CopperString 2.0

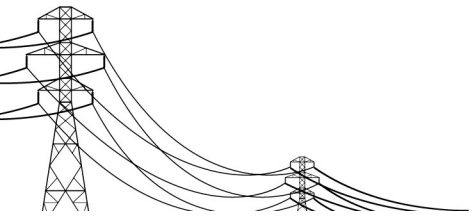
Water resources and water quality

Volume 2 Chapter 9

Table of Contents

Table index

Figure index



9. Water resources and water quality

9.1 Introduction

9.1.1 Project overview

The Project involves the construction and operation of approximately 1,060 km of extra high voltage overhead electricity transmission line that will extend from Mount Isa to the Powerlink transmission network, via a new connection point near Woodstock, south of Townsville.

The Project involves construction of seven new substations at Woodstock, Hughenden, Dajarra Road (Cloncurry), Mount Isa, Selwyn, Cannington Mine and Phosphate Hill Mine.

The CopperString transmission network is divided into the following eight sections as shown in Figure 9-1:

1. Woodstock Substation
2. Renewable Energy Hub
3. CopperString Core
4. Mount Isa Augmentation
5. Southern Connection
6. Cannington Connection
7. Phosphate Hill Connection
8. Kennedy Connection (option).

9.1.2 Objectives

The objective of this chapter is to ensure the Project:

- Is planned, designed, constructed and operated to protect environmental values of Queensland waters and supports the achievement of water quality objectives (where available).
- Provides for equitable, sustainable and efficient use of water resources and riverine quarry material.
- Retains environmental flows, water quality, in-stream habitat diversity, and naturally occurring inputs from riparian zones to support the long-term maintenance of the ecology of aquatic biotic communities.
- Retains the condition and natural functions of waterways, watercourses, lakes, springs, aquifers and other natural water systems and watercourses including the stability of beds and banks of waterways and watercourses.
- Waterway barrier works in fish habitats are constructed to maintain connectivity, habitat values and fish passage.
- Volumes and quality of water resources are maintained and current lawful users of water (such as entitlement holders and stock and domestic users) and other beneficial uses of water (such as spring flows and groundwater-dependent ecosystems) are not adversely impacted by the development.

9.1.3 Purpose of chapter

The purpose of this chapter is to describe the existing water quality and water resource environmental values and possible impacts associated with the construction and operation of the Project. This chapter also recommends associated mitigation measures to avoid/minimise impact on water quality and water resources. This assessment addresses the requirements in Sections 12.34 through to 12.45 of the ToR.

9.1.4 Defined terms

The following are a list of defined terms utilised throughout this chapter.

Corridor selection: means the baseline investigation corridor of the transmission line (a nominal 1,060 km long corridor). The corridor selection is 120 m wide from Woodstock to Dajarra Road, and 60 m wide from Dajarra Road to Mount Isa, Dajarra Road to Selwyn, and Selwyn to Phosphate Hill and Cannington. The 4 km long section of the corridor selection from Dajarra Road Substation to Chumvale Substation is 60 m wide and a 3 km long section from Dajarra Road Substation to the Dugald River 220 kV overhead line is 80 m wide.

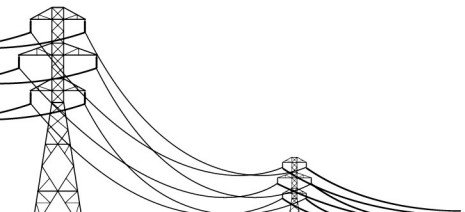
Project area: means the 120 m easement and associated infrastructure (including laydown areas, substations, CEV huts, access tracks, brake and winch sites and construction camps) and works referred to in the EIS Terms of Reference (ToR) (these include off-easement components).

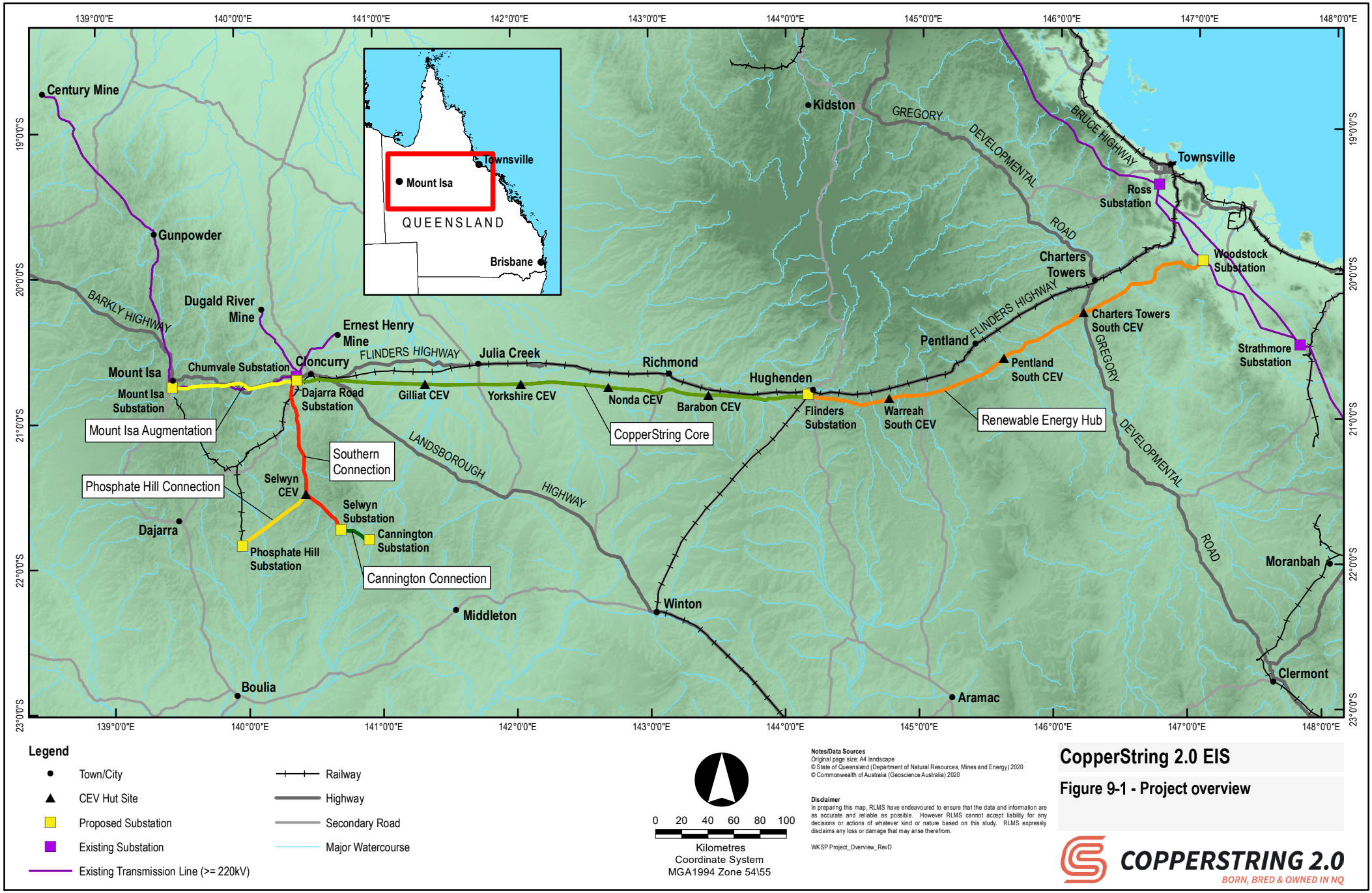
Study area: as defined by individual technical studies in the methodology section or by default the 5 km wide study corridor defined in the Initial Advice Statement and referred to in the EIS ToR.

Watercourse: as defined by the *Water Act 2000* a river, creek or other stream, including a stream in the form of an anabranch or a tributary in which water flows permanently or intermittently, regardless of the frequency of flow. Watercourses include natural or artificially modified channels and artificial channels that change the course of a stream.

Waterways: waterways include rivers, creeks, watercourses or inlet of the sea defined under the *Fisheries Act 1994* for the purpose of managing impacts on fish passage.

Water features: includes waterways, watercourses, lakes, springs, etc for general descriptor of collective features.

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QUEENSLAND
Townsville
Mount Isa
Brisbane
Century Mine
Gunpowder
Dugald River Mine
Ernest Henry Mine
Mount Isa
Mount Isa Substation
Chumvale Substation
Cloncurry
Dajarra Road Substation
Julia Creek
Richmond
Hughenden
Flinders Substation
Kidston
Pentland
Charters Towers
Charters Towers South CEV
Pentland South CEV
Warreah South CEV
Ross Substation
Townsville
Woodstock Substation
Strathmore Substation
Gilliat CEV
Yorkshire CEV
Nonda CEV
Barabon CEV
Mount Isa Augmentation
Phosphate Hill Connection
Southern Connection
CopperString Core
Renewable Energy Hub
Selwyn CEV
Selwyn Substation
Cannington Substation
Phosphate Hill Substation
Cannington Connection
Dajarra
Middleton
Winton
Boulia
Aramac
Moranbah
Clermont
BARKLY HIGHWAY
FLINDERS HIGHWAY
LANDSBOROUGH HIGHWAY
GREGORY DEVELOPMENTAL ROAD
BRUCE HIGHWAY
Legend
Town/City
CEV Hut Site
Proposed Substation
Existing Substation
Existing Transmission Line (>= 220kV)
Railway
Highway
Secondary Road
Major Watercourse
0 20 40 60 80 100
Kilometres
Coordinate System
MGA1994 Zone 54\55
Notes/Data Sources
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Figure 9-1 - Project overview
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9.2 Methodology

9.2.1 Study area

The study area of focus for this assessment is the corridor selection extending from Mount Isa to the state grid, via a new connection point at Woodstock, south of Townsville. The corridor selection is 120 m wide from Woodstock substation to Dajarra Road Substation. Construction would only occur on the southern side of the corridor selection, leaving the northern side for an expansion if necessary, in the future. The remaining sections (Mount Isa Augmentation, Southern Connection, Cannington Connection, and Phosphate Hill Connection) would have 60 m wide easements, with the transmission line being constructed in the centre of the corridor selection.

The tropical nature of the region is defined by two distinct seasons. The dry season is stable with cooler temperatures, low humidity and clear skies while the wet season brings extreme rainfall in heavy bursts that result in the potential for waterways to break their banks. Due to the seasonality and unreliability of the rainfall, people living within or adjacent to the Project area depend on dams and bores tapping into artesian and/or subartesian groundwater for their water supply. The climate of the study area is further described in Volume 1 Chapter 3 Site Description and Climate.

The Project crosses several large catchment areas in central and northern Queensland, with a number of large river systems draining from these catchment areas (Figure 9-2). The six major catchment areas and associated river systems include:

- Haughton River
- Burdekin River
- Cooper Creek
- Flinders River
- Leichardt River
- Georgina River.

Groundwater resources within the Project area predominately consist of the Great Artesian Basin (GAB). The GAB underlies nearly 50 percent of the corridor selection from Pentland to Cloncurry (Figure 9-2). The western areas of the GAB (i.e. from Cloncurry to Mount Isa) and the western diverging sections are subartesian groundwater resources. Groundwater resources are consequently an important resource for pastoral, domestic and small municipal requirements.

9.2.2 Data sources

A description of the data sources are as follows:

- Flood extent polygon - 2019 - Flinders River - This dataset represents the maximum area of inundation of the February 2019 Flinders River flood.
- Queensland flood mapping program flood investigation Burdekin Basin 2015 - This dataset was created through the Queensland Flood Mapping Program as part of the response to the Queensland Floods Commission of Inquiry. KBR was commissioned to undertake a flood investigation for the Burdekin River Basin. Dataset includes peak and modelled events (e.g. 1 % AEP or Q100).
- Queensland flood mapping program flood investigation Cloncurry - 2015 - This dataset was created through the Queensland Flood Mapping Program as part of the response to the Queensland Floods Commission of Inquiry. DHI was commissioned to undertake a flood

investigation for the township of Cloncurry. Dataset may include historic and/or modelled events (e.g. AEP 1% or Q100).

- Queensland floodplain assessment overlay – 2013 - The Queensland Floodplain Assessment Overlay (QFAO) represents a floodplain area within drainage sub-basins in Queensland. It has been developed for use by local governments as a potential flood hazard area. It represents an estimate of areas potentially at threat of inundation by flooding. The data has been developed through a process of drainage sub-basin analysis utilising data sources including 10 metre contours, historical flood records, vegetation and soils mapping and satellite imagery. This data represents an initial assessment and would be subject to refinement by respective Local Government Authorities.
- BMT WBM (2011) Flood Impact Assessment Report (Stage 1) CopperString Transmission Line. Report prated by BMT WBM for Supplementary Environmental Impact Statement.
- Queensland Globe mapping layers for Queensland wetland mapping (Version 5.0), matters of state environmental significance wetland values, wetland protection areas, groundwater dependent ecosystems, Queensland waterways for waterway barrier works, watercourse mapping and registered groundwater bores.
- Geoscience Australia (2006) GEODATA TOPO 250K Series 3.
- Department of Agriculture, Water and the Environment (DAWE) Directory of Important Wetlands in Australia.
- Queensland Government Water entitlement viewer.

9.2.3 Legislative context and standards

The following legislation, policies and guidelines are relevant to identifying values and to providing guidelines on mitigation and managing impacts on surface water:

- *Environmental* Protection *Act 1994* (EP Act)

  The EP Act aims to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

- *Environmental Protection Regulation 2019* (EP Reg)

  The EP Reg prescribes the detail for processes contained in the EP Act e.g. list of prescribed Environmentally Relevant Activities (ERAs).

- *Environment Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water))

  The EPP (Water) sits under the EP Act. The EPP (Water) aims to protect environmental values and sets water quality objectives to protect Queensland's water environment while facilitating ecologically sustainable development. Environmental values define the aquatic and human uses of the water body and water quality objectives define objectives for water characteristics (physical, chemical and biological).

- *Fisheries Act 1994* (Fisheries Act)

  The Fisheries Act is the Queensland legislation that provides for the management, use, development and protection of fisheries resources and fish habitats in Queensland. Approval must be sought under the act to construct or raise assessable waterway barriers on a waterway.

- *Plumbing and Drainage Act 2018* (PD Act)

  The PD Act regulates the carrying out of plumbing and drainage works in a way that reduces risk to public health and safety and the environment.

- *Water Act 2000* (Water Act)

  The Water Act provides a framework to deliver sustainable water planning, allocation management and supply processes to ensure the improved security of water resources.

- *Water Supply (Safety and Reliability) Act 2008*

  This legislation provides a regulatory framework for water service providers, recycled water management schemes, referrable dams and flood mitigation responsibilities.

- *Queensland Water Quality Guidelines* (DERM, 2009)

  These guidelines provide a framework for assessing water quality in Queensland through the setting of water quality objectives. These guidelines are currently under revision and not in use. A the time of writing the Australian Water Quality Guidelines are to be used in place of the Queensland Water Quality Guidelines.

- *Queensland Plumbing and Wastewater Code* (QPW Code)

  The QPW code sets out Queensland specific plumbing and drainage standards.

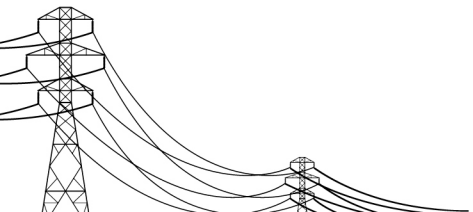
- *Australian and New Zealand Environment Conservation Council (ANZECC) Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) & *Australian and New Zealand Guidelines for Fresh* and *Marine Water Quality (ANZG), Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZG, 2018)

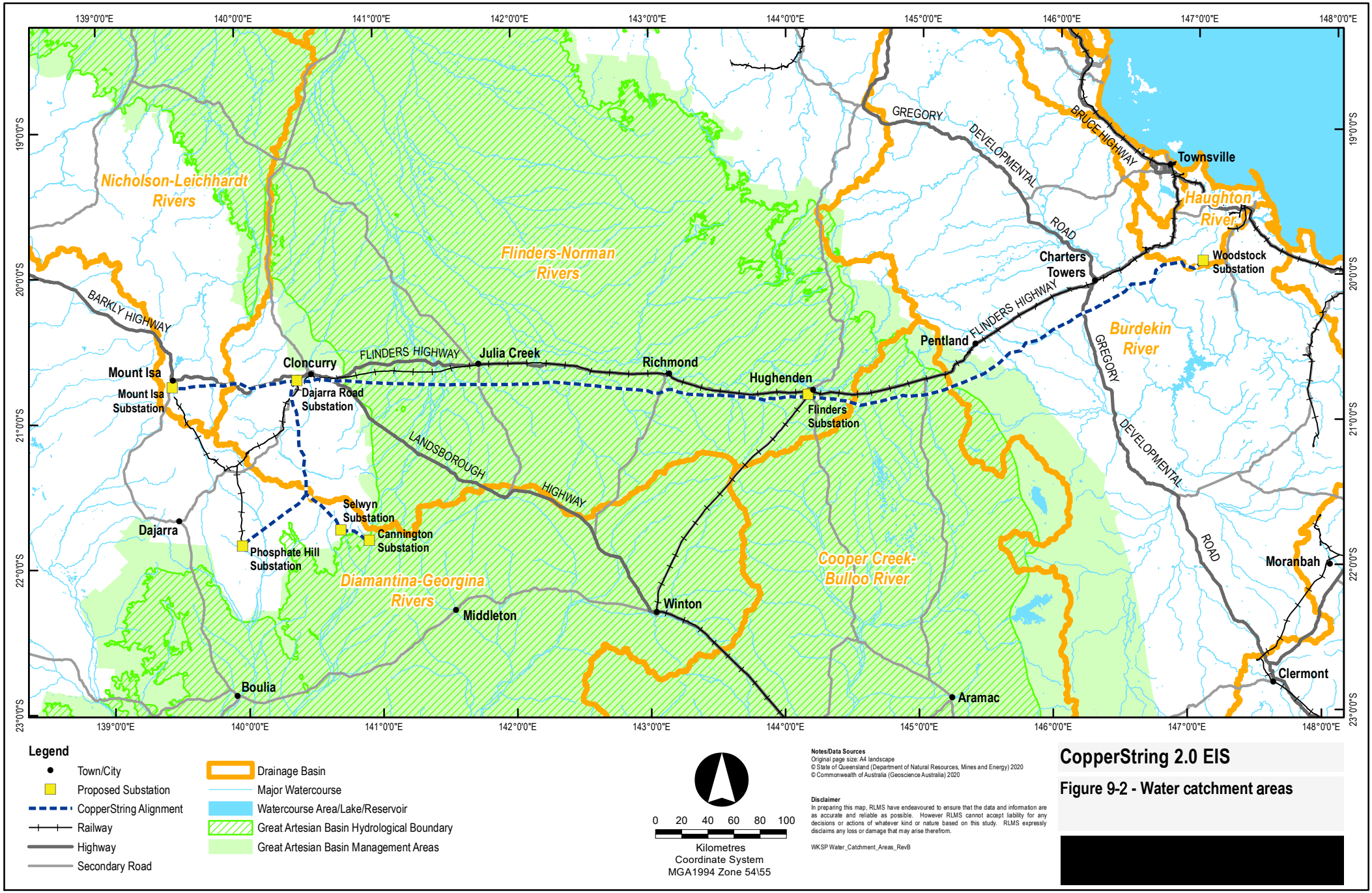
  These provide national guidelines (currently in use in place of state specific guidelines) and a method for deriving local water quality guidelines from reference data.

9.2.4 Assessment method

The methodology followed in the development of this chapter included:

- A desktop search and review of the data sources in Section 9.2.2 for available groundwater, surface water and flood data including an assessment of the extent of waterways, watercourses, floodplains and groundwater resources impacted by the project.
- An impact assessment was undertaken in order to characterise potential impacts to the water environment and provide potential mitigation measures. The existing environment section provides a broad overview and is intended to specifically address the requirements of the Terms of Reference.





Notes/Data Sources
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Figure 9-2 - Water catchment areas

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9.3 Existing environment

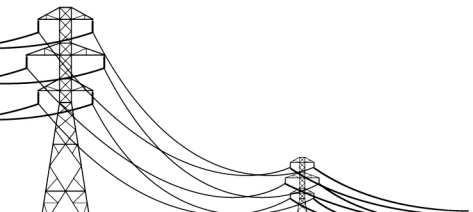
9.3.1 Environmental values and water quality objectives of water resources

The Department of Environment and Science (DES) define environmental values as aquatic and human uses of the water body and water quality objectives as objectives for water characteristics (physical, chemical and biological).Environmental values are categorised as aquatic ecosystems, irrigation, farm supply/use, stock water, aquaculture, human consumer, primary & secondary recreation, visual recreation, drinking water, industrial use, cultural and spiritual values. DES are progressively setting environmental values and water quality objectives for each catchment throughout Queensland.

No environmental values or water quality objectives have been finalised and scheduled for the corridor selection. The Burdekin and Haughton catchments under the EPP (water) have draft (not scheduled) environmental values and water quality objectives. These were considered in the assessment of environmental values for the corridor selection

The corridor selection was reviewed against the EPP (Water) environmental value categories with consideration given to surface and ground water features and known water uses. From this assessment environmental values were set for the Project corridor selection.

- Surface water:
  - Aquatic ecosystems – the majority of the watercourses would typically fall in the “slightly to moderately disturbed ecosystems” category. For slightly and moderately disturbed ecosystems the water quality objectives are to improve and maintain or improve (as required) respectively the existing water quality in the watercourse.
  - Primary industries – the majority of surface water is utilised for stock watering with crop and pasture irrigation on a small scale. While some of the water storages in the area are utilised for town water supply, the majority of water resources have a value in household consumption for farmhouses.
  - Aquaculture – Burdekin and Haughton Rivers have draft environmental values identified for aquaculture uses. No other watercourses within the corridor selection are identified as having known aquaculture values.
  - Recreation and aesthetics – some water courses in the area have primary and secondary recreation uses. All water courses have visual appreciation values.
  - Raw water drinking supply – some water courses would be utilised as a raw water drinking resource although groundwater is more likely to be the main source.
  - Industrial uses – industrial uses of surface water are likely to be dominated by the mining industry.
  - Cultural and spiritual values – all water features are likely to have strong cultural and spiritual values.
- Groundwater:
  - Groundwater (bore water) in the remote areas away from towns is heavily relied on for farm use and stock watering and as a drinking resource. Certain towns within the study area have their water supply augmented by groundwater.
  - Industrial activity such as mining is also a significant user of groundwater in the region, particularly in the western portion of the study area.



Where no water quality objectives are scheduled, the Queensland Water Quality Guidelines are applied as default guidelines. The Queensland Water Quality Guidelines are under revision and were unavailable during this assessment. Where the Queensland Water Quality Guidelines are unavailable the Australian Water Quality Guidelines (ANZG 2018) are applicable to the Project.

The Construction Contractors strategy for monitoring Project conformance with water quality objectives/guidelines would be adaptive with regular review required to reflect updates to scheduled environmental values, water quality objectives and state and national water quality guidelines.

Available background data should be used to validate the suitability of the guideline values to local water quality. The Queensland Government Water Monitoring Information Portal should be consulted and complimented by site specific background water quality sampling to assist in monitoring project performance (where required). This is important as water quality, in particular for key indicators of turbidity and total suspended solids, can exceed guidelines values by order of magnitudes. Surface water quality at selected open Surface Water Ambient Water Quality Network stations for key indicators (with count greater than 10) is shown in Table 9-1.

