenancy • Dry goods and refrigerated storage capacity for two weeks' supply • Equipment capacity for 100% of the peak tenancy per mealtime • Bain-maries for serving meals • Loading dock
Dining Hall	• Self-preparation area for lunch packs (cribs) for all residents • Self-preparation area for breakfast (industrial toaster, cereals, juice, etc.) for all residents • Covered landing on 2 sets of access doors • Hand wash facility situated on landing to main access door • Drinks fridges for milk storage • Wall mounted urns for tea and coffee making • Espresso machines
Ice Station	• Semi-enclosed structure which incorporates a wash down bench for drink containers, chilled • Potable water dispensers and ice chest.
Staff Training/ Induction/Meeting Room	• To fit 15 persons
Laundry Facilities	• One facility for each block of 20 units • 5 x Industrial type washing machines (not coin operated) in each facility • 1 x Ironing board and Iron with auto switch off • 5 x Industrial dryers (not coin operated) in each facility • Note that laundry services for workers may be outsourced to improve crew productivity.
Camp Management Office	• For the processing of "check-in and check-out" personnel, together with the provision of work areas and offices sufficient for the operation of the camp management contractor's site-based operations and CuString visitors.
Recreational Facility	• Common television viewing area (large screen) • Billiard tables x 2 • Dart board games zone • Outdoor BBQ area • Tea/coffee making area • Internet café
Gymnasium	• large enough for 5–10 persons to utilise at one time • Equipment provided shall ensure a complete range of workout options and shall include pin loaded, free weights and 2 items of cardio equipment. • Where appropriate, the Project will support local businesses by using established gymnasium services (e.g. Richmond's town gym)

Facility	Details
Accommodation Units	• Single rooms each with ensuite • Single sized bed • Bar fridge • Hard wired smoke alarms with battery backup • Fire extinguisher • Flat screen TV • Clothes cupboard • Split system air conditioner
Walkways	• Mass concrete or duckboard footpaths connecting all accommodation units and amenities. • Overhead lighting
Toilet Blocks	• "Public" male /female toilet facility including disabled access in accordance with BCA requirements and Located within the central area of the camp
Site medical facilities	• Dimensions approximately 6 m x 3 m
Generators	• Adequate size to meet power demand for each camp configuration (if an Ergon Energy connection is not available).
Sewer treatment Plant	• Adequate to meet loading for each camp configuration and compliant with applicable ERA or other regulations. • Some communities (such as Hughenden and Richmond) have offered access to the town sewerage system.
Water Treatment Plant	• For treating raw water from artesian bores to potable standard, capacity to supply each camp. • Some communities (such as Hughenden and Richmond) have offered access to the town water system. • Configuration plus allowance for onsite concrete batch plant.
Fuel, chemical and waste storage	• Including temporary storage for domestic waste and recycling collection
Vehicle wash down area	• For weed management
Maintenance workshop	• For light maintenance of vehicles and equipment

Camps will be composed of demountable accommodation units. A demountable is required at a rate of one unit per four workforce personnel, with a further four each for site office, kitchen mess and other functions. The total requirement for each 350-person camp is shown in Table 2-19.

Table 2-19 Demountable buildings required for each 350 person camp

Purpose	Number of demountable buildings required
Accommodation	88
Site office	4
Kitchen/mess	8
Other	10
Total	**110**

Consumables

Local purchase of food and other supplies will be prioritised. Where local suppliers cannot provide all requirements additional supplies for each camp will be brought in by truck or rail.

Existing carriers are available to each of the towns where construction camps will be located to handle general freight movement. There are adequate fuel supply outlets along the Flinders Highway to meet requirements locally. Special arrangements for fuel supply will be needed for the Selwyn Substation construction camp site.

Services

Associated infrastructure requirements of the temporary construction camps are detailed in the following sections:

- Water supply and usage – Section 2.22.1
- Sewage and wastewater treatment – Section 2.22.4
- Power and communications – Section 2.23.

Some additional infrastructure may be required to facilitate connection to existing services. These requirements will be subject to ongoing discussions with landholders and local councils.