Table 9-1 Mean surface water quality data (taken from open Surface Water Ambient Water Quality Network stations)

Station	Description	pH	EC (µS/cm)	DO (mg/L)	Turbidity (NTU)	TDS (mg/L)	Total N (mg/L)
119005A	Haughton River at Mount Piccaninny	7.5	296.5	6.8	21.7	168.9	-
120002C	Burdekin River at Sellheim	8.25	304.2	-	84.0	175	0.37
120307A	Cape River at Pentland	7.56	172.2	7.0	199.2	105.4	-
915208A	Julia Creek at Julia Creek	7.67	332.5	6.05	1,256.4	165.6	-

Notes:
pH (field)
EC – Electrical conductivity (field)
DO – Dissolved Oxygen (field)
TDS – Total Dissolved Solids
TN – Total Nitrogen
TN – Total Phosphorus as P
- indicates not reported or less than 10 data counts

Table 9-2 demonstrates publicly available historical groundwater data extracted from bore reports from selected groundwater bores along the length of the corridor selection.

Table 9-2 Groundwater quality data (taken from bore reports throughout corridor selection)

Approx. KP	RN	Role/Facility type	Screen depth (mbgl)	pH	Conductivity (µS/cm)
39DM	RN 146510	Mine monitoring	30-36	NS	300 (2012)
39DM	RN 146511	Mine monitoring	58-64	NS	400 (2012)
727WD	RN 91520064	Sub-artesian facility	NS	7.7 (1989)	435 (1989)
650WD	RN 2466	Artesian facility	NS	7.9 (1971)	855 (1971)

Approx. KP	RN	Role/Facility type	Screen depth (mbgl)	pH	Conductivity (µS/cm)
560WD	RN 108	Artesian facility	NS	8.3 (1986)	520 (1986)
509WD	RN 13867	Artesian facility	396.2-432.8	8.2 (1986)	530 (1986)
456WD	RN 7122	GAB monitoring water supply/Artesian facility	325.83-338.48	8.7 (2020)	606 (2020)
293WD	RN 2803	Sub-artesian facility	NS	7.9 (1969)	1,180 (1969)
176WD	RN 39493	Sub-artesian facility	NS	8.1 (1974)	3,300 (1974)
168WD	RN 39493	Water supply/Sub-artesian facility	NS	7.7 (1996)	2,393 (1996)
110WD	RN 25050	Water supply/Sub-artesian facility	NS	7.9 (1996)	2,246 (1996)
Notes: NS – not specified					

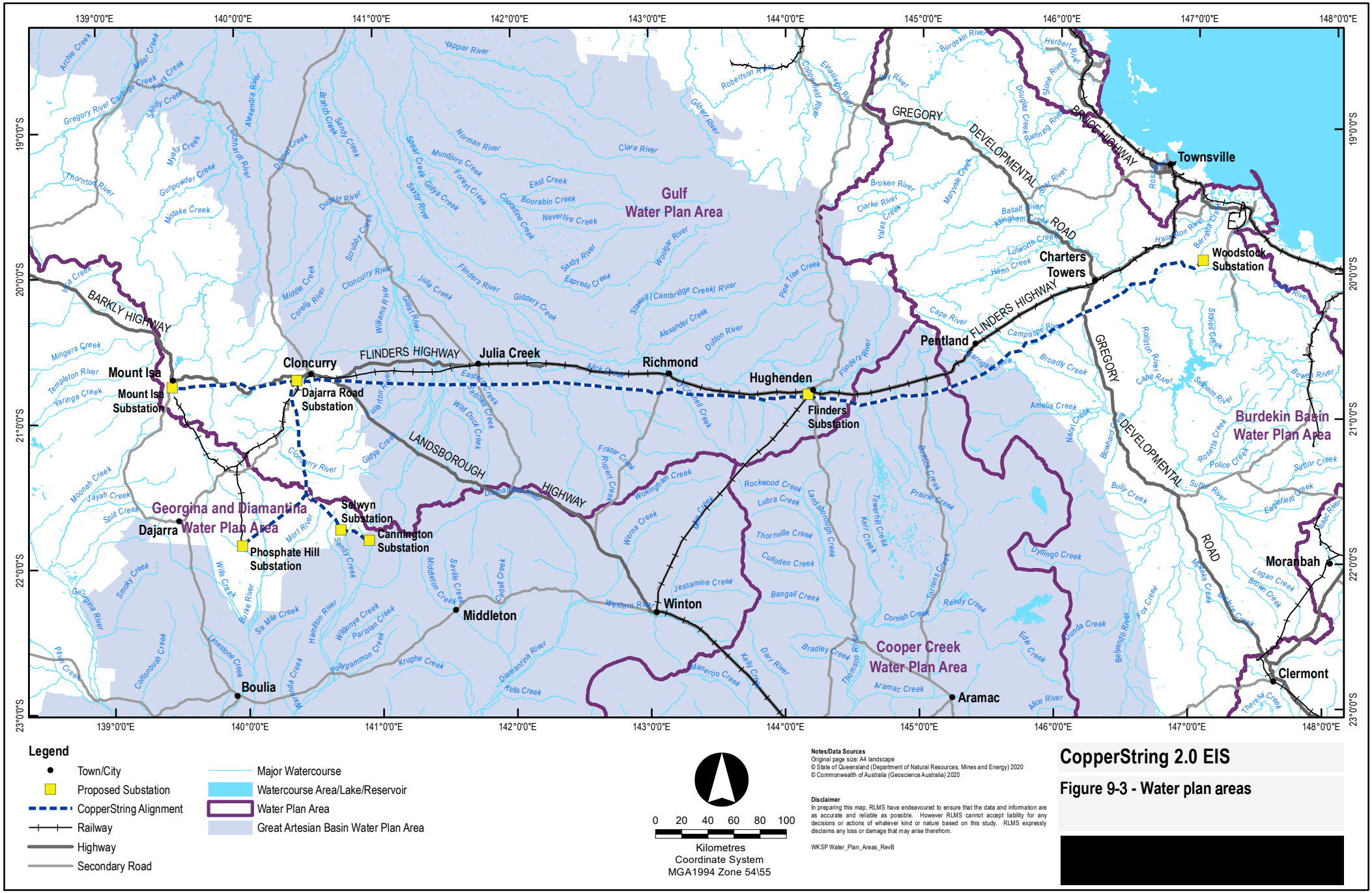
9.3.2 Surface water resources

The corridor selection traverses numerous water features in central and northern Queensland, with significant river systems draining catchments that are managed under water plans. Water plans are developed by the State under the Water Act to sustainably manage and allocate water resources in Queensland.

Water plan areas for surface water covered by the corridor selection are shown in Figure 9-3 and include:

- Burdekin Basin — covers the corridor selection from KP 0WD to 220WD
- Cooper Creek Basin— covers the corridor selection from KP 221WD to 297WD
- Gulf Basin— covers the corridor selection from KP 298WD to 723WD, KP 0DM to 100.9DM and KP 0DC to 86DC
- Georgina and Diamantina Basin— covers the corridor selection from KP 87DC to 96DC, KP 0CP to 60.2CP and KP 0CC to 154.9CC.

Major water features traversed by the corridor selection are displayed in Figure 9-3 with named water features identified on Geoscience Australia (2006) 1:250,000 Topographic data listed in Table 9-3. Of the water features identified within the corridor selection, fifty-three are identified as watercourses and 5 are identified as drainage features on Queensland Government Watercourse identification mapping. The corridor selection does not intersect any downstream limits, lakes and/or springs as identified on Queensland Government watercourse identification mapping.



Legend

- Town/City
- Proposed Substation
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Major Watercourse
- Watercourse Area/Lake/Reservoir
- Water Plan Area
- Great Artesian Basin Water Plan Area

0 20 40 60 80 100

Kilometres

Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
Original page size: A4 landscape
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Figure 9-3 - Water plan areas

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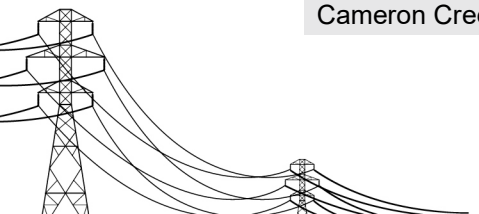
Table 9-3 Named water features traversed by the corridor selection

Watercourse	Approximate Location (KP)	Drainage Basin
Blackmore Creek	0.9WD	Haughton
Spring Creek	63.6WD	Burdekin
Stony Creek	66.7WD	
Vine Creek	69.1WD	
Boatswain Creek	71.8-76.4WD	
Cornishman Creek	78.8WD	
Lighthouse Creek	83.8WD	
Horse Creek	104.8WD	
Eight Mile Creek	108.9WD	
Oaky Creek	123.9WD	
Campaspe River	141.5-161.6WD	
Manoa Creek	174.9WD	
Five Mile Creek	189.7WD	
Sandy Creek	200.8WD	
Moocha Creek	212.3WD	
Torrens Creek	247.9WD	Cooper Creek
Bullock Creek	272.2WD	
Prairie Creek	290.4WD	
Skeleton Creek	299.3WD	
Smiths Creek	355.7-365.2WD	Flinders
Cannonball Creek	368.2WD	
Stony Creek	376.4WD	
Walker Creek	379.1-382.6WD	
Warianna Creek	382.7WD	
Eastern Creek	400.7WD	
Sloane Creek	401.9-402.3WD	
Mile Creek	417.1WD	
O'Connell Creek	447.8WD	
Alick Creek	486-545.7WD	
Julia Creek	586.3-587.1WD	
Eastern Creek	599.3-602WD	
Sadowa Creek	608.9-609.7WD	
Gilliat River	624.7-626.6WD	
Gidya Creek	630.8-635WD	
Holy Joe Creek	640-640.2WD	
Box Creek	650.7WD	
Fullarton River	661.4WD	
Scrubby Creek	674.5-674.9WD	
Williams River	682.5WD	
Elder Creek	686.7WD	
Turpentine Creek	695.8WD	
Coppermine Creek	725WD	
Cloncurry River	726.9WD	
Chinaman Creek	732.9WD	
Corella River	30.9DM	
Lunch Creek	33.2DM	
Cameron Creek	45.2-45.8DM	



Watercourse	Approximate Location (KP)	Drainage Basin
Charley Creek	55.1DM	Leichhardt
Leichhardt River (East Branch)	65.4DM	
Gorge Creek	80.5DM	
Lagoon Creek	93.6DM	
Leichhardt River	97.2DM	
Mica Creek	97.6DM	
Slaty Creek	16.5DS	Flinders
Cloncurry River	39.4-39.7DS	
Florence Creek	49.6DS	
Gorge Creek	68.6DS	
Cloncurry River	71.1-71.4DS	
Victory Creek	82.1DS	
Sandy Creek	118.9-119DS	Georgina
Lightning Creek	4.0SC	
Burke River	44.0SP	

Surface water storages

A number of significant surface water storages were identified within the general Project area as follows:

- Burdekin Falls Dam
- Burdekin Weir
- Chinaman Creek Dam
- Lake Corella
- Lake Mary Kathleen
- Lake Julius
- Lake Moondarra
- Rifle Creek Dam.

While most water storages are located some distance from the corridor selection and are unlikely to be impacted, the Dajarra Road substation site is located close to (approximately 5 km) and within the Chinaman Creek Dam catchment. The Chinaman Creek Dam is used by Cloncurry for town water supply. Smaller dams, weirs, lagoons, waterholes and bores are also commonly found in the area and are utilised for water extraction for a variety of purposes (BMT WBM, 2010)

Surface water allocations (supplemented, unsupplemented and unallocated) for the water plans within the corridor selection are described in Table 9-4.

Table 9-4 Surface water entitlements by basin

Water plan	Approximate KP	Supplemented surface water (ML)	Unsupplemented surface water (ML)	Unallocated surface water (ML)
Burdekin basin	0-220WD	1,118,522	38,023	532,944
Cooper Creek basin	221-297WD	0	14,551	2,200
Gulf basin	298-723WD 0-100.9DM 0-86DC	75,150	268,911	707,706

Water plan	Approximate KP	Supplemented surface water (ML)	Unsupplemented surface water (ML)	Unallocated surface water (ML)
Georgina and Diamantina basin	87-96DC 0-60.2CP 0-154.9CC	0	108	13,500

Wetlands, springs and groundwater dependent ecosystems

An assessment of wetlands was completed in Volume 2 Chapter 7 Flora and Fauna including wetlands of international importance, important wetlands, matters of state environmental significance wetlands and other mapped wetland values.

An assessment of groundwater dependent ecosystems and springs is completed in Volume 2 Chapter 7 Flora and Fauna. Volume 2 Chapter 7 Flora and Fauna identify surface groundwater dependent ecosystems occurring along the corridor selection, with 80-100% of water derived from groundwater. Groundwater dependent ecosystems traversed by the Project include surface, terrestrial and subterranean ecosystems.

Wetland, spring and groundwater dependent ecosystem description, mapping and impact assessments are provided in Volume 2 Chapter 7 Flora and Fauna.

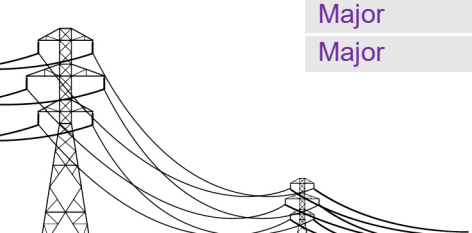
Waterways for waterway barrier works

The corridor selection traverses a number of waterways that are mapped as waterways for waterway barrier works. Table 9-5 presents the waterways mapped as high (red) and major (purple) under the waterway barrier works mapping.

Table 9-5 Waterways for waterway barrier works crossings

WWBW Code	Approx. Location (KP)
High	0.9WD
Major	23.4WD
Major	24.4WD
High	35.3WD
Major	48.6WD
Major	55.4WD
Major	69.1WD
Major	71.2WD
High	78.8WD
High	83.8WD
Major	85.8WD
High	104.8WD
High	107.2WD
Major	123.9WD
High	124.8WD
Major	138.2WD
Major	161.3WD
High	174.9WD
Major	180.5WD
Major	181.4WD
Major	200.8WD
Major	201.3WD
Major	206.7WD
Major	212.3WD

WWBW Code	Approx. Location (KP)
High	222.5WD
Major	248.0WD
High	272.2WD
Major	379.3WD
Major	380.2WD
Major	382.5WD
Major	382.6WD
Major	383.2WD
Major	383.5WD
High	400.7WD
High	401.9WD
High	445.8WD
High	447.8WD
Major	486.1WD
Major	486.7WD
Major	487.0WD
Major	525.2WD
Major	525.5WD
Major	526.2WD
Major	543.3WD
Major	544.2WD
Major	544.6WD
Major	545.2WD
Major	545.7WD
High	586.4WD
High	586.8WD
High	587.2WD
Major	599.3WD
Major	601.7WD
High	608.9WD
High	609.5WD
High	609.7WD
Major	624.7WD
Major	625.0WD
Major	625.1WD
Major	625.4WD
Major	625.5WD
Major	625.6WD
Major	625.9WD
Major	626.0WD
Major	626.1WD
Major	626.6WD
Major	631.7WD
Major	632.2WD
Major	632.7WD
Major	632.9WD
Major	633.4WD
Major	633.6WD
Major	634.0WD



WWBW Code	Approx. Location (KP)
Major	634.3WD
Major	634.5WD
Major	634.8WD
Major	635.1WD
High	661.4WD
High	674.4WD
High	682.5WD
High	686.7WD
Major	726.8WD
High	31DM
High	65.5DM
High	97.2DM
High	5.9SC
Major	39.4DS
Major	39.4DS
Major	39.6DS
High	49.6DS
Major	71.2DS
Major	71.3DS
Major	71.4DS
Major	43.9SP

9.3.3 Groundwater resources

The corridor selection traverses over 1,060 km and overlies a vast array of hydrogeology and groundwater reserves. The most significant groundwater reserve in the area is the GAB, which is largely located beneath the central portion of the corridor selection between Pentland and Dajarra Road. Water resources of the GAB are managed and allocated through the Great Artesian Basin and Other Regional Aquifers water plan, which covers the corridor selection from KP 179WD to 689WD and from KP 143CC to 154.9CC (Figure 9-3).

Groundwater reserves to the east and west of the corridor selection are largely from varying rock forms and floodplain alluviums that supply reasonable quantities of water close to the surface (BMT WBM, 2010).

The primary use of groundwater bores in the area is for domestic and stock purposes. A search on the Queensland Globe indicates numerous existing groundwater bores that are in proximity to the corridor selection. The groundwater bores that have been identified to exist within the corridor selection are presented in Figure 9-4.

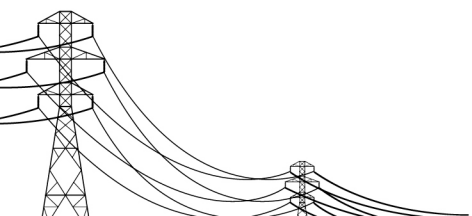
Groundwater is used as a water supply source for the following towns in the general vicinity of the Woodstock to Dajarra Road section of the corridor selection (BMT WBM, 2010):

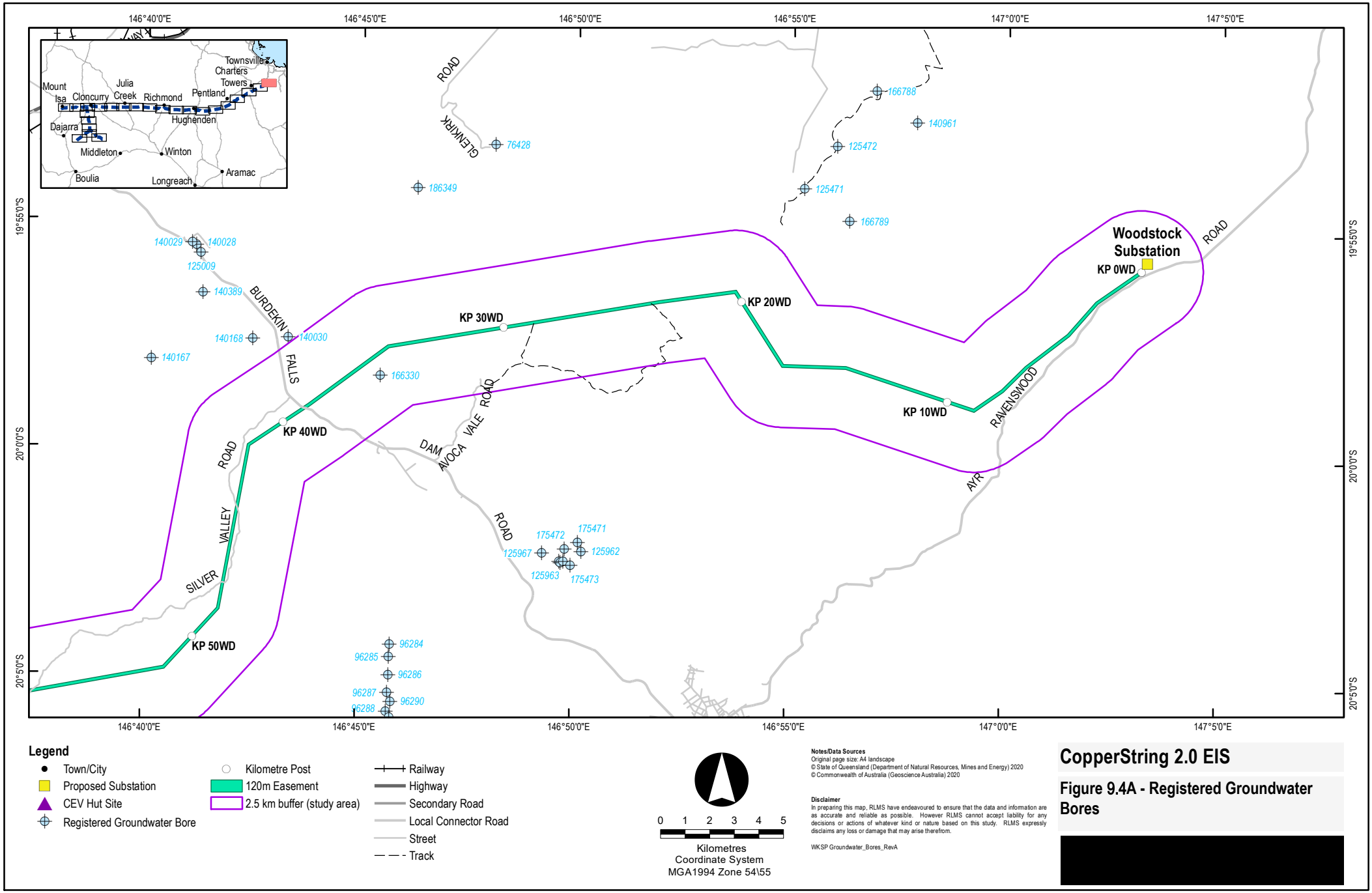
- Pentland
- Torrens Creek
- Prairie
- Hughenden
- Richmond
- Maxwelton
- Julia Creek.

Groundwater water allocations (supplemented, unsupplemented and unallocated) for the water plans within the corridor selection are described in Table 9-6.