If a camp is located adjacent to the laydown and storage compound, then maintenance of camp facilities could be carried out from a common workshop that supports both the camp and storage compound as well as the power generation facility. Where electricity generation is required on-site for the camp, co-location with the storage compound is the Project’s preference so that only one generating and only one fuel storage facility will be required at each location. This will reduce the number of potential spillage sites and facilitate the management of waste produced from these facilities.

Where appropriate and competitive, local businesses will be utilised to provide services (such as catering, cleaning, security, laundry, office supplies and maintenance) to the camps. In some instances, as an alternative (or in addition) to camp catering, local restaurants or hotels may be used to provide meals.

2.18 Construction facilities

2.18.1 Construction laydown/delivery areas

Laydown areas will either be co-located with a camp or a substation construction area. Deliveries will occur in a manner to ensure that audible noise is not clearly heard by an individual who is an occupier of a building outside the hours of 6.30 am to 6.30 pm Monday to Saturday.

Each site will have a construction site office to coordinate local construction activities, lunchrooms, ablutions, and workshops. The buildings are likely to be in the form of demountable huts. Electricity requirements will be provided by diesel powered generators if connection to the Ergon Energy network is not feasible. Sites will not be fenced however access gates may be required at existing fenced boundaries.

Volume 4 Attachment D Revised concept infrastructure plans provides more detailed plans of laydown areas.

2.18.2 Construction materials

Materials such as foundation reinforcing steel, transmission tower steelwork, drums of conductor and all equipment and materials will be delivered by truck and stored in laydown/delivery areas.

Reinforcing and transmission tower steel bundles will then, where practicable, be partially pre-assembled then organised into transmission tower lots for delivery. The specific means of transporting transmission tower steelwork will depend upon the specific transmission tower location and related access constraints. The delivery from the laydown area to the transmission tower location may be made by (in order of easiest to most difficult access conditions):

- Direct delivery by road train (possibly bypassing the laydown area)
- Delivery by individual trailer
- Delivery by individual trailer hauled by an all-wheel drive prime mover
- Delivery by rigid all-wheel drive off-road truck
- Delivery by helicopter (in which case higher amounts of pre-assembly will be undertaken in laydown areas).

Store facilities will also be provided at laydown areas to house smaller and more vulnerable components such as spacers and insulators. Stores will also likely house construction hand tools, small construction equipment, fixing and assembly materials including containers of touch-up paint or other protective coatings.

2.18.3 Concrete batching plants

Cement will likely be sourced from Townsville, where well established large-scale operations already supply materials to the NWMP.

Concrete batching plants will be required for the supply of concrete for foundations during the preparation and construction phases of the Project. The preferred hierarchy for the development of batching plants required for the Project is as follows:

- Where possible maximise the use of existing operational batching plant. Discussions will be held with relevant local councils and commercial providers to ascertain the feasibility of utilising existing plants.
- Construction of a new batching plant next to operating batching plants in major localities. The co-location of these sites will minimise the environmental impact of the operations and potentially leave a legacy business within the town.
- Construction of a new mobile batching plant adjacent to the regional construction zone areas.

The recommended distance between concrete batching plants and transmission tower sites is as follows:

- During summer, maximum 1.0 hour (est. 60 km)
- During winter, maximum 1.5 hours (est. 90 km).

Note that some transmission tower sites may have access constraints that preclude deliveries within these timeframes. For such sites concrete may be required to be delivered by helicopter or prepared on site with the use of a mobile batching plant such as volumetric concrete mixer (a mixer mounted on the back of a flatbed truck or trailer complete with up to 12 m^3 of raw materials and 2 kL of water).

It is estimated that 52,350 m^3 of concrete will be required for the transmission lines (averaging approximately 28 m^3 per tower) and 25,030 m^3 is required to construct all substations and CEV huts.

Where mobile concrete batching plants are proposed, the batching plants will be managed by operators under the appropriate licence. Once construction in a construction zone is complete the plant will be removed.

Concrete batching plants comprise the following key components:

- Raw materials receivable and storage areas for sand, aggregate, cement powder, setting retardants and additives
- Plant and equipment for the processing, production, and delivery of wet concrete
- Cleaning and waste collection facilities
- Administration and management offices
- Small workshops.

It is proposed the concrete batch plant will be located within the communities associated with the construction zones. For some construction zones these facilities could be co-located with the laydown areas and/ or construction camp.