Table 9-6 Groundwater entitlements by basin

Water plan	Approximate KP	Supplemented groundwater (ML)	Unsupplemented groundwater (ML)	Unallocated groundwater (ML)
Burdekin basin	0-220WD	0	56,645	0
Cooper Creek basin	221-297WD	0	394	0
Gulf basin	298-723WD 0-100.9DM 0-86DC	0	0	0
Georgina and Diamantina basin	87-96DC 0-60.2CP 0-154.9CC	0	0	0





Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track

0 1 2 3 4 5
Kilometres
Coordinate System
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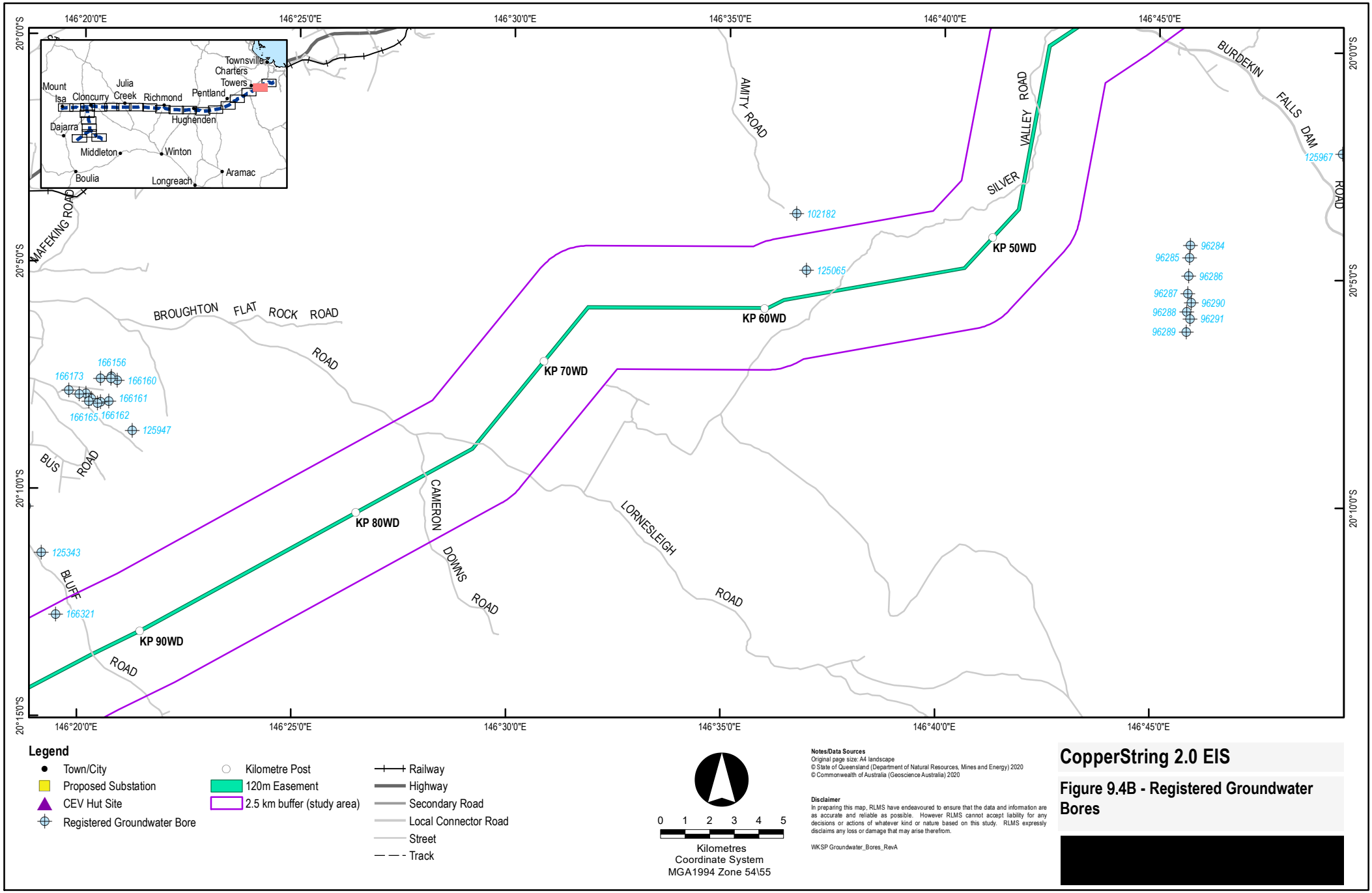
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4A - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
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- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
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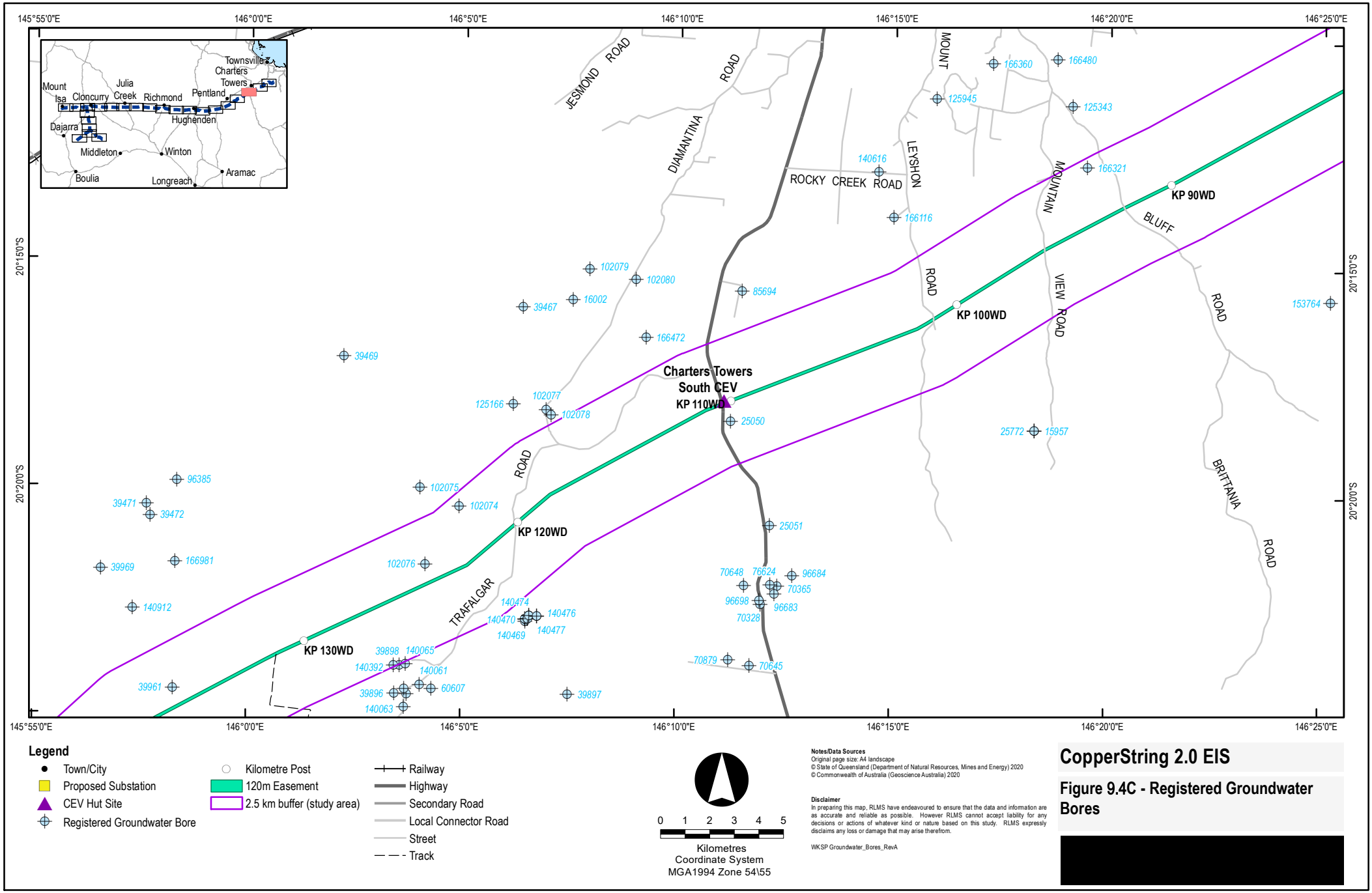
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4B - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
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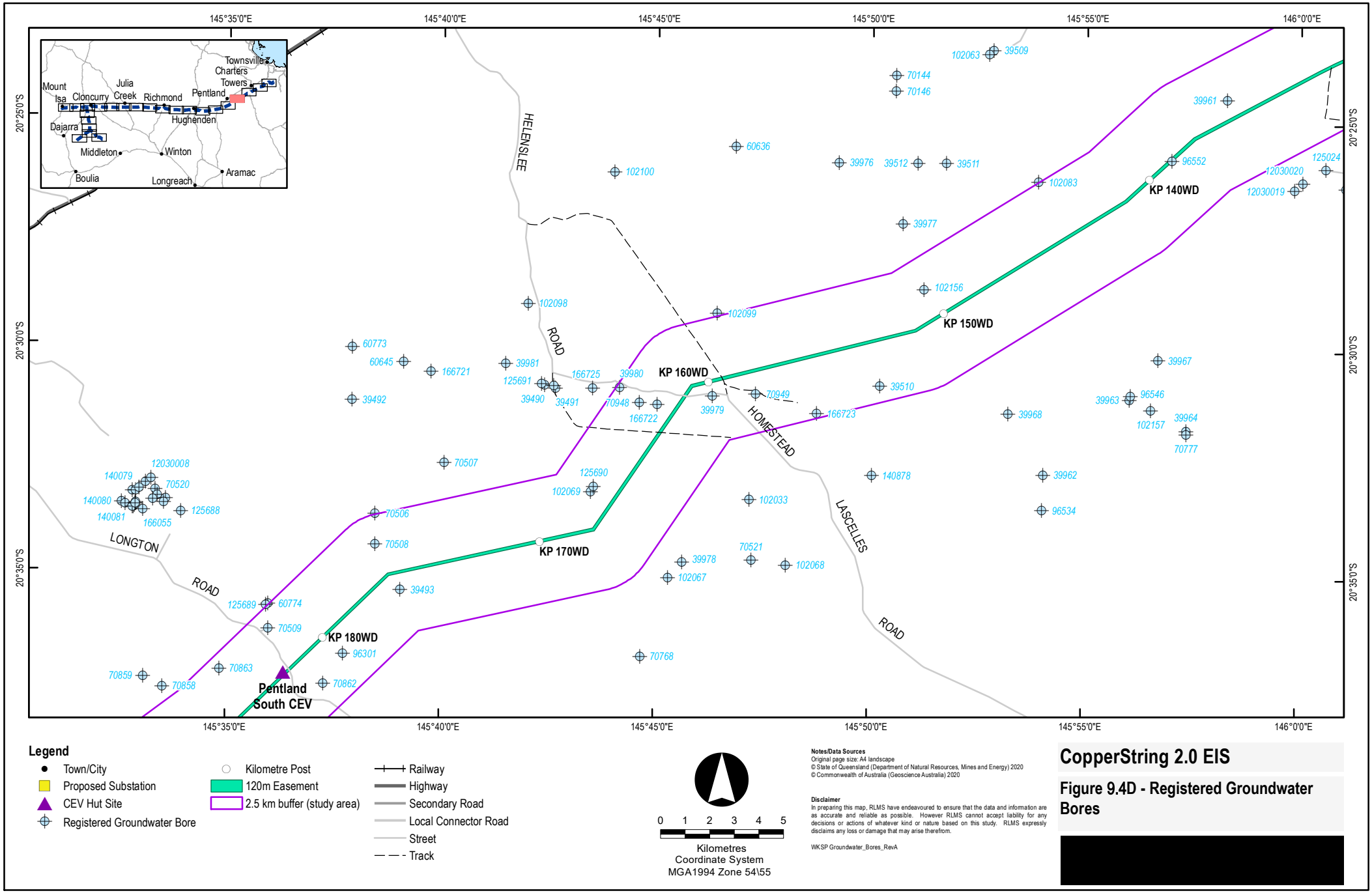
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4C - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
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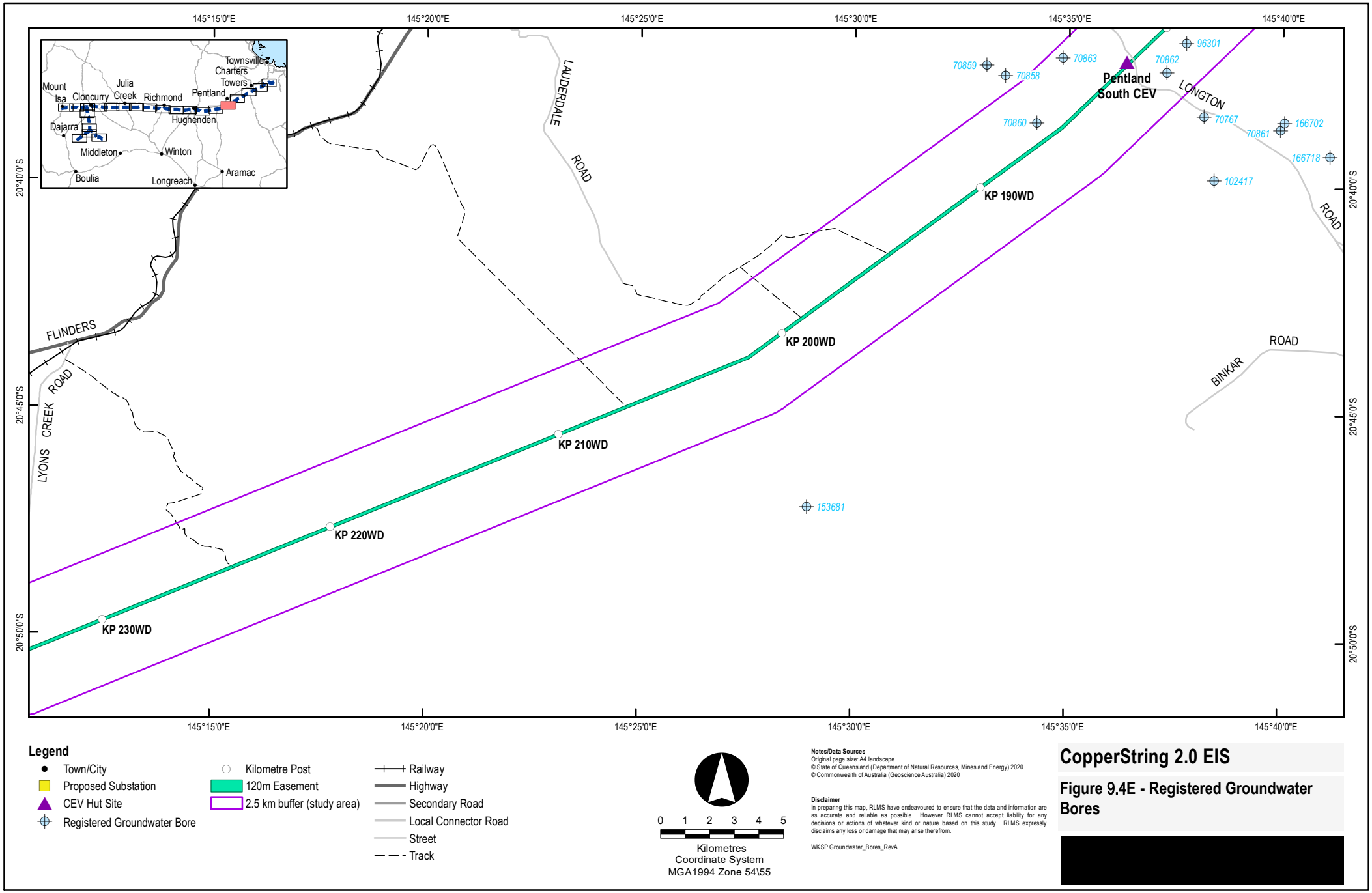
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4D - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
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Kilometres
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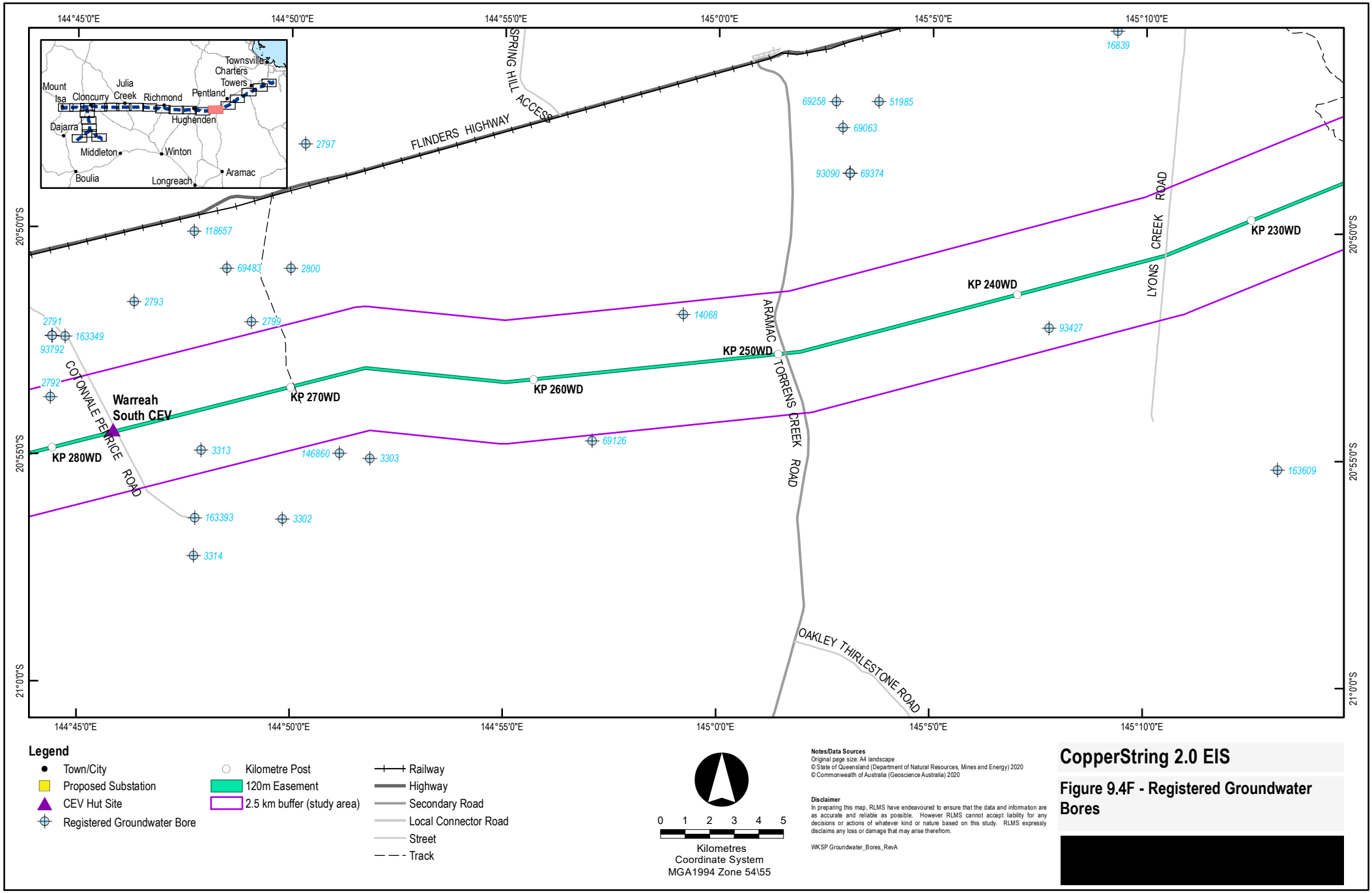
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4E - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
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0 1 2 3 4 5

Kilometres
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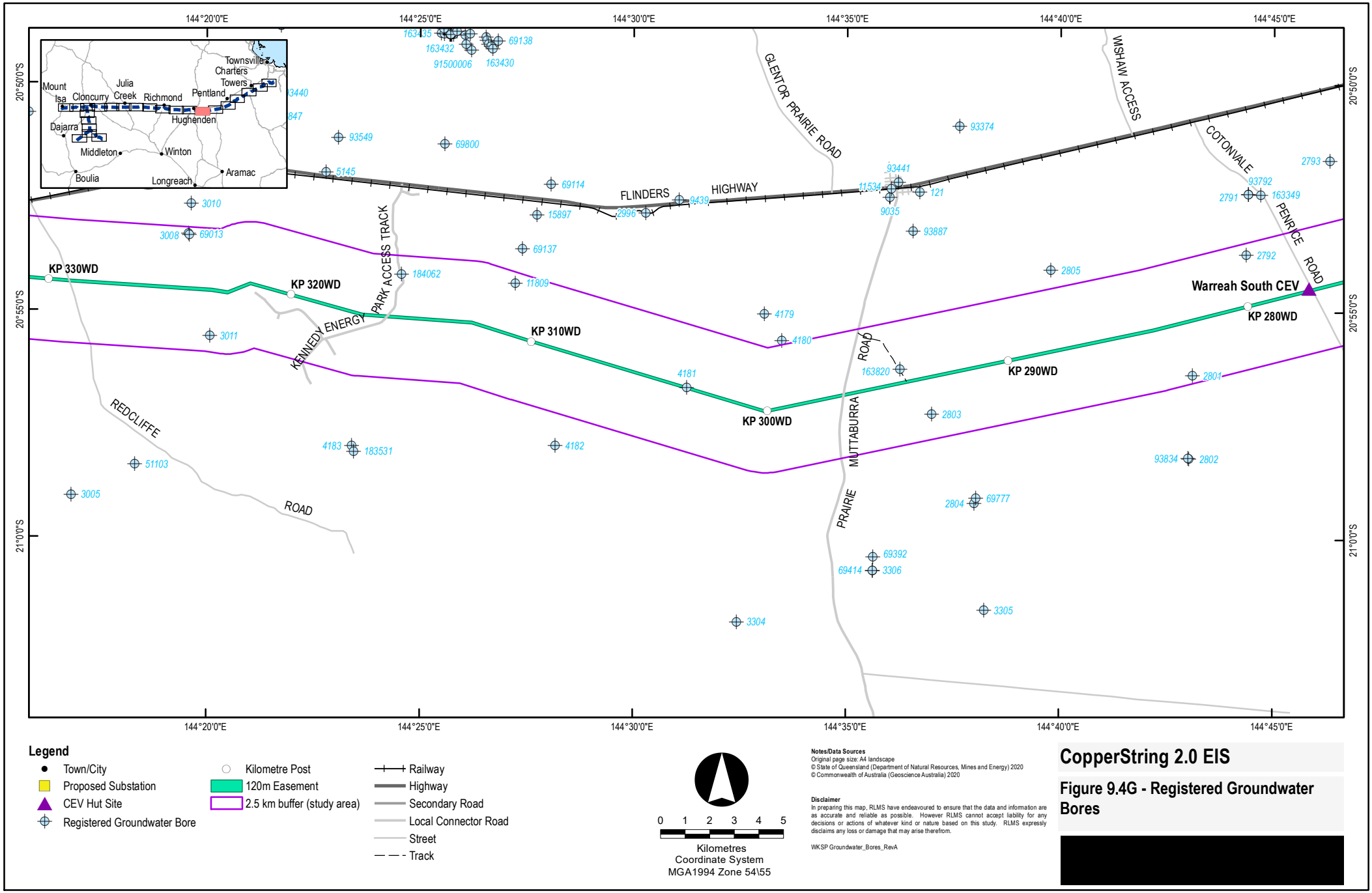
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4F - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
- Local Connector Road
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- Track