Any mobile batching plants located away from town water supplies will require transport of water at a rate of 220 L per cubic meter of concrete. However, it is expected that they will be located where town water is available for both transmission tower construction and substation sites.

Details regarding the source of materials for producing concrete are included in Section 2.19.

2.18.4 Townsville logistics yard

Most plant will be imported as pre-assembled modules (as far as is practicable). For efficiency, plant will be packaged for import in containers, ISO frames or as bulk break in consignments that will not require re-packaging prior to delivery at their final site.

A logistics yard near the Port of Townsville intermodal terminal may be used to marshal deliveries prior to dispatch by road or rail to the project site.

This logistics yard will be operational for the duration of the Project's construction.

2.18.5 Decommissioning of construction facilities

At the completion of the construction program all facilities associated with the operation of the temporary construction camps, laydown/delivery areas and any onsite works will be dismantled, removed, and disposed. The contractors engaged to construct and operate the temporary construction camps will also be responsible for the decommissioning of these facilities and the process will be subject to contractual requirements.

Where opportunities exist to leave upgraded infrastructure and legacy items this will be discussed with the landholder and subject to future contractual arrangements with the construction camp contractor and any required statutory approvals.

Decommissioning is discussed in Section 2.25 and rehabilitation is discussed in Volume 3 Appendix T Concept rehabilitation plan.

2.19 Source of quarry materials

The aggregate required for the concrete batching process is likely to be supplied from the region and the final source of these materials will be subject to further discussions with key stakeholders, including local councils. Sand and aggregate for the Hughenden, Richmond and Julia Creek area (black soil areas) may need to be drawn from the Charters Towers/Pentland or Cloncurry areas.

2.20 Procurement and storage of other construction materials

Construction materials will be sourced from a variety of locations. An understanding of the scope of material that can be supplied by fabricators and suppliers in Townsville will be reviewed as part of current Project activities. It is anticipated that most imported materials will be shipped in containers to Townsville Port or through the Port of Brisbane.

Some construction materials have particularly long manufacture and delivery times that need to be reflected in the forward planning of the Project.

The main substation components are a specific example that may either be sourced from an international or domestic supplier depending on availability and commercial arrangements.

It is anticipated that procurement of transmission tower steel may occur in advance of construction requirements and will be stored in Townsville or the regional laydown/delivery areas until construction commences in that zone.

The Project may receive up to approximately 4,000 t of transmission tower steel each month during Project construction.

2.21 Machinery and equipment requirements

An indicative summary of the plant and equipment that may be required for each work front is summarised in Table 2-20 (excluding the transport and freight logistics fleet). The quantities of materials and equipment in Table 2-20 are typical for one work front however up to two work fronts may be in operation at a time. The same equipment will be reused in different construction zones where the construction schedule allows, limiting the need for duplication of some items.

Table 2-20 Typical plant and equipment required for each transmission line work front

Activity	Quantity	Materials and Equipment
Clear and Grub	2	D10 Dozer
	2	Grader 16GRP
	2	D7Dozer – with stick rake
	2	Tub Grinder
	2	30 t excavator (and grab in sensitive areas)
Construction of access tracks	2	Graders 16GRP
	2	30 t excavator (and grab in sensitive areas)
	2	Front End Loader
	2	20 t Articulated Truck
	2	Water Truck
	2	Backhoe
Foundation Excavation	8	Excavator mounted auger
	2	30 t Excavator
	2	Airtrack
Stub Set and Form	4	8x8 with 2 t Hiab (truck)
	8	Foundation Jigs
	4	20 t Franna (crane)
Batch Plant	2	Front End Loader
	16	Cement Truck
	4	8x8 with 2 t Hiab (truck)

Activity	Quantity	Materials and Equipment
Transmission tower Assembly and Erection	4	Manitou (forklift)
	4	20t Franna (Crane)
	4	Mobile Crib Room
	4	25 t Franna (crane)
	4	120 t Crane (with long boom)
	4	70 m Elevated work platform
Stringing	1	Helicopter
	1	Helicopter Support Vehicle
	4	15 t Brake and Winch
	4	9 t Brake and Winch
	4	8x8 with 2 t Hiab (truck)
	2	25 t Franna (crane)
	12	70 m Elevated work platform
	4	Winch Trucks
	2	30 t Excavator
	2	Earthing Backhoe
	2	Earthing Airtrack
	500	Triple Stringing Blocks
	4	Mobile Crib Room
Laydown area	2	Water Truck
	2	Grader 140G
	2	Front End Loader
	2	Fuel Truck
	2	20 t Franna (crane)
	2	Welding Plant
	2	5 t Forklift
Rehabilitation	2	Backhoe
	2	Bobcat
	2	30 t Excavator
	2	20 t Articulated Truck
	2	Front End Loader

2.22 Location of utilities

The Project will require utilisation of existing water, telecommunications, power, fuel, and road infrastructure services. This section outlines Project requirements for these services and where they will be sourced from.

2.22.1 Water supply

Construction camps

The preferred hierarchy for proposed water sources for use in construction camps is as follows:

- Use of town water supplies from the existing local council water reticulation networks through the construction of water supply pipelines
- Use of groundwater through existing licensed bores if required

- Access existing town water supplies and transport water by trucks to the temporary camp sites, where it will be stored in tanks at the facility site.

Water will require treatment to a potable standard where existing town water supplies are not proposed to be used. This will be achieved through water treatment plants at the temporary construction camps. No new groundwater bores are proposed as part of the Project. Where existing licenced bores are proposed for use, consultation will be undertaken with the Department of Regional Development, Manufacturing and Water to determine whether the purpose and conditions of the water licence allow the taking of water for the proposed purpose.

Where feasible, recycling of water will be implemented to reduce the total load of the water requirements, though the quantity of this water supply will be subject to further negotiations with the engaged contractor.

Construction activities

Water requirements for the Project construction include water for concrete batching, dust suppression and cleaning of insulators. The total water requirements estimated for the Project are summarised in Table 2-21.

Table 2-21 Construction phase water usage

Activity	Estimated water usage (kL)	Assumptions
Concrete batching plants	23,500	220 L/m^3 of water for concrete
Construction water usage – dust suppression / soil conditioning for compaction	519.000	80,000 hours water cart usages, dump every 2 hours (40,000 dumps) 13, L per dump / 1000 to get KL.
Construction camp utilisation	46,000	70 L/man/day over the life of the construction camps and proportion for fire-fighting requirements
Site offices	6,500	10 L/man/day over the life of the site offices
Cleaning of insulators	500	Requirement of approximately 200 L/tower
Contingency	21,510	10% contingency
Total	**666,510**	-

It is anticipated that the site offices at each of the laydown/delivery areas will require a small amount of potable water to service the personnel at each site. An allowance of 1,200 kL has been allocated for this purpose over the construction schedule, approximately 100 kL per site office.

Water required for concrete batching will be sourced from appropriate water sources and quantities will be finalised during the detailed design of the Project. The preference is to utilise existing concrete batching plants and therefore the water supply of these facilities. Where new or temporary mobile batching plants are proposed, the water source will be determined in consultation with local councils and the Department of Regional Development, Manufacturing and Water (DRDMW) .If required a seasonal water assignment notice or water permit will be obtained under the Water Act 2000 where existing town water supplies are unavailable to meet project demand.

Dust suppression will occur by the watering of access tracks to limit the risk of dust and air emissions related to vehicle movement. It is anticipated that watering of access roads near homesteads or sensitive receptors will be sufficient to mitigate the anticipated air quality impacts to the human environment during construction. Further information on potential impacts to air quality and suitable mitigation measures is detailed in Section 10.4 and Section 10.5 in Volume 2 Chapter 10 Air and greenhouse gas.

As part of the commissioning program individual transmission tower sites will be inspected and cleaned to ensure the optimal function and efficiency of the installed equipment. The insulators will be washed, prior to energisation of the transmission line, to remove pollutants, such as particulates and dust that may impact on the lightning and over-voltage withstand capacity of the insulators.

2.22.2 Surface water resources and water quality

Existing surface town water supplies are proposed to be utilised for the temporary construction camps and associated construction activities in Charters Towers and Cloncurry. The main drinking water sources are shown in Table 2-22.