0 1 2 3 4 5

Kilometres

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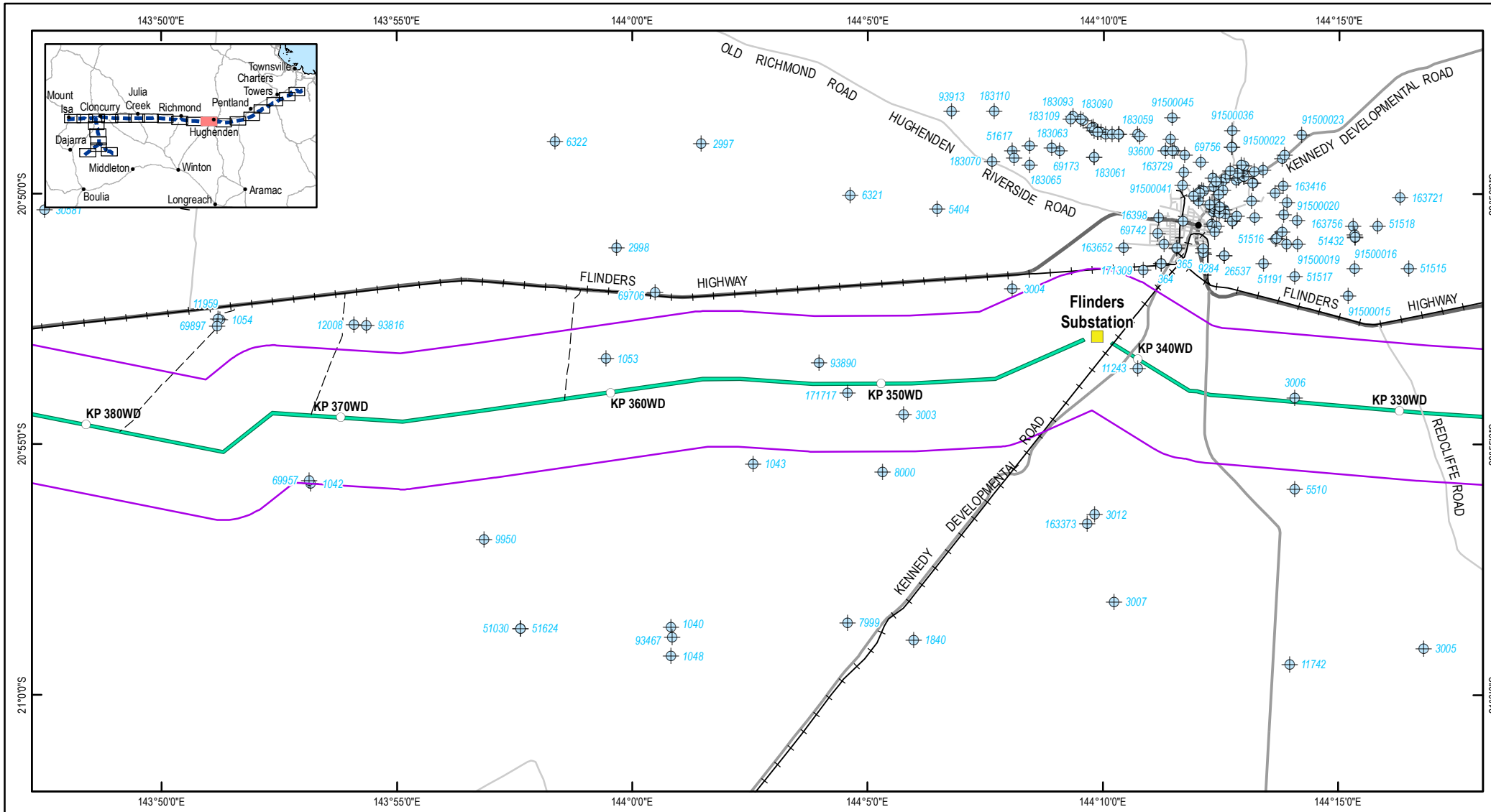
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4G - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
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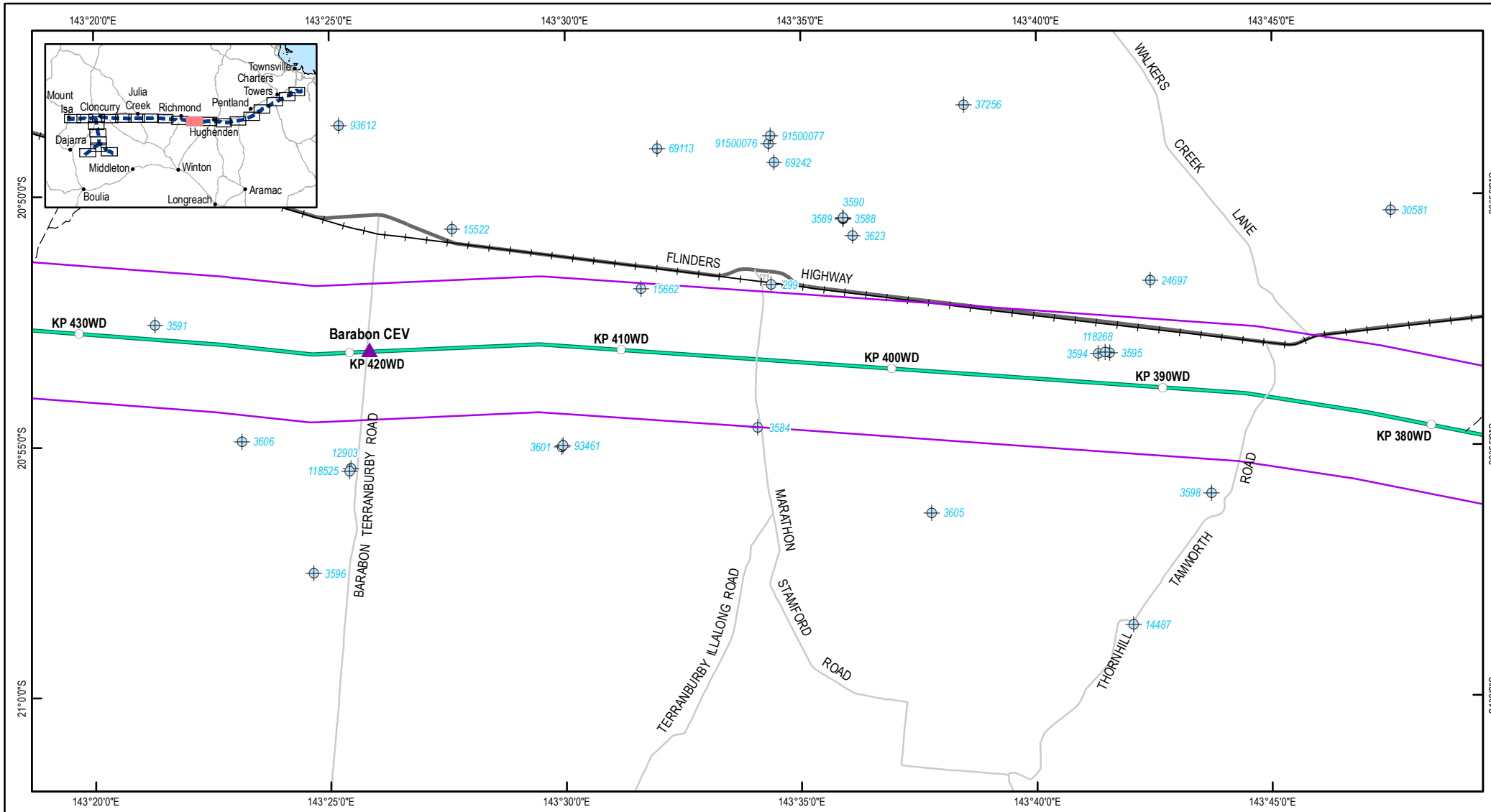
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4H - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
- Railway
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0 1 2 3 4 5
Kilometres
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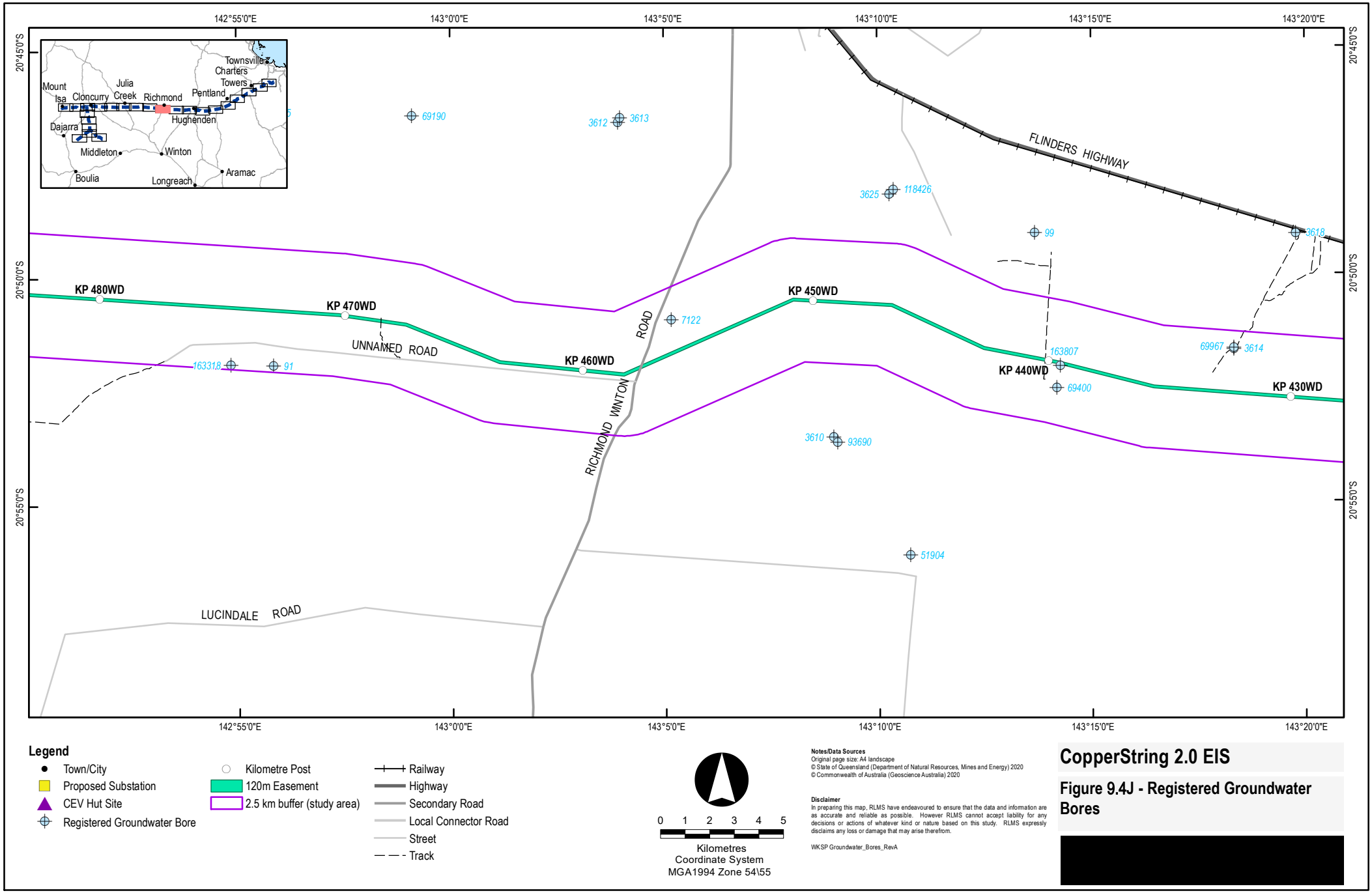
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4l - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
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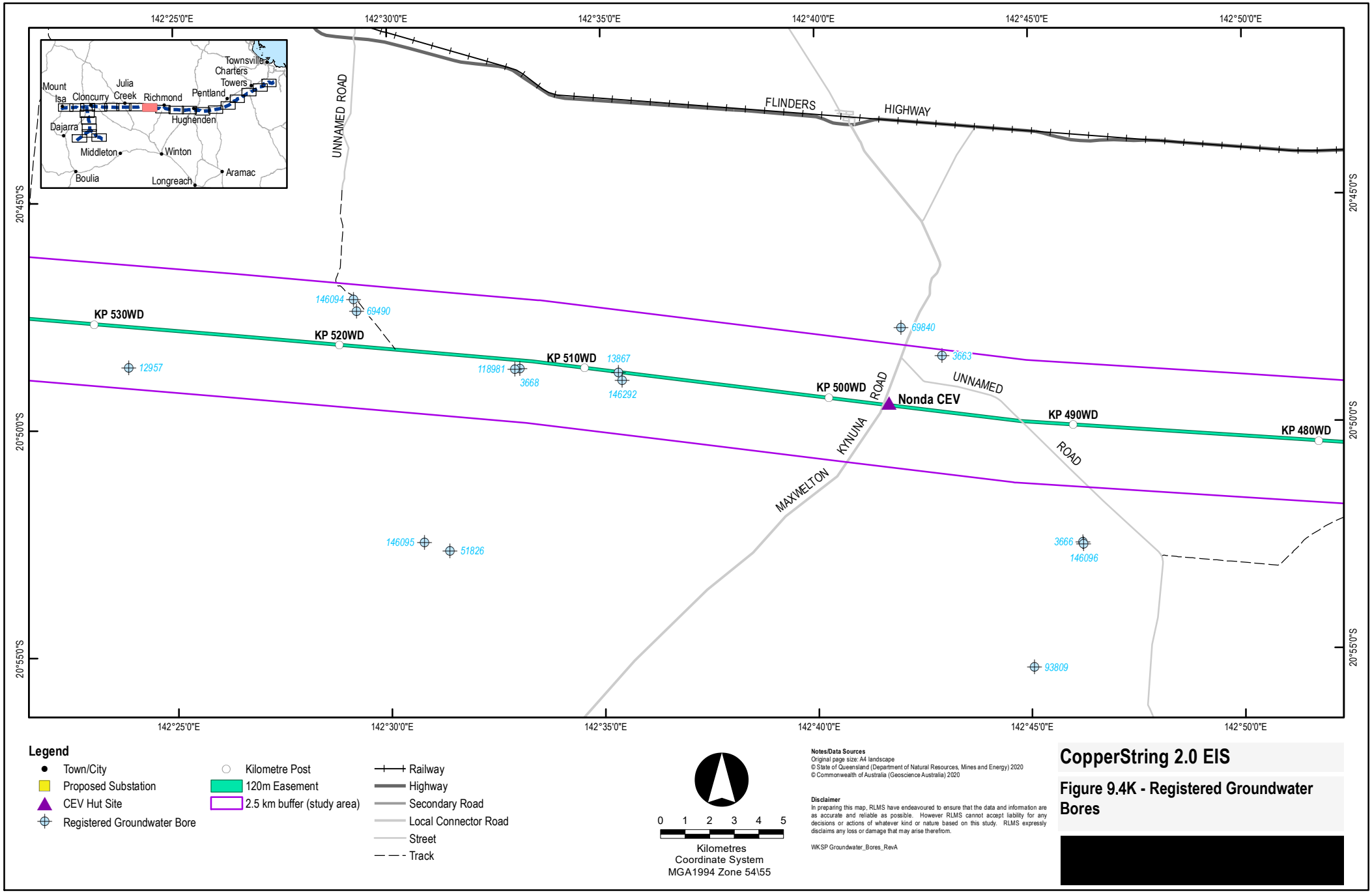
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4J - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
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0 1 2 3 4 5
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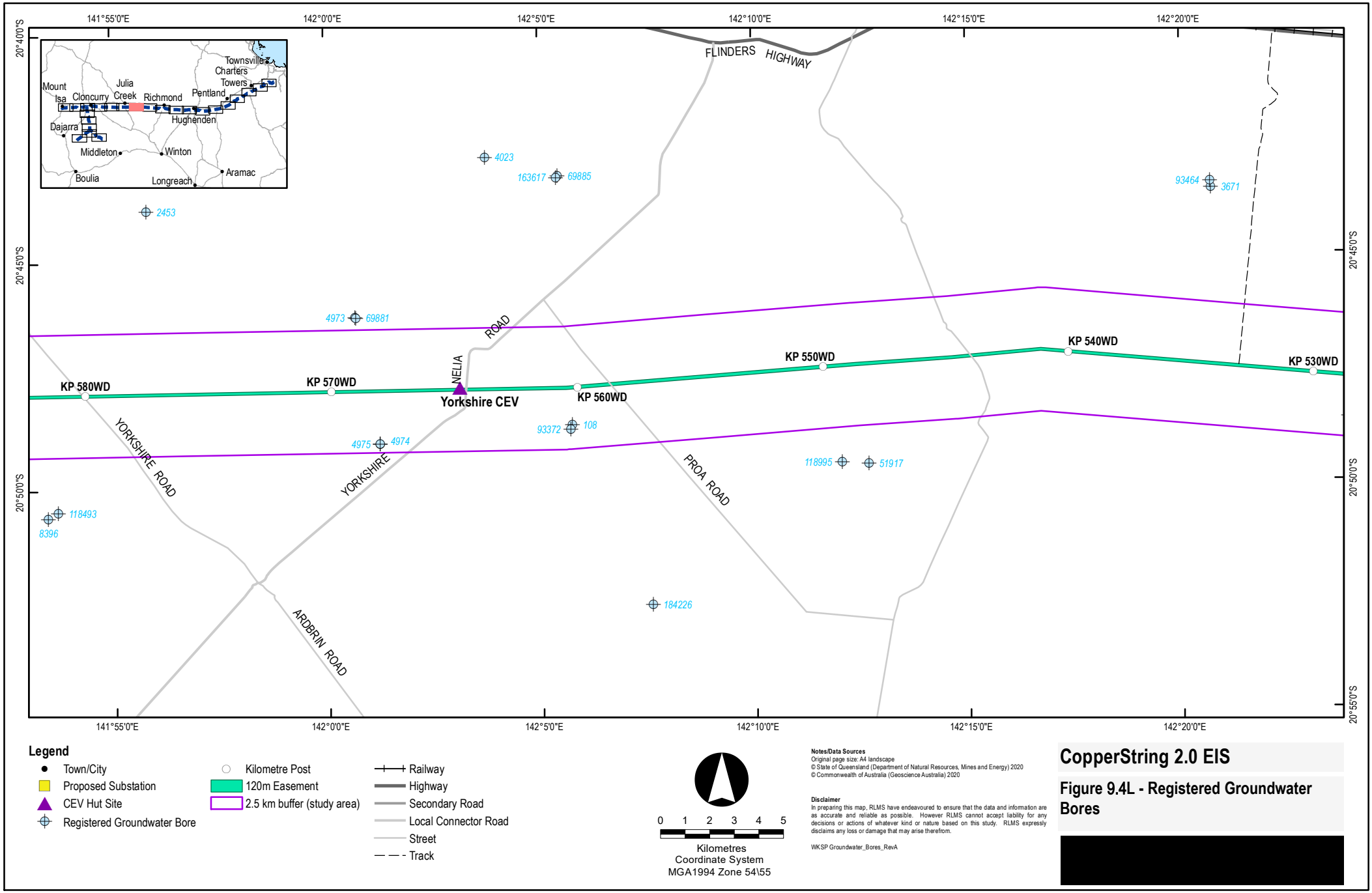
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4K - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
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- 2.5 km buffer (study area)
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Kilometres
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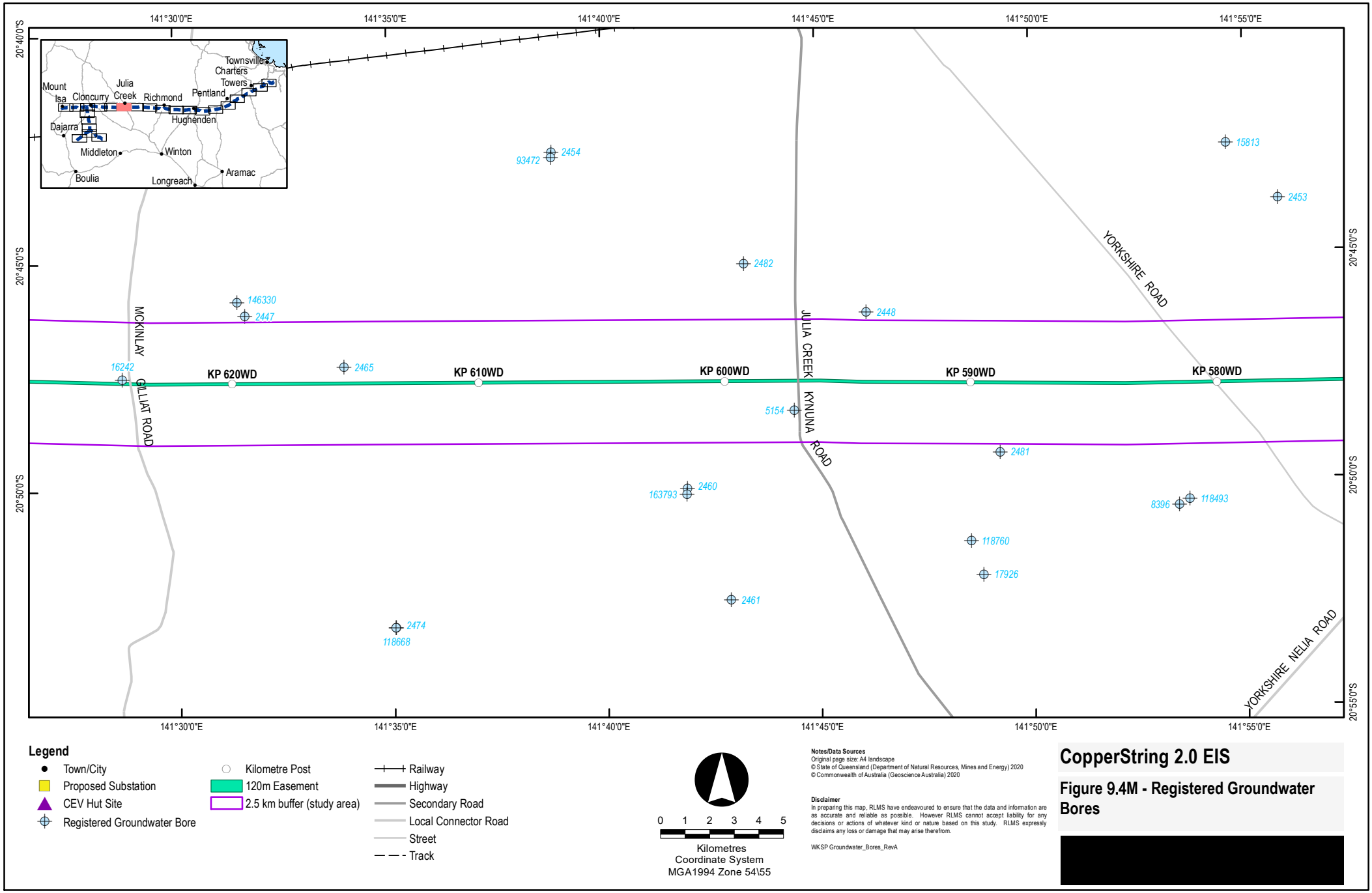
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4L - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
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Kilometres
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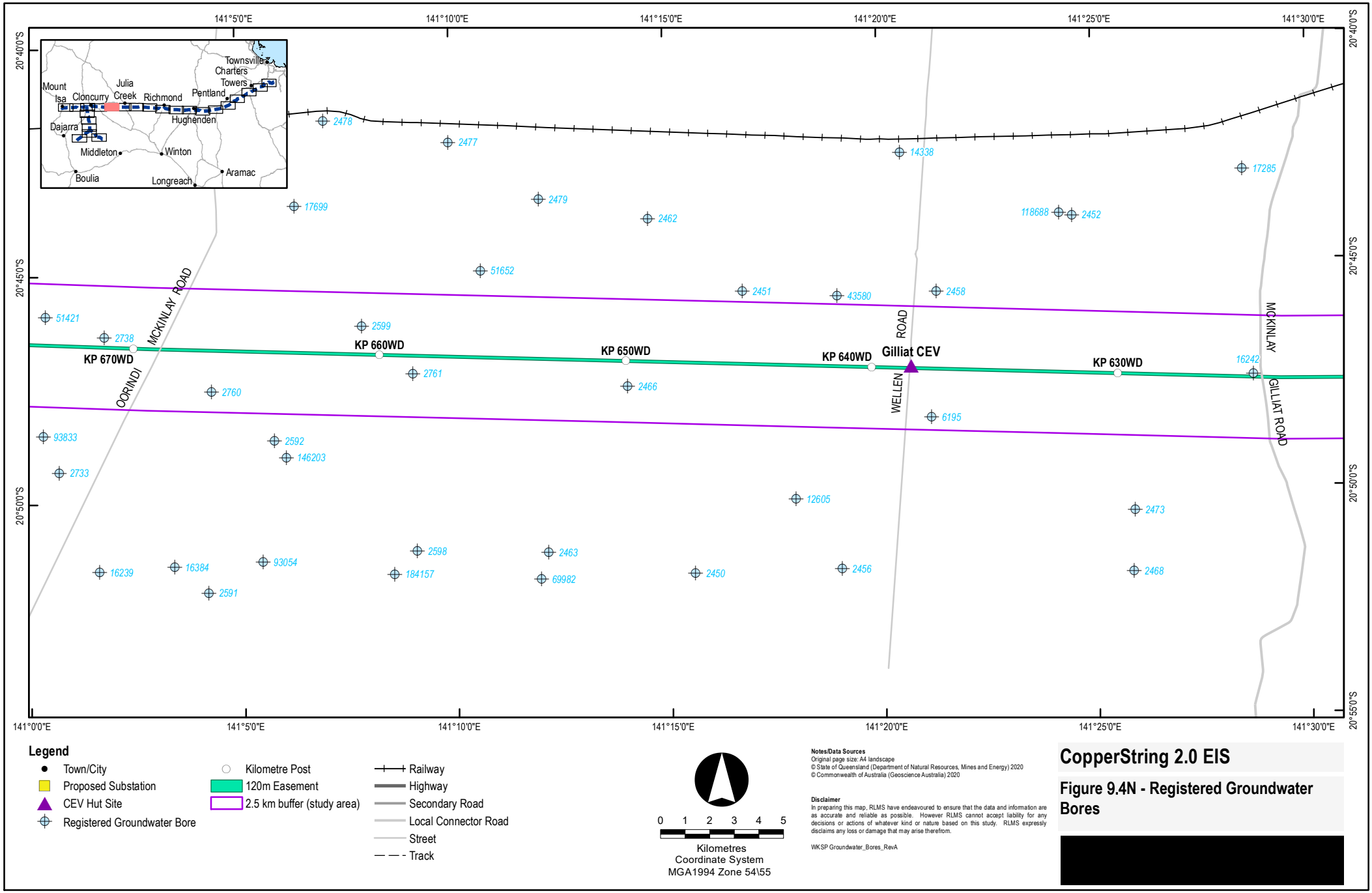
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4M - Registered Groundwater Bores