Table 2-22 Primary drinking water sources

Town	Primary drinking water sources
Woodstock	Groundwater
Charters Towers	Charters Towers Weir located on Burdekin River
Hughenden	Groundwater – Great Artesian Basin (GAB)
Richmond	Groundwater (GAB)
Julia Creek	Groundwater (GAB)
Cloncurry	Cloncurry River Wells, Chinamans Creek Dam or Lake Julius
Mount Isa	Lake Moondarra and Lake Julius

Further details on water supply is included in Volume 2 Chapter 9 Water resources and water quality Volume 1 Chapter 4 Legislation and approvals discusses the approvals and consents required to access and use water resources within the project area.

The impacts to surface waters is detailed in Volume 2 Chapter 9 Water resources and water quality. The potential impacts to surface water resources will be minimal for all phases of the Project, provided that the recommended mitigation measures are implemented.

2.22.3 Groundwater resources

The corridor selection traverses the Great Artesian Basin (GAB), one of the largest artesian groundwater basins in the world. Groundwater from the GAB provides the only source of reliable water along most of the corridor, and as such is of vital importance to both human users and the environment.

Assessment of existing town water supplies has indicated that the use of town water is expected to have minimal impacts to existing groundwater resources. Water will be sourced in in consultation with Councils, Landholders and the Department of Resources.

The exception to this includes the proposed construction camps at Pentland and near Selwyn Substation, where other existing bores may be required, or water will need to be carted to the camps. Approvals to access and take water from existing bores may be required under the *Water Act 2000* and/or *Planning Act 2016* and will be obtained if required.

Groundwater sources are proposed to be utilised within the following construction zones:

- Pentland
- Hughenden
- Richmond
- Julia Creek
- Selwyn.

Investigation of potential impacts to groundwater has indicated that the Project is likely to have minimal impacts on existing users and environmental values of groundwater, providing the recommended mitigation measures are undertaken. Where new or existing bores are proposed to access water, the following management measures will be undertaken to ensure impacts of use are minimised:

- A pump test and drawdown investigation will be undertaken to ensure adequate yields will be available for camp use and that adequate yields will be maintained for surrounding users
- Ongoing monitoring of surrounding bore levels will be undertaken to ensure yields are maintained and an appropriate management plan should yields decrease to ensure compensation is provided
- Water quality testing will be undertaken to determine the treatment requirements to comply with the Australian Drinking Water Guidelines (2011), version 3.5.

2.22.4 Sewage and wastewater treatment

Sewage and wastewater from the temporary construction camps will primarily come from domestic uses though trade waste may need to be disposed of due to the operation of the onsite workshop.

Sewage and wastewater disposal systems will be required at all construction camp sites unless town STPs are utilised. Camps located within town areas may be able to access the local council reticulated sewage system. Where this is not possible, construction camps will require a STP adequate to meet the loading for each camp and will be developed to comply with requirements of Queensland Health, Department of Environment and Science (DES) and local councils.

Onsite wastewater treatment plants will be designed to maximise the stabilisation of wastewater and settling of solids, avoid the generation of odours, and prevent the discharge of partly treated wastes into the environment. Where a local authority operated STP is not available, disposal of treated sewage will be via an irrigation scheme designed to adequately dispose of the volume of effluent in compliance with best practice, local conditions, and applicable legislation. Design of the STP will incorporate meteorological considerations of the region, including rainfall variability. Buffer distances to watercourses and sensitive receptors will be integrated into the design of the STP.

Removable toilet facilities (e.g. porta-loos) will be utilised by each work crew for intra-day ablutions on the construction sites. Licensed waste contractors will be engaged to service and transport this waste. Waste management related to the Project is further described in Volume 2 Chapter 12 Waste management.

2.23 Telecommunications, power, and fuel

2.23.1 Construction camps

Several of the proposed construction camp sites already have access to the local electricity network and will not require further system upgrade to the planned construction camp site.

The preferred hierarchy for the proposed electricity supply for use in the camps is as follows:

- Access the existing local electricity supply network (an upgrade may be required)
- Utilise a standalone diesel generator to provide the required electricity supply.

All temporary construction camps will have back-up diesel generators of an adequate size to meet the power demand for each camp's capacity in the event of a power blackout from the local electricity supply or in an emergency. These generators will make use of acoustic enclosures to minimise the noise levels that result from their operation.