[redacted]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20°45'0"S
20°50'0"S
20°55'0"S
Townsville
Charters Towers
Mount Isa
Cloncurry
Julia Creek
Richmond
Pentland
Hughenden
Dajarra
Middleton
Winton
Boulia
Longreach
Aramac
2478
2477
14338
17285
17699
2479
2462
118688
2452
51652
2451
43580
2458
51421
2738
2599
MCKINLAY ROAD
KP 670WD
KP 660WD
KP 650WD
KP 640WD
Gilliat CEV
KP 630WD
16242
MCKINLAY ROAD
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2761
2760
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WELLEN ROAD
6195
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2463
16239
16384
93054
184157
69982
2450
2456
2468
2591
Legend
Town/City
Proposed Substation
CEV Hut Site
Registered Groundwater Bore
Kilometre Post
120m Easement
2.5 km buffer (study area)
Railway
Highway
Secondary Road
Local Connector Road
Street
Track
0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55
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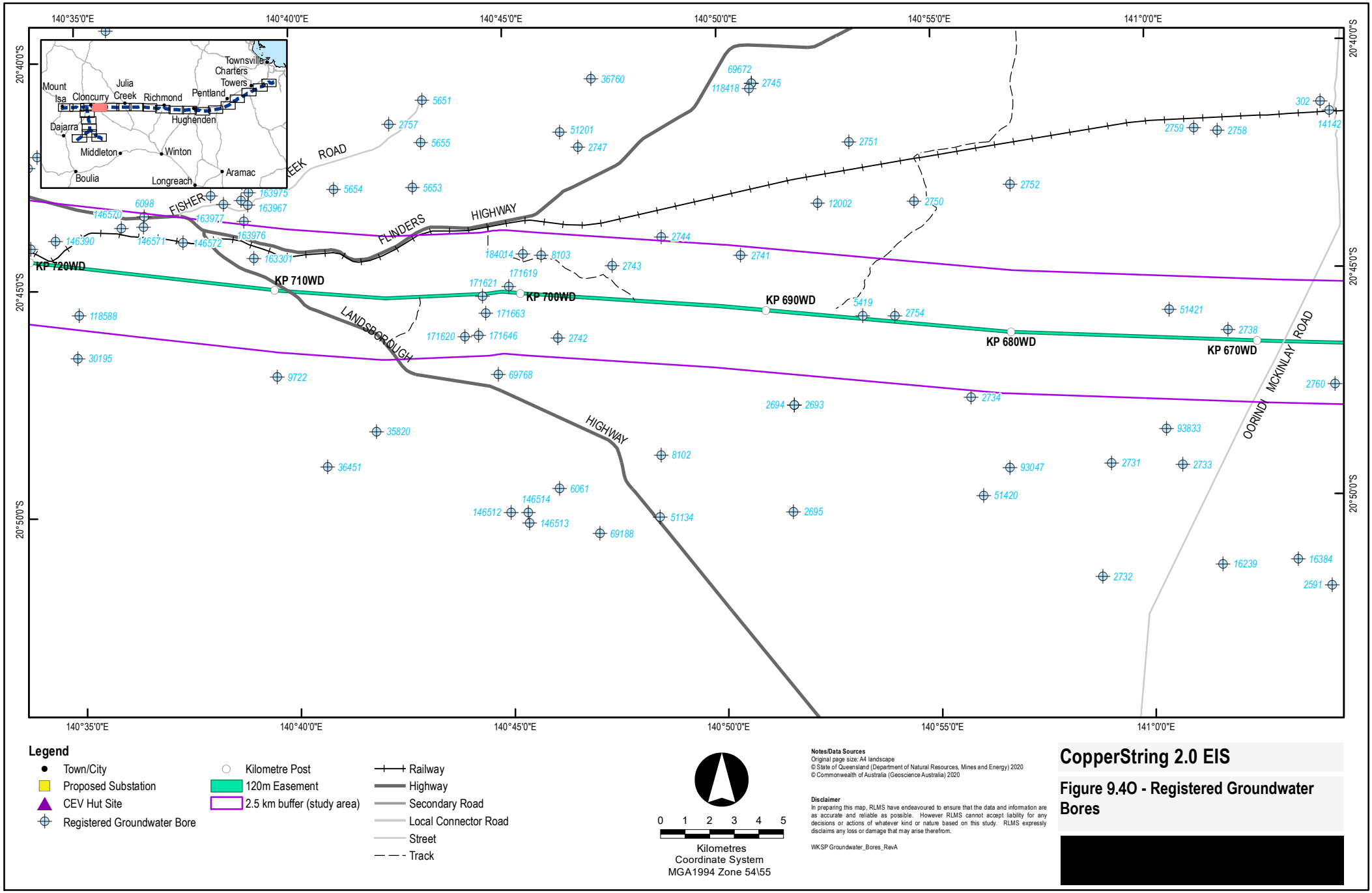
WKSP Groundwater_Bores_RevA
CopperString 2.0 EIS
Figure 9.4N - Registered Groundwater Bores
[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 120m Easement
- 2.5 km buffer (study area)
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- Track

0 1 2 3 4 5

Kilometres
Coordinate System
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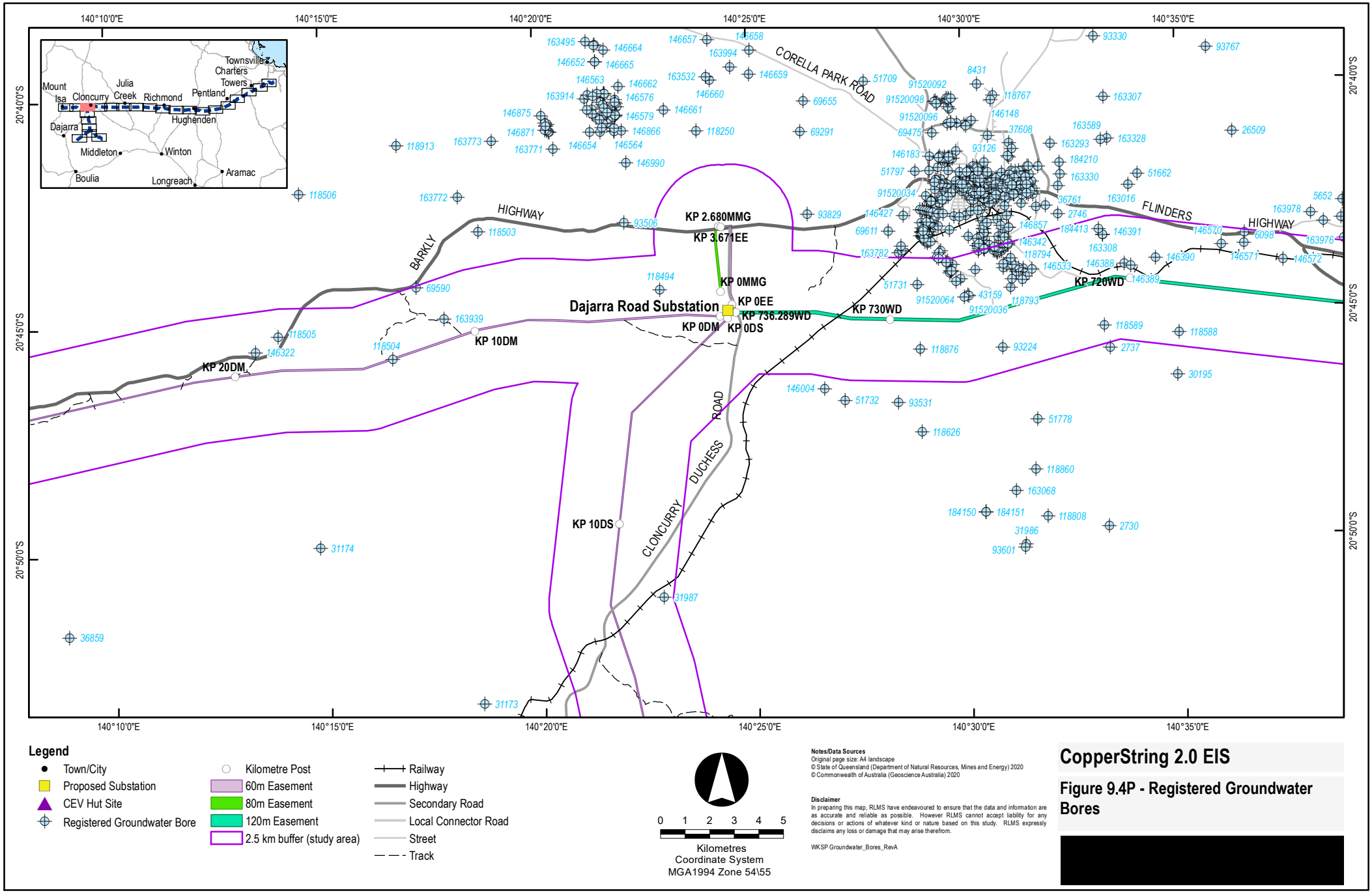
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4O - Registered Groundwater Bores

[redacted]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20°45'0"S
20°50'0"S
Townsville
Charters Towers
Mount Isa
Julia Creek
Cloncurry
Richmond
Pentland
Hughenden
Dajarra
Middleton
Winton
Boulia
Longreach
Aramac
CORELLA PARK ROAD
HIGHWAY
BARKLY
FLINDERS
HIGHWAY
DUCHESS ROAD
CLONCURRY
KP 2.680MMG
KP 3.671EE
KP 0MMG
KP 0EE
Dajarra Road Substation
KP 736.289WD
KP 0DM
KP 0DS
KP 730WD
KP 720WD
KP 10DM
KP 20DM
KP 10DS
118913
118506
163772
118503
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163068
184150
184151
118808
2730
31986
93601
31987
31174
36859
31173
Legend
Town/City
Proposed Substation
CEV Hut Site
Registered Groundwater Bore
Kilometre Post
60m Easement
80m Easement
120m Easement
2.5 km buffer (study area)
Railway
Highway
Secondary Road
Local Connector Road
Street
Track
0 1 2 3 4 5
Kilometres
Coordinate System
MGA1994 Zone 54\55
Notes/Data Sources
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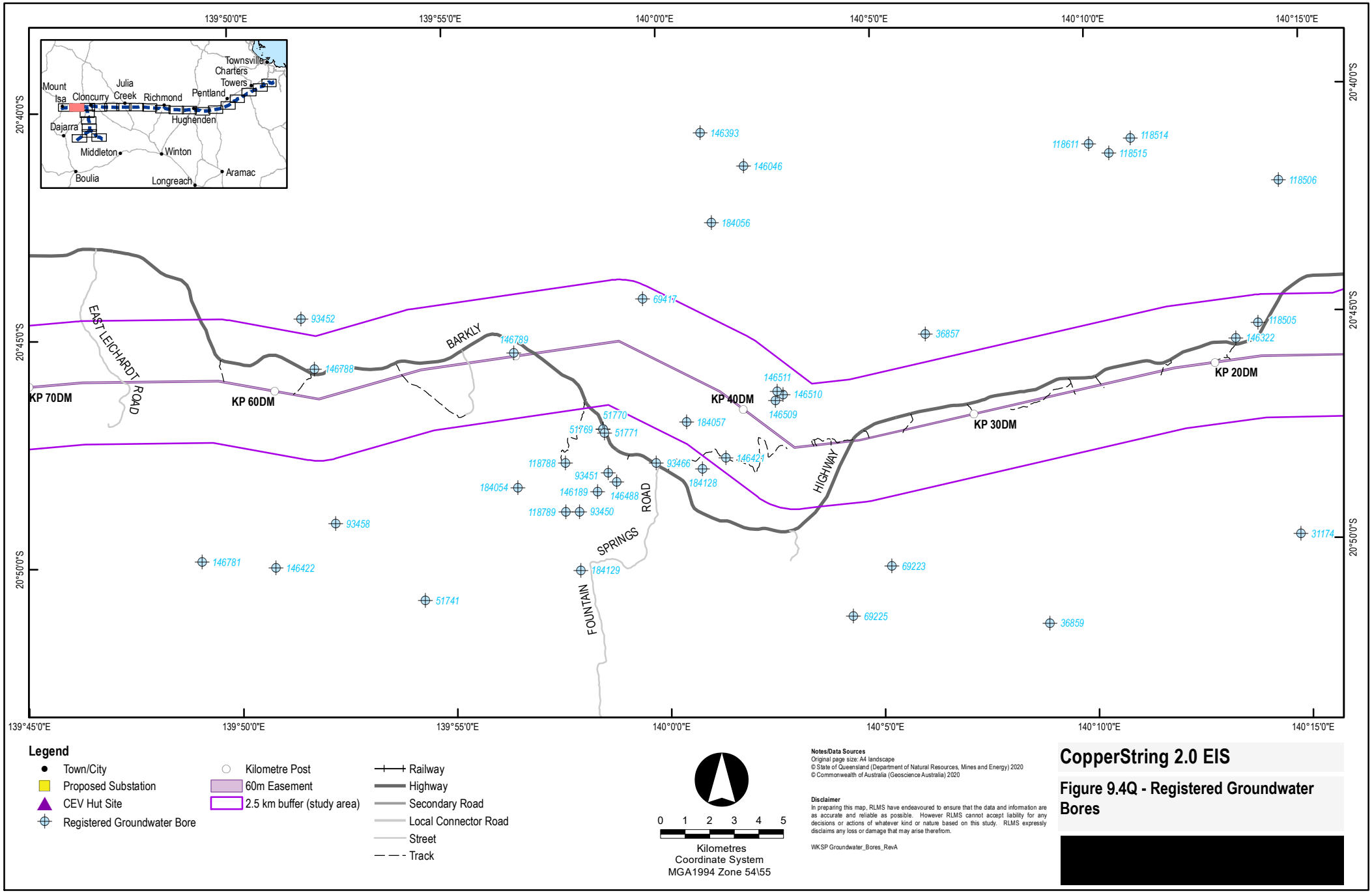
WKSP Groundwater_Bores_RevA
CopperString 2.0 EIS
Figure 9.4P - Registered Groundwater Bores
[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track

0 1 2 3 4 5

Kilometres
Coordinate System
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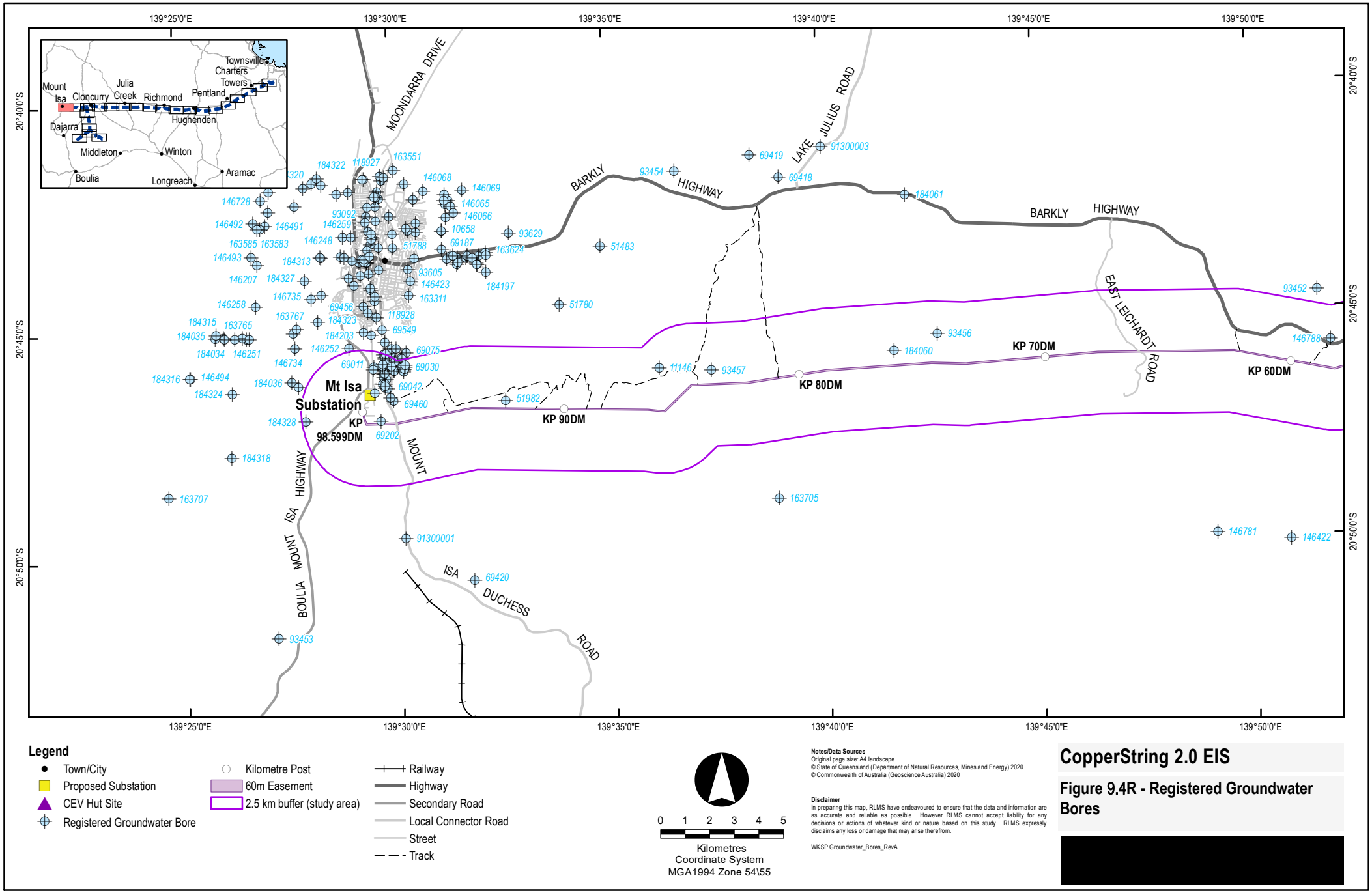
WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4Q - Registered Groundwater Bores

[redacted]



Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track

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Kilometres
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WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4R - Registered Groundwater Bores

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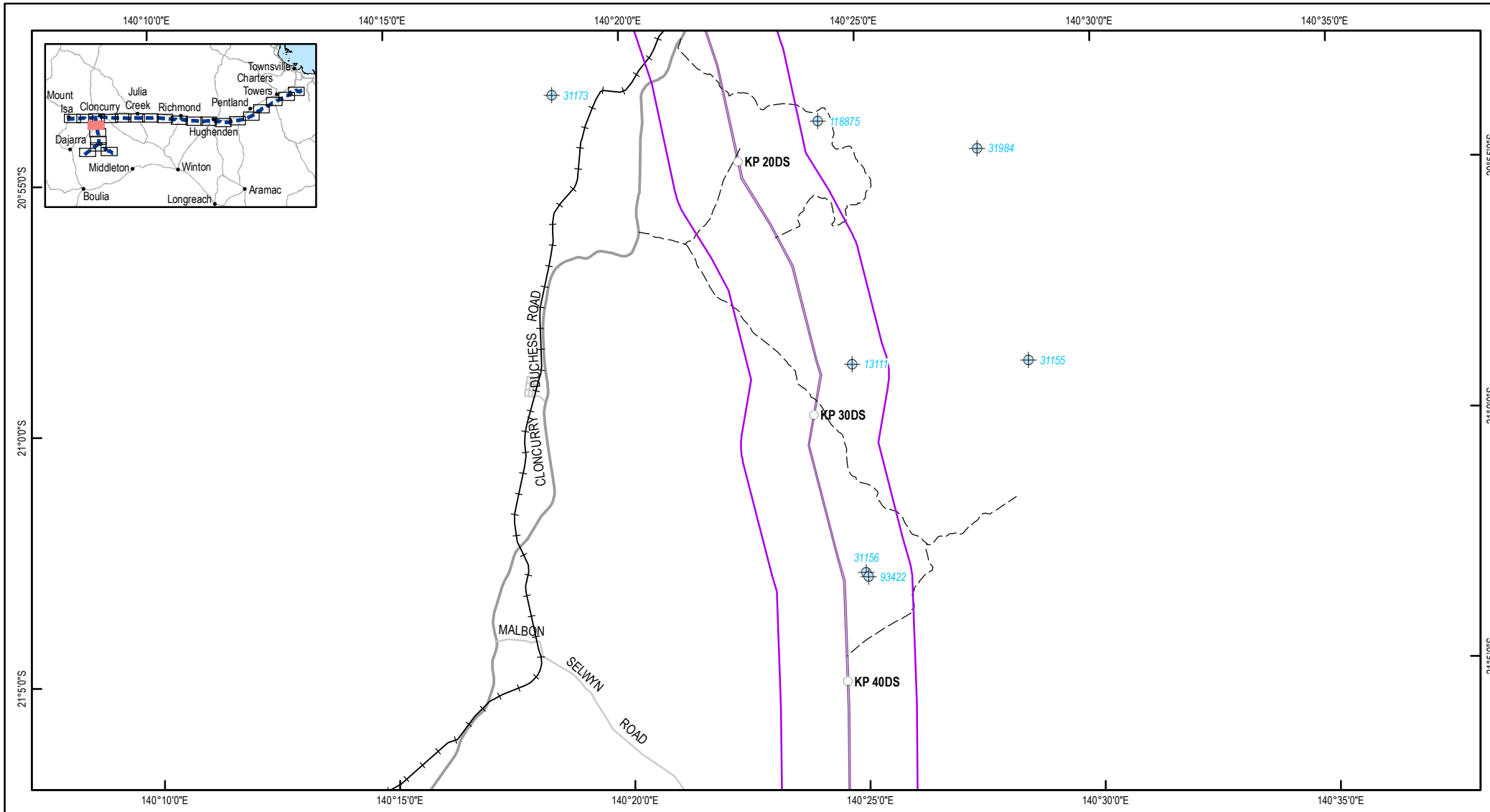

Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
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- Street
- Track

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Kilometres
Coordinate System
MGA1994 Zone 54\55

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WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4S - Registered Groundwater Bores

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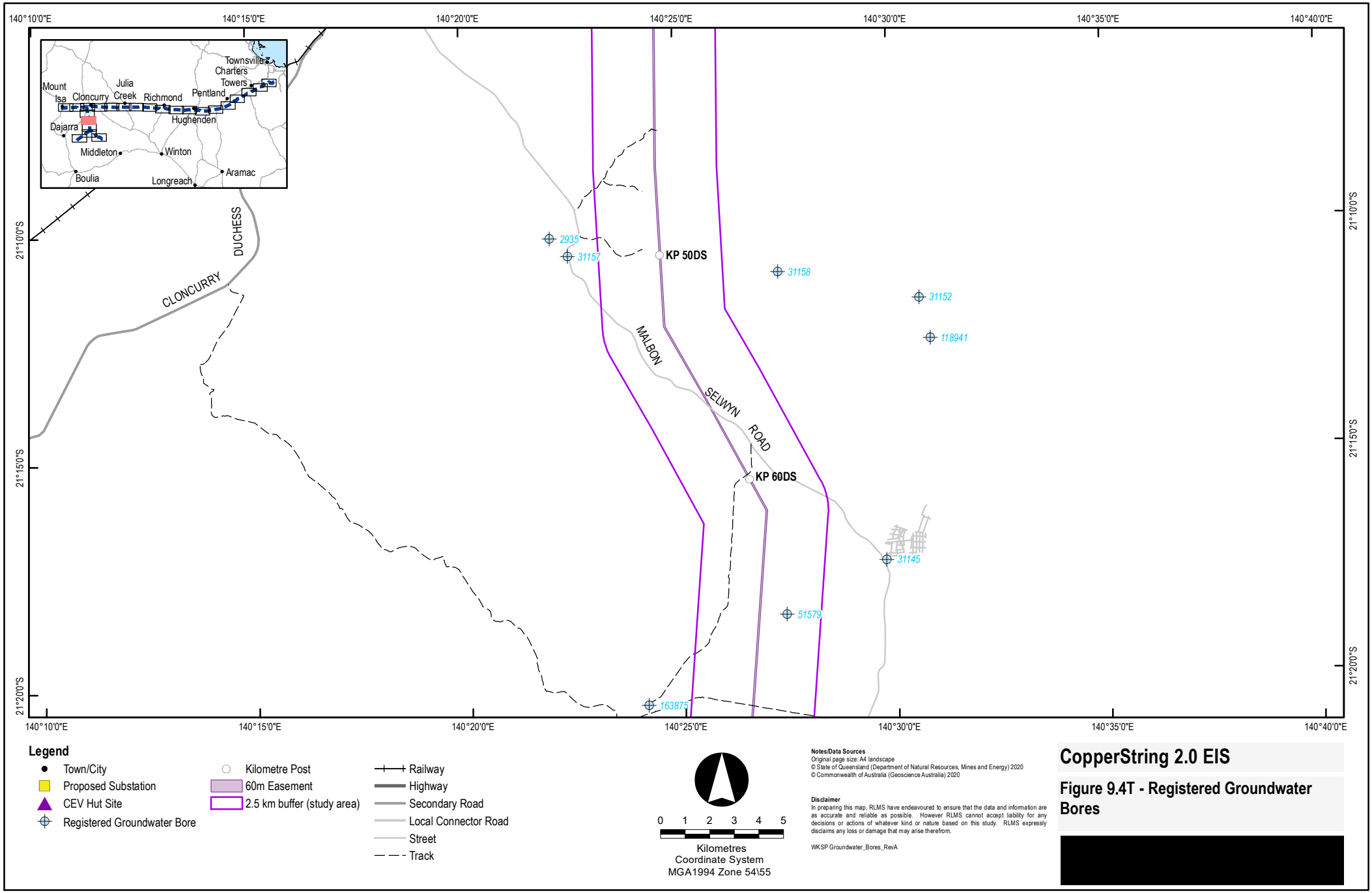

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- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
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WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4T - Registered Groundwater Bores

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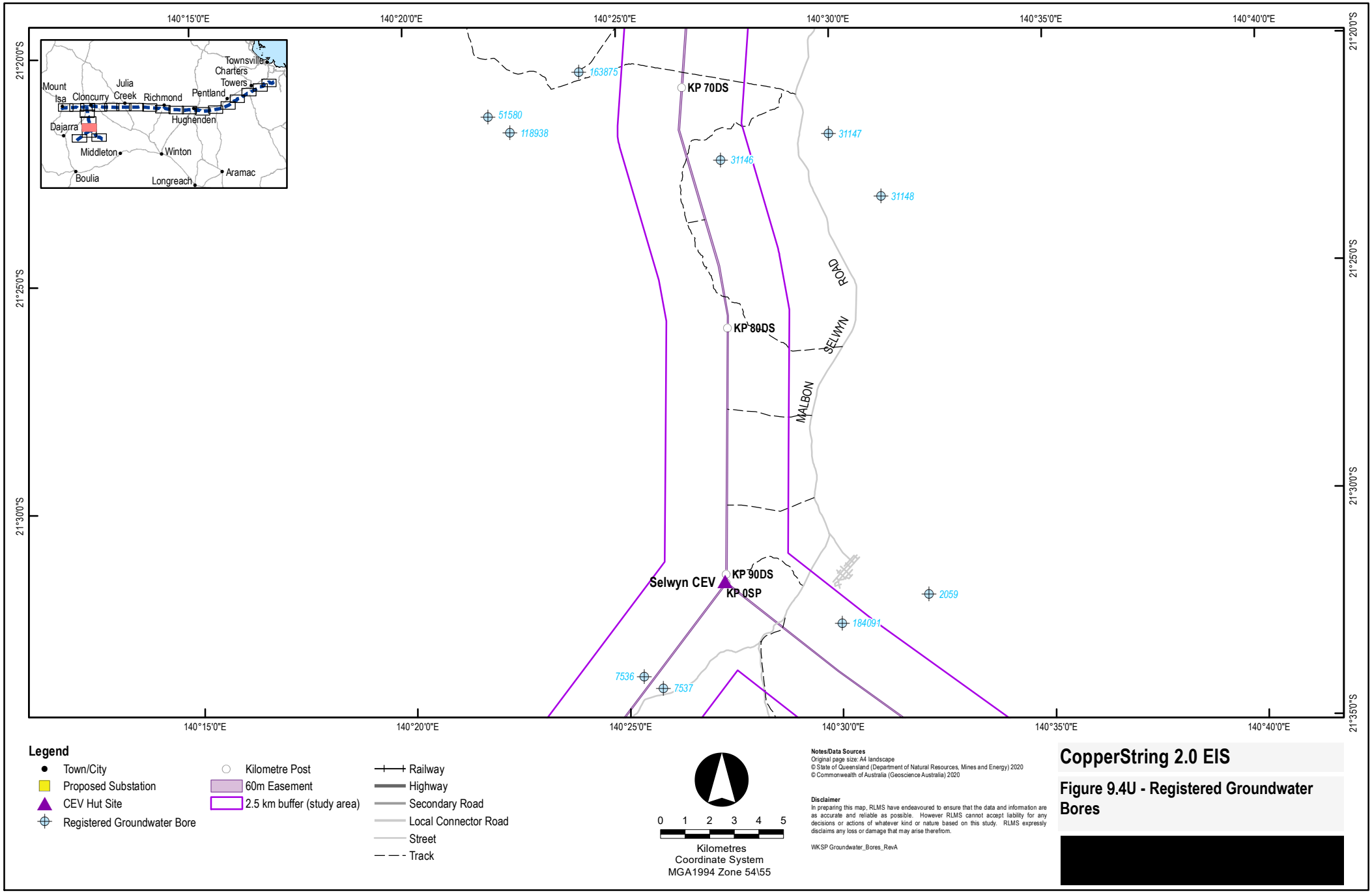

Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
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WKSP Groundwater_Bores_RevA

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Figure 9.4U - Registered Groundwater Bores

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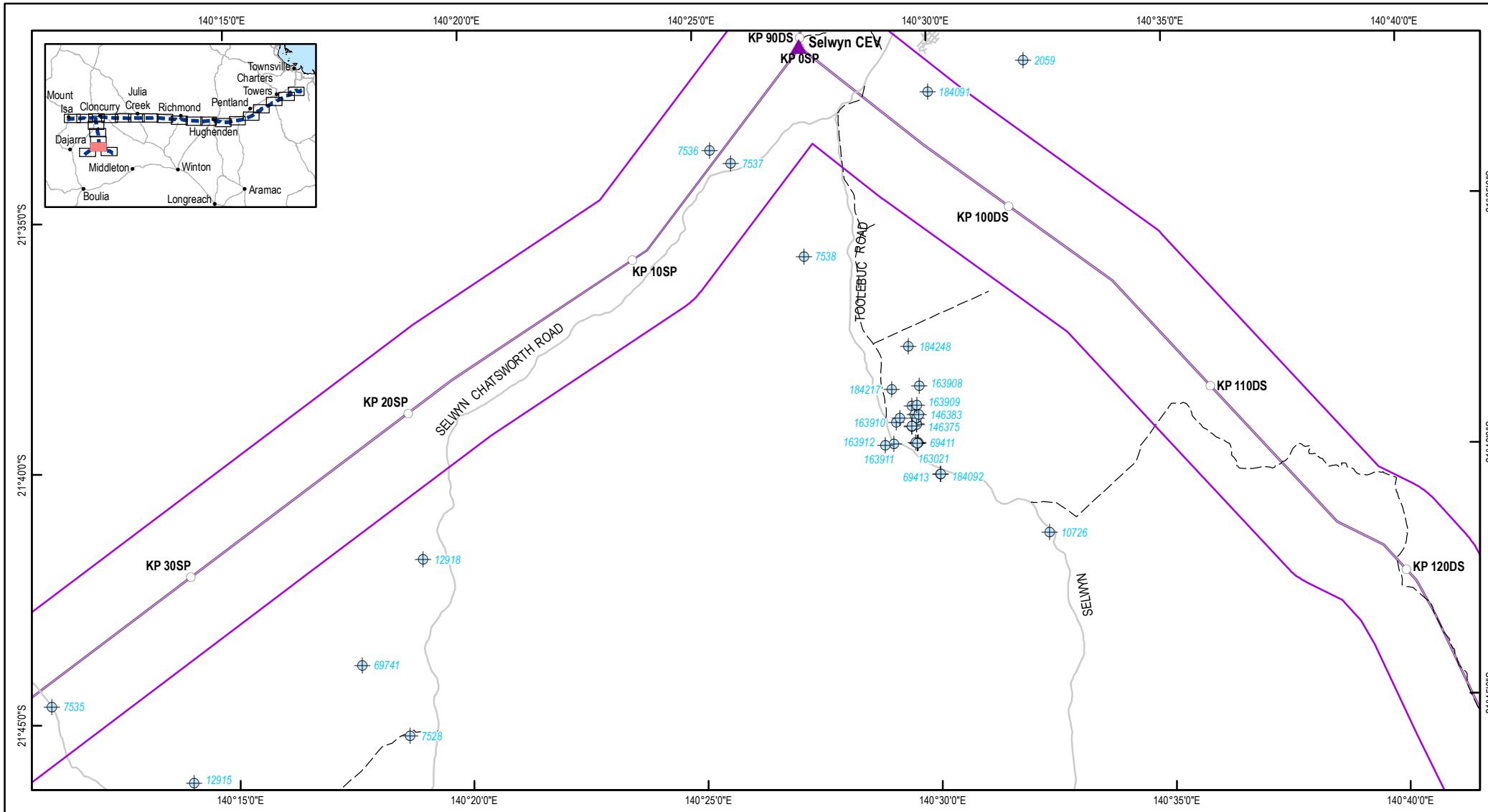

Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track

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Kilometres
Coordinate System
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WKSP Groundwater_Bores_RevA

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Figure 9.4V - Registered Groundwater Bores

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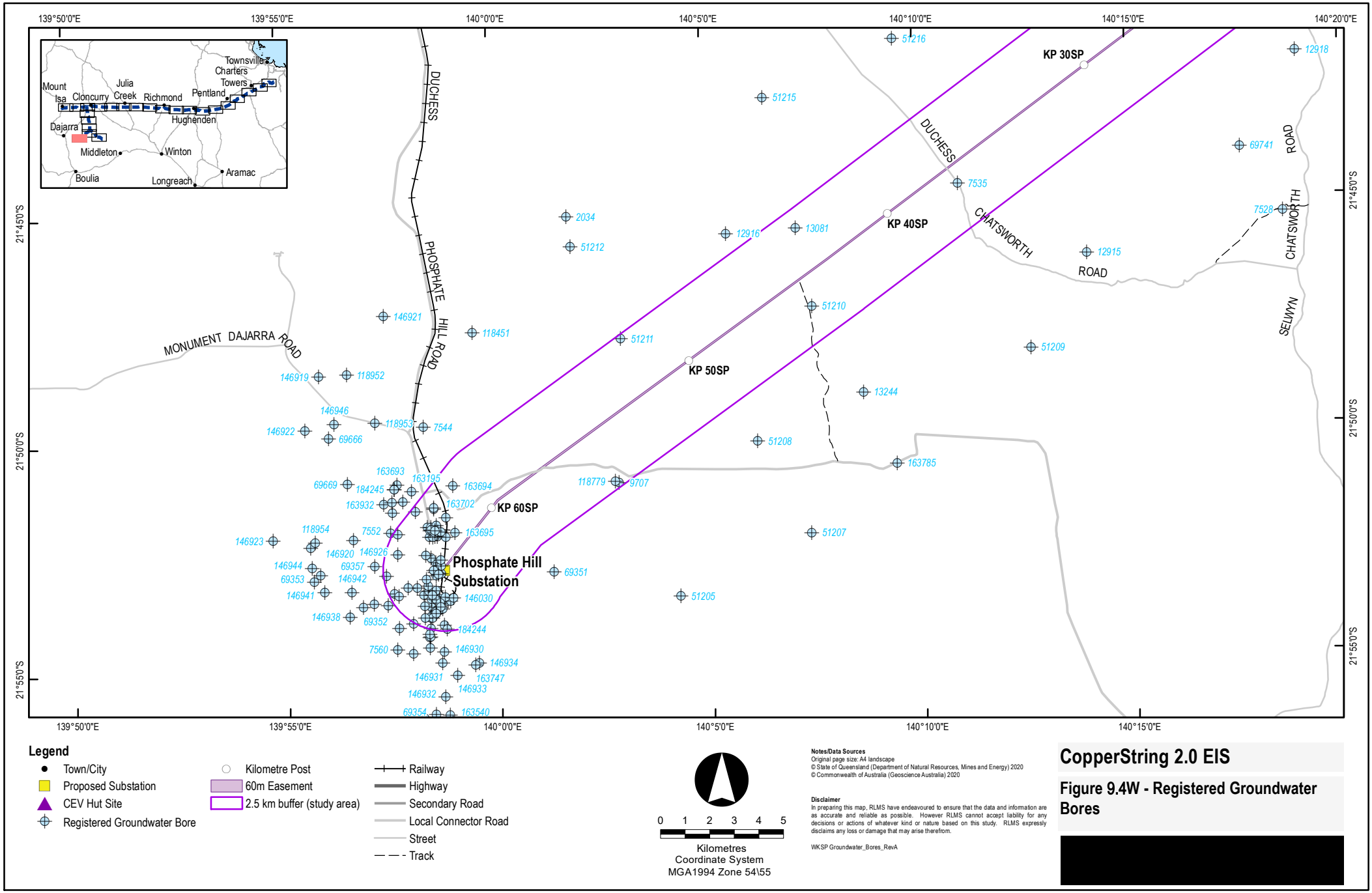

Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street
- Track

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Kilometres
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WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4W - Registered Groundwater Bores

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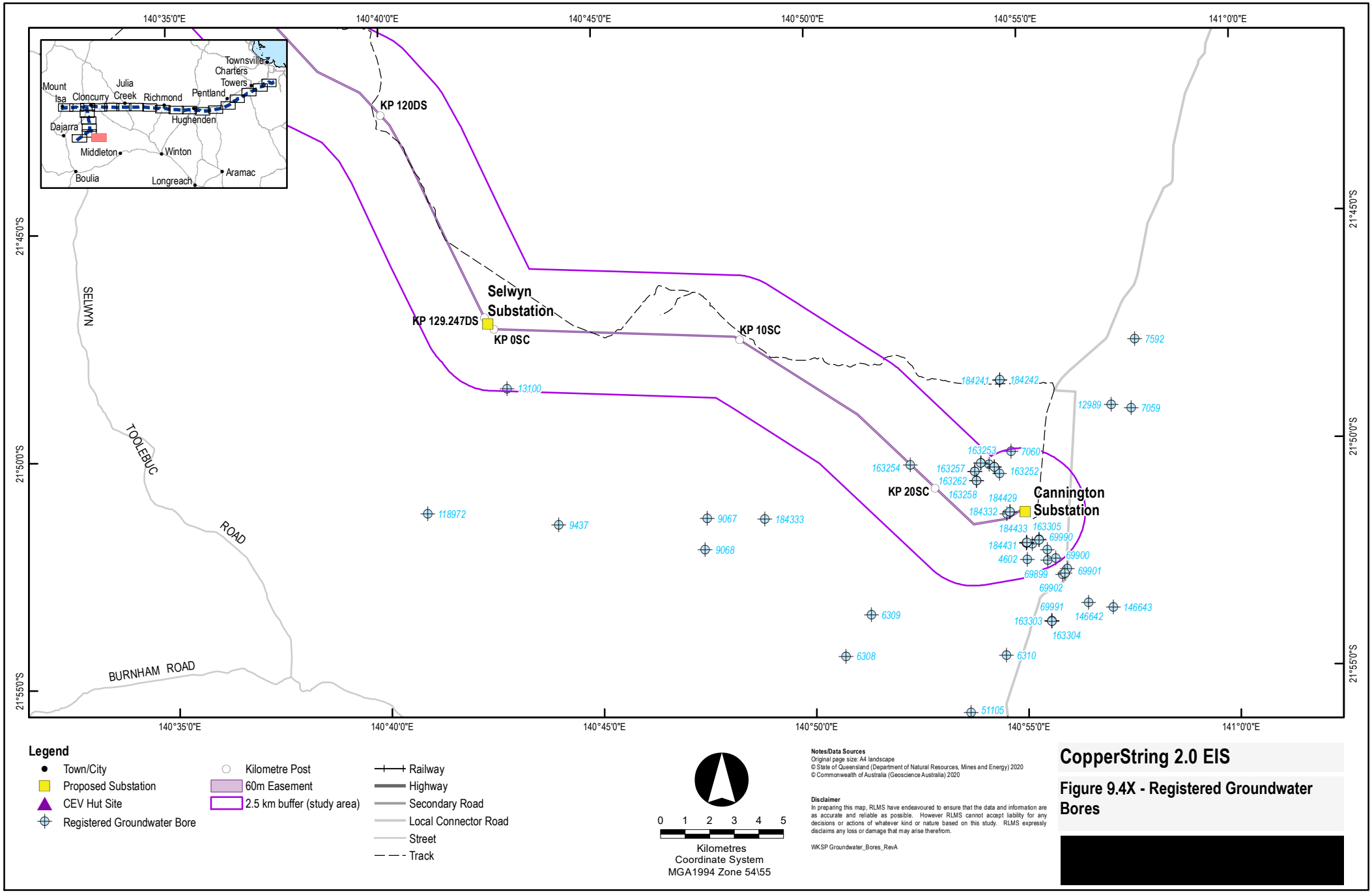

Legend

- Town/City
- Proposed Substation
- CEV Hut Site
- Registered Groundwater Bore
- Kilometre Post
- 60m Easement
- 2.5 km buffer (study area)
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WKSP Groundwater_Bores_RevA

CopperString 2.0 EIS

Figure 9.4X - Registered Groundwater Bores

[redacted]

9.3.4 Drinking water resources

Primary drinking water sources for major townships between Townsville and Mt Isa are identified in Table 9-7.

Table 9-7 Primary drinking water sources

Township	Primary drinking water sources
Woodstock	Groundwater
Charters Towers	Charters Towers Weir located on Burdekin River
Hughenden	Groundwater (GAB)
Richmond	Groundwater (GAB)
Julia Creek	Groundwater (GAB)
Cloncurry	Cloncurry River Wells, Chinamans Creek Dam or Lake Julius
Mt Isa	Lake Moondarra and Lake Julius (if required)

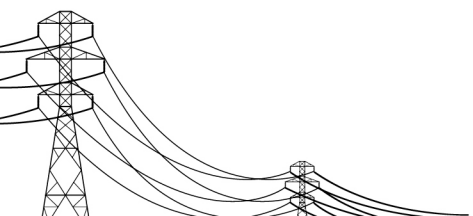
9.3.5 Flooding and flow dynamics

The corridor selection traverses several large catchment areas in central and northern Queensland and crosses at least 29 major water features that drain a portion of these catchment areas. The five major river systems include the following:

- Burdekin River
- Flinders River
- Haughton River
- Leichardt River
- Georgina River.

There are approximately 185 km of floodplain crossings along the corridor selection. Figure 9-5 through Figure 9-7 presents selected portions of the corridor selection as long-sections, which highlights the larger floodplain crossings. This graphic shows that the corridor selection spans multiple large floodplains. There would be several tower structures constructed within these floodplain zones, with proposed tower spacings ranging from 400 m to 500 m.

The most notable floodplain crossed by the corridor selection is along the Flinders River. Here, the floodplain is approximately 70 km wide. There would be a number of towers constructed within this zone.