An adequate communications system will be established at each construction camp to ensure that the site and camp offices can effectively control the activities of staff in the field and comply with the emergency planning and response procedures developed for the Project. Emergency management, including development of an Emergency Response Plan is detailed in Section 17.5.4 of Volume 2 Chapter 17 Hazards, health and safety.

2.23.2 Construction activities

Construction activities will generally be conducted on site with mobile equipment that utilises diesel fuel. A list of vehicle and machinery requirements for each construction zone is detailed in Section 2.21.

Each construction workshop, co-located with the laydown/delivery yards, will have refuelling facilities for machinery and vehicles. Regional construction laydown/delivery areas will operate with diesel generators as they are likely to be located away from major centres and require a reliable source of electricity.

2.23.3 Fuel

Fuel depots or other refuelling facilities are likely to be established in some of the remote laydown areas (such as Selwyn) and are expected to be incorporated with laydown and equipment storage compounds for management and security reasons. Fuel storage tanks will comply with the relevant codes and standards for storage of fuels. Dispensing areas will also be designed to facilitate spillage management and clean-up. Fuel, primarily being diesel, is expected to be delivered by a refuelling truck, however some fuel/s may be delivered in 200 L drums. The contribution of Project fuel use to greenhouse gas emissions is discussed in Section 9.5 of Volume 2 Chapter 10 Air and greenhouse gas.

2.24 Operational activities

2.24.1 Operational and maintenance requirements

Ongoing maintenance will be required throughout the operation of the transmission network. The operational period of the Project will require approximately 15 full-time equivalent employees to operate the transmission network plus an additional 15 part-time maintenance employees as required.

Broadly the operation and maintenance of the Project will necessitate:

- Maintenance – field based planned and reactive maintenance, asset management systems and associated supportive staff
- Network control (operations) – continuous operation of a control centre capable of monitoring the network and dispatching field teams for routine and defect maintenance
- Life cycle replacement requirements
- Administrative management of the system.

2.24.2 Maintenance

Routine maintenance activities are expected to occur on a regular basis according to the maintenance contractor's maintenance plan. The frequency of maintenance will vary for different components of the transmission network and is dependent on aspects such as their immediate operating environment, seasonal constraints, risks associated with their failure and regulatory requirements.

Visual inspection of the transmission line, easement and access tracks will be conducted via 4WD vehicles, helicopter, or aerial remote sensing, such as lidar technology. The visual inspections will examine network components for signs of degradation or failure. The inspection will confirm that no unauthorised activities are taking place within the easement that may affect the safe operation of the transmission network. Unauthorised activities include anything outside of operational and maintenance activities and what is agreed upon with the landholder in the easement agreement.

The visual/lidar inspection will inform vegetation management control. The frequency of vegetation control will be dependent on the type of vegetation cover and the risk it poses to the transmission network and will be conducted as necessary. The landholder will be consulted before any scheduled vegetation control activities and agreement will be sought on the preferred control approach. Environmentally sensitive areas may be cleared by hand to limit disturbance to the surrounding environment. Any clearing will be conducted in accordance with the Framework Environmental Management Plan described in Volume 3 Appendix Q Framework environmental management plan.

During operation of the transmission network, access will be required to each tower. This will necessitate the continuing management of access tracks, which will also be assessed as part of the regular maintenance inspections. Measures to limit the risk of erosion from access tracks are included in Volume 3 Appendix S Concept erosion and sediment control plan.

Routine inspection and maintenance activities will also be required in the remainder of the transmission network infrastructure such as equipment in the substations and CEV huts.

In addition to these routine inspection and maintenance activities, network components will require access for unplanned events and failures.

The transmission lines traverse regions of severe storm, lightning, and bushfire activity and although these risks are considered in the design, selection and installation of transmission network components, such activity may lead to protection elements tripping a line section. Unplanned events, such as lines tripping, may require visual inspection to ensure the network is safe to re-energise.

The transmission network will be remotely monitored. Maloperation or failure of components and systems in the substations and CEV huts will be alarmed. Such alarms may require on-site investigation together with any repairs identified as being required.

Reliability and availability of energy supply from the network will form part of operational agreements with the Australian Energy Regulator and individual bulk customers. The impacts from frequency, duration and severity of outages, load-shedding and curtailment will vary across the customer base. These factors will drive decisions on responses to events. Depending on location within the network and impacts on travel time from seasonal access aspects this response may be by vehicle or helicopter.

The replacement of any defective components can usually be completed without the need to de-energise the transmission line.

Where on the ground maintenance and repair is performed, the spread of weeds will be limited by conforming to the Concept biosecurity plan developed for the Project, included in Volume 3 Appendix U Concept biosecurity plan.

Maintenance of the transmission network is likely to be contracted to existing transmission line maintenance service providers in the region. Specialist crews will be required to inspect and maintain the substation infrastructure. A part-time workforce of approximately 15 people is expected to maintain the transmission network.

2.24.3 Network control

The transmission network will likely be operated by an existing network service provider from an existing operating centre. The network control centre will be responsible for monitoring and emergency response of the transmission infrastructure and ensuring the network performance and reliability targets set by CuString and the associated regulatory bodies are met. The operational and asset management strategies will be consistent with existing industry best practice and make certain the control systems interface with the regulators, network providers and electricity users and generators.

If a dedicated network control room is required, it will be established in the region.

2.24.4 Equipment design life

CuString will employ industry best practice to maintain and operate a cost-effective transmission network with the aim of reducing operating and maintenance costs while maintaining or improving reliability and public safety. A thorough inspection and maintenance regime will be implemented to ensure reliability and extend the life of the network components.

The design life of the transmission network is expected to be 45 years. It is anticipated during the operation of the Project some components will require to be replaced, which is likely to extend the life of the network and maintain the reliability of supply. Components will be operated in accordance with the manufacturers' recommendations. Items that have a design life of less than 45 years and are likely to require replacement during the life of the Project include:

- Electronic equipment and systems (including building auxiliary systems such as control and protection systems, fire alarms, security systems, batteries, and extinguishers) – design life of 15 years
- Transformer oil refurbishment/replacement – design life of 10-20 years.

Equipment will be standardised as far as practicable to ensure ease of replacement, whether due to a fault or exceedances of the equipment design life. Some specialist components will require specialist manufacture and will not be standardised. Where the reliability of the network is dependent on the availability of spare parts, appropriate strategies will be established including storage local to the Project or contingency spares held by an OEM or with an industry partner.

Suitable spares will be considered by the relative importance of the assets, remoteness of locations and relative risk of failure and corresponding repair time of different components. Special consideration will also be given to long lead items of some of the transmission network components.

2.24.5 Operational standard and potential upgrades

The design of the transmission infrastructure is based on providing 400 MW, limited by transformer and line losses, to the Dajarra Road Substation and performance standards complying with the NER, including the N-1 level of security.

Several foundation network users underpin the commercial feasibility of the Project's construction. While no future staged development of the Project is planned, it is acknowledged that the Project will provide opportunities for new and existing large energy users, generators and network service providers within the region to participate in the NEM, through future connections to the CopperString transmission network.

To achieve any capacity expansion beyond that of the foundation network user requirements, further investment may be required to ensure the capacity and reliability of the network. Potential upgrades to the transmission network will be subject to further development and regulatory approvals if an upgrade is determined to be required at a future date. The easement widths for the Renewable Energy Hub and CopperString Core include allowance for an additional transmission line.

2.25 Decommissioning activities

The decommissioning process would essentially necessitate the reverse of the construction process, where, following electrical isolation the conductors and earth wires would be lowered, wound onto drums, and transported for recycling. Towers would be removed, and the steel transported for recycling.

Footings that occur in agricultural land and other places where they would cause a nuisance would be cut off, typically about 1 m below ground level, with the lower end of the footing remaining in place. In areas of grazing quality, or not used for agricultural purposes, the footings will be cut off at approximately 300 mm deep. Rubble from the removed section of the footing would be removed from site and disposed of via a licenced waste disposal facility.

Decommissioning activities will also be addressed regarding the same impacts as the construction phase. If no further transmission lines were planned for the easement, then the easement would be surrendered and returned in an acceptable condition regarding the existing land use in the area.

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