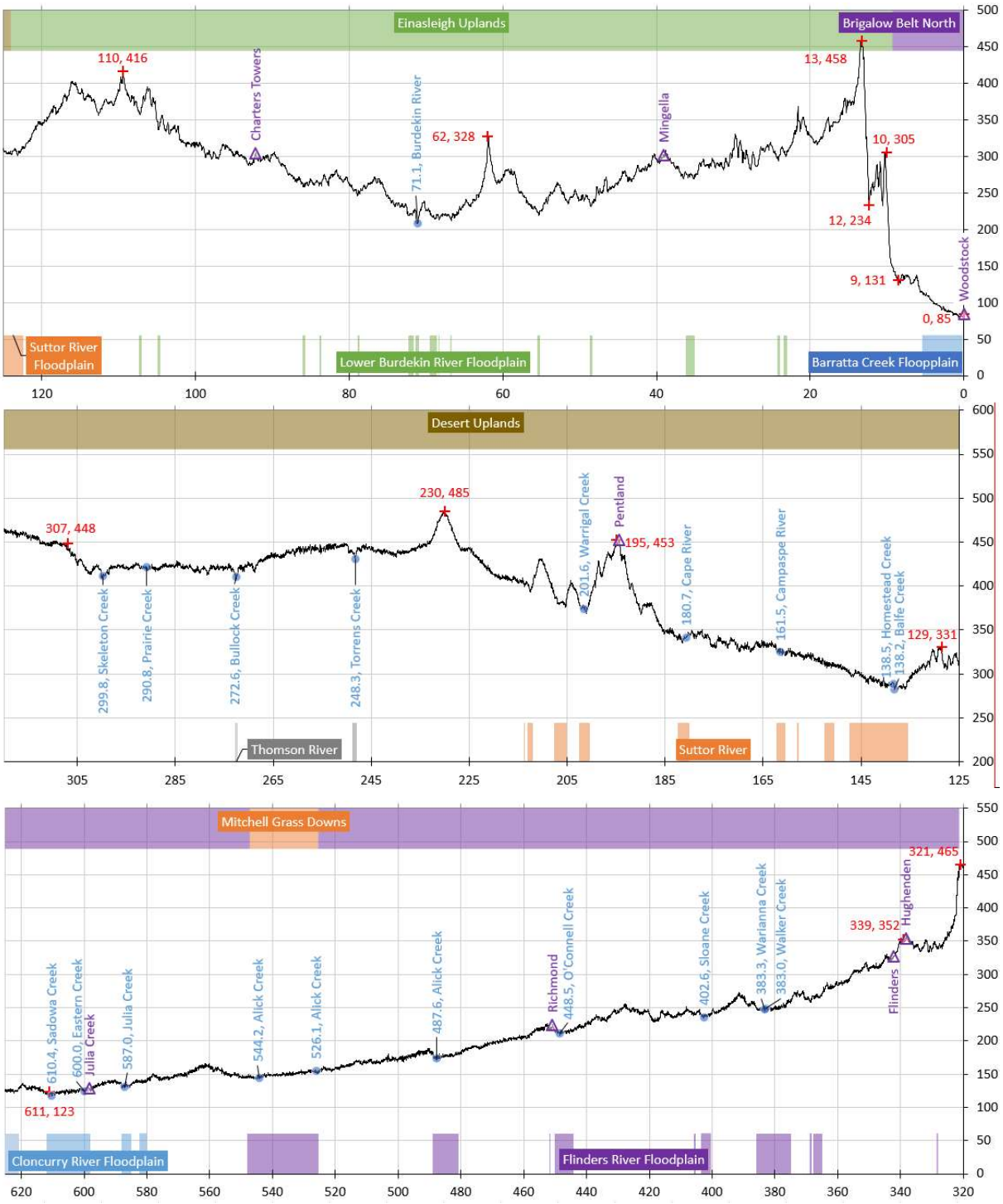


Figure 9-5 Select long sectional plots showing the larger floodplain crossings – Barratta Creek to Cloncurry River

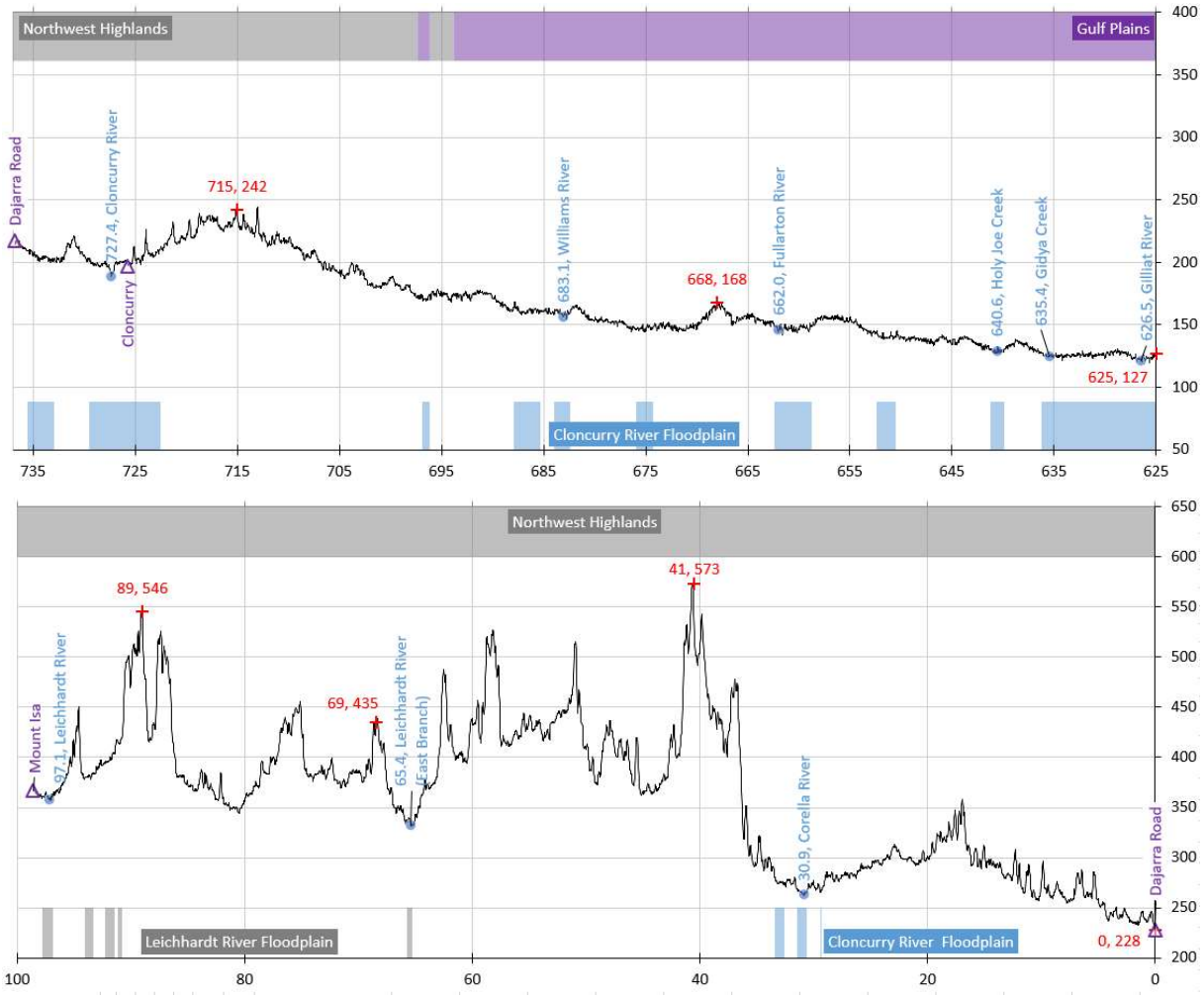


Figure 9-6 Select long sectional plots showing the larger floodplain crossings – Cloncurry River to Leichhardt River

Figure 9-7 Select long sectional plots showing the larger floodplain crossings – Cloncurry River, Eyre Creek and Georgina River

The Burdekin River is by far the largest river system (based on streamflow volume) in the study area, with mean annual flow volumes of 4,400 GL/yr recorded at Sellheim. The next largest river system is Flinders River with a mean annual flow of 520 GL/yr recorded at Richmond. All other watercourses have mean annual flow volumes less than 250 GL/yr.

Most of the major water features in the study area are non-perennial in nature. For these, flows are only experienced during the wet season, which generally spans about four to five months of the year. For the remaining seven to eight months of the year, these are virtually dry, with minimal flow recorded (Figure 9-8). These rivers are reduced to a few scarce and vulnerable waterholes during the dry season. The waterholes are replenished by streamflow, rather than groundwater and act as critical refugia for aquatic biota (Petheram, Watson & Stone, 2013).

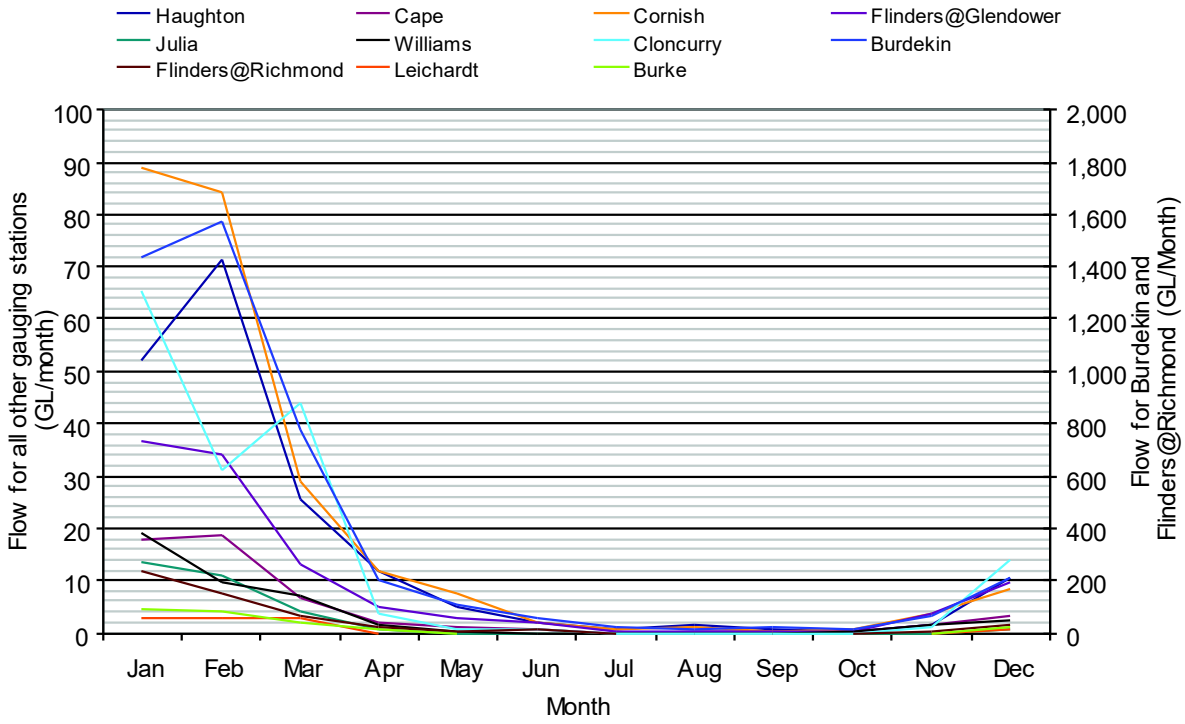


Figure 9-8 Mean monthly flow for major waterways (BMT WBM, 2010)

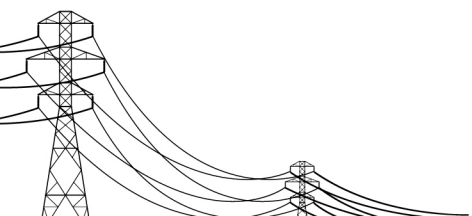
A number of gauging stations are located on river systems near the corridor selection. These gauges collect river level and discharge information and are monitored by the DES and the Bureau of Meteorology (BOM). BMT WBM (2010) used available gauging station data together with local Council data to undertake a flood frequency analysis (FFA) and qualitative flood assessment to provide an estimate of peaks flows for design flood events.

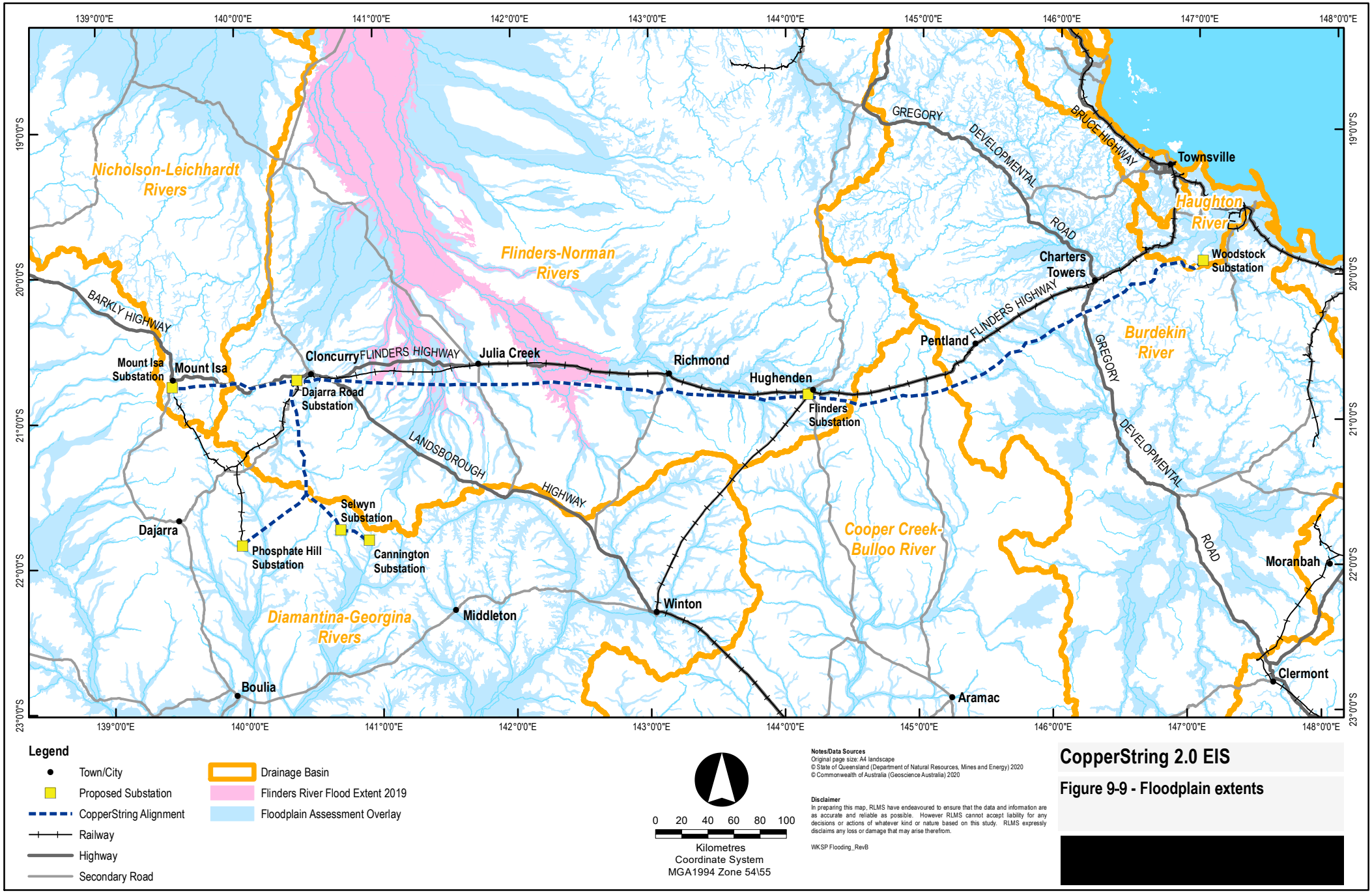
With regards to FFA, the discharge provides a basic understanding of the flood behaviour in the catchments. For a 1 in 100-year Annual Exceedance Probability (AEP) event, the discharge at the selected river stream gauges was estimated to range between approximately 400 m^3/s to 30,000 m^3/s.

Much of the corridor selection experienced such an event in late January and early February 2019. During this event, tropical low TL-13U was the principal system associated with a long-lived and disastrous monsoon event that brought unprecedented rainfall and flooding to parts of north-west Queensland and Townsville (BOM, 2020a), with many sites exceeding 1% AEP event conditions for durations of four or more days.

No hydraulic flood modelling has been undertaken in order to determine flood levels. Existing flood inundation data was sourced from the Queensland Government Queensland Spatial

Catalogue – Qspatial http://qldspatial.information.qld.gov.au) and analysed against the corridor selection of the transmission line (see Figure 9-9).





Legend

- Town/City
- Proposed Substation
- CopperString Alignment
- Railway
- Highway
- Secondary Road
- Drainage Basin
- Flinders River Flood Extent 2019
- Floodplain Assessment Overlay

0 20 40 60 80 100

Kilometres

Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
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WKSP Flooding_RevB

CopperString 2.0 EIS

Figure 9-9 - Floodplain extents

[redacted]

Table 9-8 illustrates where the corridor selection crosses significant floodplain extents greater than 500 m in width (Queensland floodplain assessment overlay – 2013, http://qldspatial.information.qld.gov.au), which accounts for over 90% of the overall floodplain crossing extents.

Table 9-8 Notable floodplain extents located along the corridor selection

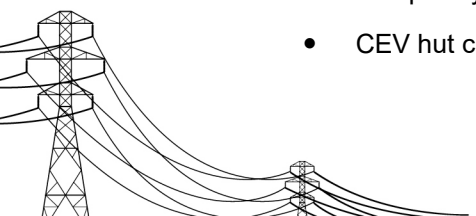
Catchment	Water features	Floodplain Extent at Corridor Selection Crossing (km)
Burdekin	Oaky Creek	0.256
	Burdekin River	1.766
	Balfe Creek	14.701
	Campaspe River	6.121
	Cape River	2.170
	Warrigal Creek	5.545
Cooper Creek	Torrens Creek	0.965
	Bullock Creek	0.990
Flinders	Walker Creek	14.212
	Sloane Creek	3.221
	O'Connell Creek	5.542
	Alick Creek	37.040
	Julia Creek	3.265
	Eastern Creek	11.336
	Sadowa Creek	2.749
	Gilliat River	10.395
	Holy Joe Creek	1.448
	Gidya Creek	4.808
	Fullarton River	4.499
	Williams River	4.991
	Cloncurry River	10.956
	Corella River	0.746
Leichhardt	Leichhardt River (east branch)	0.498
	Gorge Creek	2.462
	Leichhardt River	0.961
Flinders	Slaty Creek	0.978
	Cloncurry River	4.313
Georgina	Bustard Creek	3.423
	Burke River	4.084

9.3.6 Project infrastructure and activities

Typical construction and operational phase infrastructure and activities

Volume 1 Chapter 2 Project Description highlights typical construction and operational phase infrastructure and activities with potential to impact on existing environmental values within the corridor selection including:

- General transmission line easement and permanent and temporary infrastructure clearing works
- Transmission line tower construction
- Temporary and permanent access track construction
- CEV hut construction



- Sub-station construction
- Temporary camp and laydown area construction inclusive of concrete batch plants, wash bays, refuelling areas, workshops, waste storage, chemicals storage and accommodation facilities.
- Temporary and permanent fly yards for line installation and ongoing maintenance.

Indicative layouts and siting plans for temporary and operational phase infrastructure is provided in Volume 3 Appendix I Indicative Infrastructure Layout and Cross-section Drawings and Volume 3 Appendix H Tower Siting Plans.

In addition to these, the following provides an overview of key activities as they relate to water quality and water resources.

Water usage in construction activities

Water requirements for the construction of the Project include water for the concrete batching process, dust suppression and cleaning of insulators. The total water requirements of the Project are estimated in Table 9-9.

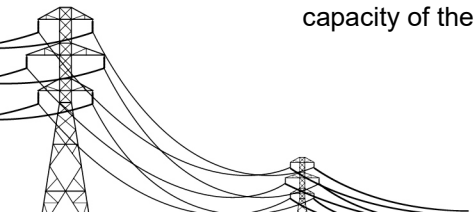
Table 9-9 Construction phase water usage

Activity	Estimated Water Usage (kL)	Assumptions
Concrete batching plants	23,500	220 L/m3 of water for concrete
Dust suppression during construction	138,600	Average 13-month construction duration over seven construction zones (operational at one time) at five water dumps per day (10,000 L)
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	**236,610**	**-**

It is assumed that water required for concrete batching would be sourced from existing appropriately licenced and authorised water sources that will be finalised during the detailed design of the Project. The preference is to utilise existing concrete batching plants as well as their existing licensed and authorised water supply. Where new or temporary mobile batching plants are proposed, the water source would be determined in consultation with local Councils, DNRME and landholders. Direct extraction from surface water features is not proposed under the Project unless it is from an existing licenced and authorised water source agreed in consultation with local Council, DNRME and landholders.

Dust suppression would occur via watering of access tracks, speed restrictions on access tracks and the regular removal of “bull dust” via mechanical means 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 would be sufficient to mitigate the anticipated air quality impacts to the human environment during the construction program. Further information on potential impacts to air quality and suitable mitigation measures are presented in Volume 2 Chapter 10 Air and Greenhouse Gas.

As part of the commissioning program, individual tower sites would be inspected and cleaned to ensure the optimal function and efficiency of the installed equipment. The insulators would be washed to remove particulates and dust that may impact on the lightning/over-voltage withstand capacity of the insulator.



Construction camps water usage and sewage

Where possible, the construction camps will be located near major towns of the region, to make best use of existing services, including water supply and sewage. Indicative locations of construction camps are included in Volume 3 Appendix I Indicative Infrastructure Layout and Cross-section Drawings.

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

- Access town water supplies from the existing local Council water reticulation networks through the construction of water supply pipelines where possible.
- Access the existing town water supplies and transport the water by truck to the temporary camp sites, where it would be stored in tanks.
- Utilise groundwater through existing licences and authorised groundwater reserves in consultation with local Council, DNRME and landholders.

Direct extraction from surface water features is not proposed under the Project unless it is from an existing licences and authorised water source agreed in consultation with local Council, DNRME and landholders.

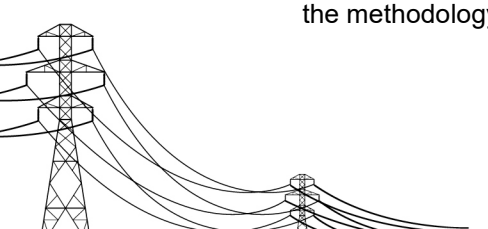
Water would be required to be treated to a potable standard where existing town water supplies are not proposed to be utilised. This would be achieved through the use of a package reverse osmosis plant at the temporary construction camps.

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

Sewage and other wastewater from the temporary construction camps would come from primarily domestic uses, although trade waste may need to be disposed of due to the operation of construction camp laydown workshops. Sewage and wastewater disposal systems would be required at all construction camp sites unless Council sewage treatment plants (STP) are utilised and connected. Where STP connection requires establishment, this will be assessed as part of the construction camp Council approval process. Where Council connection is not possible, construction camps would require a STP adequate to meet the loading for each camp and would be developed to comply with requirements of Council, Department of Housing and Public Works (DHPW) and DES as applicable.

The planned treatment approach of sewage and wastewater is described in Table 9-10. Onsite wastewater treatment would 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 utilisation of an existing Council operated STP is not available, disposal of treated sewage would be via an irrigation scheme for construction camps. Irrigation schemes will be designed to adequately dispose of the volume of effluent in compliance with best practice, local conditions and applicable legislation.

Depending on the size of the facility, the STP may be regarded as an ERA requiring an environmental authority under the EP Act and EP Reg. It would be the responsibility of the Construction Contractor(s) to obtain STP approvals. Design of the STP would incorporate meteorological considerations of the region, including rainfall variability, depth to groundwater and buffer distances to watercourses and sensitive receptors. This would be undertaken with reference to the following Standards, Guidelines and Model Operating Conditions depending on the final treatment capacity (i.e. equivalent persons) that would be calculated in accordance with the methodology prescribed in the EP Reg:



- Planning Scheme engineering and development codes
- QPW Code
- Eligibility criteria and standard conditions for sewage treatment works (ERA 63) (ESR/2015/1710)
- Model Operating Conditions ERA 63 - Sewage treatment (ESR/2015/1668).

Table 9-10 Construction camp sewage treatment summary

Construction Camp Location	Proposed Sewage & Wastewater Treatment System
Woodstock	Onsite treatment
Charters Towers	Onsite treatment
Pentland	Onsite treatment
Hughenden	Potential Council operated STP or onsite treatment
Richmond	Potential Council operated STP or onsite treatment
Julia Creek	Onsite treatment
Cloncurry	Potential Council operated STP or onsite treatment
Mt Isa	Potential Council operated STP or onsite treatment
Selwyn	Onsite treatment

Construction activities would incorporate removable toilet facilities (or porta-loos) on site, which would effectively deal with the sewage generated by the workforce. Licensed waste contractors would be engaged to service and transport this waste. Waste management related to the Project is further described in Volume 2 Chapter 12 Waste Management.

9.3.7 Recommendations

The following key recommendations are made to avoid/minimise impact on water quality and water resources from Project infrastructure and activities:

- Avoid/minimise direct disturbance to water features
- Utilise existing access tracks wherever possible for access to the Project and when crossing waterways comply with DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works
- Use existing licensed and authorised sources of construction material (e.g. aggregate) from local suppliers.
- Implement best practice erosion and sediment controls during construction
- Design temporary and permanent infrastructure with industry standard stormwater management controls.
- Locate infrastructure away from flood prone areas where practicable or provide appropriate flood immunity.
- Utilise existing licenced and authorised water sources during construction in consultation with Council, DNRME and landholders.
- Transport, store, use and dispose potentially contaminating substances in accordance with manufactures specifications, legislative requirements and industry best practice.
- Design, construct, operate and decommission STPs in accordance with manufactures specifications, legislative requirements and industry best practice.

9.4 Impact assessment and mitigation measures

9.4.1 Planning and design response

The follow outlines high-level planning and design response measures that will be adopted in response to recommendations made in section 9.3.7 to avoid/minimise impacts on water quality and water resources from Project infrastructure and activities. Further detailed construction and operational phase impact assessment and mitigation are described in section 9.4.2 through 9.4.4.

Infrastructure siting to avoid/minimise direct impacts on water features

The distance between transmission towers will typically be in the range of 400–500 m. This may vary depending on the topography and conductor clearance required areas of the easement. The final transmission tower sites will be determined after careful consideration of all physical constraints such as sensitive environmental areas, rock/soil types, significant 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 infrastructure will be located outside of active water features. Where the corridor selection crosses large braided ephemeral systems, some of which are more than 1km 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. Conductors and earth wire pull cables would be strung over water features using helicopters where there is a risk of significant disturbance from manual line stringing. No water features will require bank modification (i.e. extraction or placement of fill material) during construction or permanently resulting from the installation of Project infrastructure (excluding access tracks below).

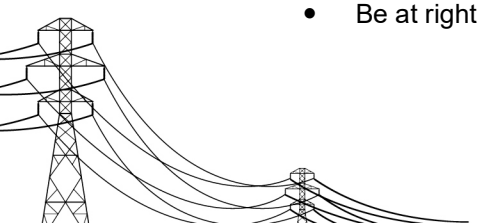
Indicative layouts and siting plans for temporary and operational phase infrastructure is provided in Volume 3 Appendix I Indicative Infrastructure Layout and Cross-section Drawings and Volume 3 Appendix H Tower Siting Plan.

Access track siting to minimise modification of water features

Construction phase and permanent tracks would be constructed to meet DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works relevant to the specific waterway barrier works category. Assessable waterway barrier works would not apply to this project and as such an assessment against SDAP state code 18: Constructing or raising waterway barrier works in fish habitats has not been completed.

As outlined in the Volume 3 Appendix R Field Development Plan, the following will apply to access tracks:

- New on-easement and off-easement access tracks are selected to avoid establishing multiple crossings of the same water feature where possible.
- Where crossings are required, existing crossings will be preferentially utilised and with agreement of the landholder.
- Be a maximum of 7 m wide.
- Constructed in a manner which will not undermine the existing natural bank stability and positioned so as to minimise potential interruption of low flow conditions and scour or erosion.
- Be at right angles to the water flow.



Riverine materials

Aggregate required for the concrete batching process and other general construction activities would be supplied from the local regions from existing authorised suppliers. The final source of these materials will be subject to further discussions with key stakeholders, including Councils and quarry operators. 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. New sources of aggregate from water features (i.e. riverine material) is not considered under the Project.

Vegetation clearing and earthworks (erosion and sedimentation)

The primary controls to mitigate Project impacts on water quality and water resources associated with vegetation clearing and earthworks are:

- Avoid/minimise vegetation clearing and general land disturbance
- Avoid/minimise construction activities during the wet season where risks are greatest.

Volume 3 Appendix R Field Development Plan prescribes planning and design response for regulated vegetation including that associated with water features (e.g. watercourses and wetlands) which are Class A and Class B environmental constraints for consideration in detailed design.

Riparian areas which are located along the banks of watercourses and mark the transition to from terrestrial to aquatic environments perform an important function in providing bank stability to the watercourse, protecting water quality, habitat connectivity and directing flood flows. Volume 3 Appendix R Field Development Plan lists actions to be reflected in the detailed design of the Project including riparian area clearing restrictions. For simple, single channel watercourses, no clearing of riparian vegetation will occur – the transmission line will span over vegetation. For wider watercourses and multi-channel watercourses, riparian vegetation will be retained where possible by means of spanning over taller vegetation as required. Other infrastructure i.e. Substations, CEV huts and temporary construction camps will not be located with riparian areas. Where clearing is required, vegetation will be felled by hand and be cut as close to the ground as possible to mitigate erosion and sedimentation of waterways.

Construction works are staged and planned for occurrence during the dry season with the construction staging schedule (refer Volume 1 Chapter 2 Project Description) having been developed with reference to the seasonal rainfall anticipated during the summer months. Additionally, rehabilitation will occur progressively as detailed within in Volume 3 Appendix T Concept Rehabilitation Plan to ensure construction areas are closed prior to wet season where erosion and sedimentation risk is greatest. 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.

Topsoil and spoil from project infrastructure including towers will be stockpiled and reused in rehabilitation. Stockpiles will be stabilised or where deemed necessary (dependant on the duration and size of the stockpile) will be protected utilising a range of viable erosion and sediment control devices (may include minor diversion of upslope surface water, sediment fencing, down slope controls), so as to be erosion resistant and not located in or adjacent to drainage lines or areas where eroded material can be transported into surface water bodies.

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 and sedimentation. The CESCP is included in Volume 3 Appendix S Concept Erosion and Sediment Control Plan and has been developed with reference to the International Erosion Control

Association's Best Practice Erosion and Sediment Control and the former Department of Environment and Resource Management's Urban Stormwater Quality Planning Guidelines 2010. Construction contractor will be required to develop site-specific Erosion and Sediment Control Plan (ESCP) once detailed design, construction and site establishment information becomes available. These would be developed to protect relevant environmental values and water quality objectives with reference to relevant water quality guidelines, available background water quality data and site specific sampling as they relate to the corridor selection.

Flooding and stormwater risk

Floodplains are extensive within the corridor selection and transmission towers would be constructed within flood prone areas. The potential impact of flooding can be two-fold:

- Infrastructure associated with the Project can be directly damaged/lost as a result of a flood event. This can indirectly lead to function loss of the transmission line and associated infrastructure, which would reduce capacity on the electrical grid and potentially lead to possible outages of affected communities.
- The Project can contribute cumulatively through catchment alteration such as removal of riparian vegetation, surface hardening, poor stormwater management and associated drainage.

No significant diversion or interception of overland flow will result from the Project. Flood analysis would be required in the detailed design phase to confirm the required flood immunity is provided to infrastructure and in isolated cases where Project infrastructure may change existing flood/stormwater behaviours (e.g. concentration of flows). The latter would only be expected to potentially arise at temporary camps and buildings in proximity to local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure where localised hydrologic and hydraulic modelling and reporting to facilitate approvals would be required.

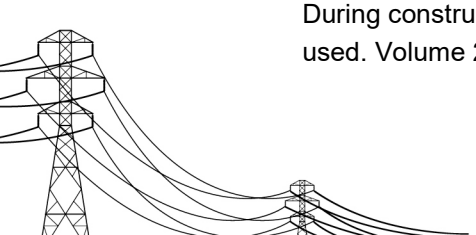
Project infrastructure would be provided with the required flood immunity typically the 1 in 100 to 1 in 200 year flood event depending on infrastructure type and stormwater management controls to mitigate offsite stormwater impacts. These structures will undergo a detailed design process in which these factors are accounted for at an engineering design level.

The transmission tower foundations will be comprised of reinforced concrete. Transmission tower sites that may be subject to inundation from flooding and large rainfall events will utilise concrete sleeves over the base of the footings and foundations to armour the structure and site from erosion or degradation. Transmission line flood clearance criteria are nominally 7.5 m and 8.0 m for 275 kV and 330 kV lines respectively. Volume 3 Appendix H Tower Siting Plans demonstrates conductor line ground clearances based on indicative placement of transmission tower.

Substations would be designed to accommodate stormwater drainage. Drainage work consists of the installation of all drains, pits and culverts necessary to control the flow of stormwater from the substation footprint. Substation platform surface runoff would filter through a crushed rock surface layer and be collected by open drains around the platform perimeter to suitably sized secondary containment ponds. A first flush diversion system would be installed to mitigate the risk of releasing sediments and contaminants from the area. The need for drainage works shall be kept to a minimum to the extent practically possible and care taken also to minimise damage to natural drainage channels and soil erosion.

Accidental spills/release of contaminants

During construction and operation of the Project, a number of hazardous substances will be used. Volume 2 Chapter 17 Hazards, Health and Safety provides an indicative list of the



hazardous substances that will be used, their purpose and approximate quantities to be stored on site inclusive of diesel, unleaded petrol, kerosene or jet fuel, oils, explosives and sulfuric acid and associated management and mitigation measures.

Bulk storage will be primarily at designated laydowns and will be in accordance with current Australian Standards and industry codes of practice. Typical laydown layouts are provided at Volume 3 Appendix I Indicative Infrastructure Layout and Cross-section Drawings which provide for designated storages for various hazardous and nonhazardous substances. Laydowns will also include designated refuelling and washdown areas such that potential contaminating activities and substances are appropriately contained and to prevent unauthorised release to the environment.

Day to day use of substances on work front i.e. refuelling vehicles will be governed by the Volume 3 Appendix Q Framework and Environmental Management Plan in accordance with best practice hazardous substance management procedures inclusive of spill response and recovery. General wash bay design criteria are provided in Volume 3 Appendix U Concept Biosecurity Plan. Herbicide selection and use is discussed in Volume 3 Appendix U Concept Biosecurity Plan

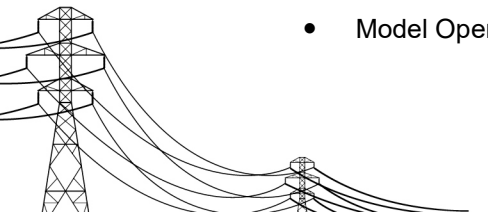
The main power transformers to be installed will be large oil filled static units, with a delivery weight without oil in the order of 65 to 200 t, with oil volumes up to 150 kL for the larger transformers. Transformer installations are designed with oil containment bunds and oil interception systems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

General design response for STPs

Where utilisation of an existing Council operated STP is not available, disposal of treated sewage would be via an irrigation scheme for construction camps. Connection to Council STP would be assessed as part of the construction camp Council approval process and be in general accordance with engineering and development codes as applicable.

Where Council connection is not possible, construction camps would be provided with an STP adequate to meet the loading for each camp. Design of the STP would incorporate meteorological considerations of the region, including rainfall variability, depth to groundwater and buffer distances to watercourses and sensitive receptors. This would be undertaken with reference to the following Standards, Guidelines and Model Operating Conditions depending on the final treatment capacity (i.e. equivalent persons) that would be calculated in accordance with the methodology prescribed in the EP Reg:

- Planning Scheme engineering and development codes
- QPW Code
- Eligibility criteria and standard conditions for sewage treatment works (ERA 63) (ESR/2015/1710)
- Model Operating Conditions ERA 63 - Sewage treatment (ESR/2015/1668).



Where required, an EA would be obtained under Schedule 2 of the EP Reg for standard, variation and/or site specific applications as applicable. Substation sites will have an allowance amenities with greywater and sewage to be managed in accordance with the PD Act which regulates on-site sewage facilities (on-site sewage treatment for less than 21 equivalent persons — i.e. sewage treatment that is not ERA 63) and greywater disposal or use.

General design responses for water utilisation and demand

Potable water for the supply to construction camps and for construction and cleaning purposes would be sourced from existing Council supplies where capacity is available. Further consultation with Council will be required to facilitate subsequent camp and laydown development approvals. As with sewage, connection to Council water supply is preferred and would be assessed as part of the construction camp development approval process and be in general accordance with engineering and development codes as applicable. Alternatively, bulk water supply arrangements from existing Council standpipes will be considered for supply to construction camps and/or for construction and cleaning purposes.

Where access to Council supply is not possible or feasible due to remote locations of camps or construction activities, existing licenced and authorised groundwater reserves will be used in consultation with DNRME and landholders. This would ensure that volumes and quality of groundwater are maintained and current lawful users of water (such as entitlement holders and stock and domestic users) and other beneficial uses of water (such as spring flows and groundwater-dependent ecosystems) are not adversely impacted by the project.

Water would be required to be treated to a potable standard where existing town water supplies are not proposed to be utilised. This would be achieved through the use of a package reverse osmosis plant at the temporary construction camps.

Best practice water saving and recycling would be implemented within construction camp design restricted through deployment of water saving devices such as low flow shower heads and dual flush toilets.

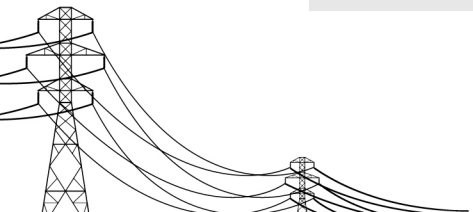
9.4.2 Construction

Potential impacts to water resources and water quality during the construction phase are described in Table 9-11.

Table 9-11 Potential construction phase water resource and water quality impacts

Construction Activities	Associated Potential Impacts
Vegetation clearing and mulching	Erosion and sedimentation from exposed soils due to vegetation clearing causing elevated turbidity and total suspended solids (TSS).
	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.
	High nutrient runoff (i.e. mulch stockpiles leachate) entering surface water features stimulating algae and aquatic plant growth.
	Organic material (e.g. mulch and other cleared vegetation) entering waterways and impacting on water quality (e.g. depletion of dissolved oxygen levels).
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).
Construction and	Erosion and sedimentation from exposed soils/scouring due to access track construction causing elevated turbidity and TSS.

Construction Activities	Associated Potential Impacts
maintenance of access tracks	Surface water contamination from accidental spills/leaks from plant and equipment.
	Modification/removal of surface water feature terrestrial and aquatic fauna habitat due to deposition of sediment as a result of erosion and sedimentation.
	Surface water contamination from poor quality water used in dust suppression.
	Acute and chronic effects on aquatic flora and fauna due to degradation of downstream water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).
Earthworks including stockpiling of soils, use of riverine materials (e.g. aggregate)	Erosion and sedimentation from exposed soils causing elevated turbidity and total suspended solids (TSS) in surface water.
	Modification/removal of surface water feature terrestrial and aquatic fauna habitat due to deposition of sediment as a result of erosion and sedimentation.
	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.
	Surface/groundwater from poor quality water used in dust suppression.
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).
	Extraction and use of surface water feature riverine material affecting existing users' rights.
Construction of towers, substations, CEV huts, etc.	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.
	Surface/groundwater contamination (e.g. pH imbalance) from concrete waste/washouts used in construction of footings.
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).
	Alteration of existing flood/stormwater behaviours (e.g. concentration of flows) impacting local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure.
Temporary camps/laydowns	Erosion and sedimentation from exposed soils causing elevated turbidity and total suspended solids (TSS) in surface water.
	Modification/removal of surface water feature terrestrial and aquatic fauna habitat due to deposition of sediment as a result of erosion and sedimentation.
	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.
	Surface/groundwater contamination from poor quality water used in dust suppression.
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).
	Flood/stormwater damage to temporary camps/laydowns e.g. refuelling, storage, waste, wash bay area resulting in offsite surface water and/or underlying groundwater contamination.
	Alteration of existing flood/stormwater behaviours (e.g. concentration of flows) impacting local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure.



Construction Activities	Associated Potential Impacts
	Surface/groundwater water contamination from improper treated effluent irrigation from construction camp STPs
Surface water use in construction and temporary camps	Altered surface water flow regimes (volumes and quality) for surface water features affecting existing user rights (e.g. local Council and their customers, landholders and industry).
	Altered surface water flow regimes (volumes and quality) for surface water features affecting ecological processes and cultural values (i.e. environmental values and water quality objectives)
Groundwater use in construction and temporary camps	Altered groundwater flow regimes (volumes and quality) for aquifers affecting existing user rights (e.g. local Council and their customers, landholders and industry).
	Altered groundwater flow regimes (volumes and quality) for aquifers affecting ecological processes and cultural values (i.e. environmental values and water quality objectives).

Note: All project works are to occur greater than 20 m AHD therefore risk of encountering acid sulfate soils is considered negligible and not discussed further as a potential impact. Refer to Volume 2 Chapter 6 Geology and Soils for further details on acid sulfate soils and management for unexpected occurrences.

9.4.3 Operations, maintenance and decommissioning

The majority of impacts relating to water resources and water quality have potential to occur during the construction phase of the Project. Operations and maintenance activities will generally be limited to vegetation management, access track maintenance and life cycle replacement. 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 also be removed, and the steel transported for recycling. Footings would be cut off, typically about 300 mm to 1 m below ground level, with the lower end of the footing remaining in place. Construction phase impacts described in 9.4.2 would generally apply to operations, maintenance and decommissioning activities though at a reduced scale.

The main potential impacts associated with Project operations would be associated with substation sites addressed through appropriate stormwater/flooding design controls. Potential impacts to water resources and water quality during the operations phase are described in Table 9-12.

Table 9-12 Potential operations phase water resource and water quality impacts

Construction Activities	Associated Potential Impacts
Project infrastructure including towers, CEV huts and substations	Alteration of existing flood/stormwater behaviours (e.g. concentration of flows) impacting local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure.
	Flood/stormwater damage to Project infrastructure resulting in damage to surface water features (scour of bed and banks).
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).
	Inadequate management and disposal of Substation seepage and greywater resulting in offsite surface water and/or underlying groundwater contamination.

Construction Activities	Associated Potential Impacts
Substations	Flood/stormwater damage to Project infrastructure including substation (oil and fire response) resulting in localised offsite surface water and/or underlying groundwater contamination.
	Inadequate management and disposal of Substation sewage and greywater resulting in offsite surface water and/or underlying groundwater contamination.

9.4.4 Summary of mitigation and management measures

Table 9-13 summarises mitigation and management measures proposed to manage potential impacts to water resources and water quality. Refer to Appendix Q Framework and Environmental Management Plan for additional monitoring responsibilities and requirements for each Project phase. Primary planning and design response controls described in 9.4.1 that will avoid/minimise impacts to water resources and water quality are also summarised here.

Table 9-13 Summary of mitigation and management measures

Timing	Mitigation and Management Measures
Planning and design	Final transmission tower sites will be determined after careful consideration of all physical constraints including water features.
	Transmission towers and associated infrastructure will be located outside of active water features as far as practicable.
	Where the corridor selection crosses large braided ephemeral systems tower sites will be individually selected to avoid existing channels.
	New on-easement and off-easement access tracks will be selected to avoid establishing multiple crossings of the same water feature where possible.
	Where crossings are required, existing crossings will be preferentially utilised and with agreement of the landholder. The construction of watercourse and waterway crossings will be scheduled during dry or low flow periods, where practicable.
	Final design will be undertaken to avoid/minimise vegetation clearing and general land disturbance. Vegetation including that associated with water features (e.g. watercourses and wetlands) which are Class A and Class B environmental constraints for consideration in detailed design (refer Volume 3 Appendix R Field Development Plan)
	For simple, single channel watercourses, no clearing of riparian vegetation will occur - the transmission line will span over vegetation. For wider watercourses and multi-channel watercourses, riparian vegetation will be retained where possible by means of spanning over taller vegetation as required.
	Construction works will be staged and planned for occurrence during the dry season with the construction staging schedule (refer Volume 1 Chapter 2 Project Description) having been developed with reference to the seasonal rainfall anticipated during the summer months.
	Detailed flood analysis will be completed in the detailed design phase to confirm the required flood immunity/protection is provided to all Project infrastructure.
	Where Project infrastructure may change existing flood/stormwater behaviours (e.g. concentration of flows) and impact local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure, localised hydrologic and hydraulic modelling and reporting will be completed during detailed design to facilitate secondary approvals.
	Project infrastructure will be provided with the required flood immunity typically the 1 in 100 to 1 in 200 year flood event depending on

Timing	Mitigation and Management Measures
	infrastructure type. Transmission line flood clearance criteria will be nominally 7.5 m and 8.0 m for 275 kV and 330 kV lines respectively.
	Project infrastructure will be provided with the required stormwater management controls to mitigate offsite stormwater impacts inclusive of first flush systems where required.
	Transformer installations will be 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 significant environmental risk. This will be further investigated during the detailed design phase.
	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. This will be further investigated during the detailed design phase.
	Connection existing Council operated STPs will be preferred. This will be confirmed with Councils during the detailed design phase. Where this is not possible, construction camps will be provided with an STP adequate to meet the loading for each camp
	Design of STPs will incorporate meteorological considerations of the region, including rainfall variability, depth to groundwater and buffer distances to watercourses and sensitive receptors. This would be undertaken with reference to the contemporary Standards, Guidelines and Model Operating Conditions. Where required, an EA will be obtained under Schedule 2 of the EP Reg for standard, variation and/or site specific applications as applicable.
	Substation amenities will be designed in accordance with the PD Act for on-site sewage facilities and greywater disposal or use (where less than 21 EP).
	Potable water for the supply to construction camps and for construction and cleaning purposes will be sourced from existing Council supplies where capacity is available. Further consultation with Councils will be undertaken during the detailed design phase.
	Where access to Council supply is not possible or feasible due to remote locations of camps or construction activities, existing licenced and authorised groundwater reserves will be used in consultation with DNRME and landholders. Further consultation will be undertaken during the detailed design phase. Prior to using an existing bore, undertake investigations to confirm adequate yield available for existing and proposed construction use. If required under licence or authorisation, monitoring will be undertaken to confirm draw down will not impact on existing entitlements or environmental values and water quality objectives.
	Best practice water saving and recycling will be implemented within construction camp design restricted through deployment of water saving devices such as low flow shower heads, dual flush toilets, etc
Construction and operations	Construction phase and permanent tracks will be constructed to meet DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works relevant to the specific waterway barrier works category.
	The route used by machinery in and out of the work sites on watercourses and waterways will be controlled and the need for access of heavy machinery to the bed of the watercourse or waterway will be avoided, where safe to do so. Works will be undertaken from the top of watercourse and waterway banks where possible.

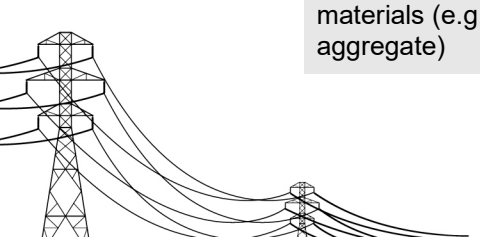
Timing	Mitigation and Management Measures
	Aggregate required for construction activities will be supplied from the local regions from existing authorised suppliers
	All work will minimise disturbance to the natural ground cover to reduce the potential for erosion and sedimentation. Volume 3 Appendix S Concept Erosion and Sediment Control Plan will be used as a guide by the Construction Contractor to develop site-specific ESCP(s) once detailed design, construction and site establishment information becomes available. These will be developed to protect relevant environmental values and water quality objectives with reference to relevant water quality guidelines, available background water quality data and site specific sampling as they relate to the corridor selection.
	Clean construction camp/laydown stormwater captured on site will be reused for irrigation, dust suppression or passed through appropriately sized sediment basins before being discharged. Dirty water captured in first flush/sumps/washdowns will not be used in for irrigation or dust suppression unless passed through appropriate treatment facilities and tested prior to reuse or disposed offsite as regulated waste.
	Any timber felled will not be allowed to impact on the flow of water. For major crossings, draw-wire pull cables would be strung using helicopters to minimise impact to the riparian vegetation.
	Where other localised riparian vegetation clearing is required, vegetation will be felled by hand and be cut as close to the ground as possible to mitigate erosion and sedimentation. Vegetation stockpiles will not be located in or adjacent to drainage lines or areas where eroded material can be transported into surface water features. .
	Rehabilitation will occur progressively as detailed within in Volume 3 Appendix T Concept Rehabilitation Plan to ensure construction areas are closed prior to wet season where erosion and sedimentation risk is greatest as far as practicable
	Stockpiles will be stabilised or where deemed necessary (dependant on the duration and size of the stockpile) will be protected viable erosion and sediment control techniques (may include minor diversion of upslope surface water, sediment fencing, down slope controls), so as to be erosion resistant.
	Stockpiles will not be located in or adjacent to drainage lines or areas where eroded material can be transported into surface water bodies.
	Bulk hazardous material storage will be at designated laydowns and will be in accordance with current Australian Standards and industry codes of practice
	Laydowns will include designated refuelling and washdown areas such that potential contaminating activities and substances are appropriately contained and to prevent unauthorised release to the environment. General wash bay design criteria are provided in Volume 3 Appendix U Concept Biosecurity Plan.
	Day to day fuels, chemicals, wastes and other potentially environmentally hazardous substances will be stored away from surface water features.
	Mobile refuelling will take place away from watercourses and waterways. Spill kits will be available during refuelling. Portable bunds for refuelling will be used in the field.
	Plant and equipment will be regularly inspected and checked for oil leaks in accordance with daily, weekly, monthly inspection checklists (as applicable).
	Plant and equipment will be regularly maintained in accordance with manufacturers specifications.
	Emergency response protocols and procedures for implementation in the event of a contaminant spill or leak will be developed. Personnel will be appropriately trained in their implementation and use of associated equipment.

Timing	Mitigation and Management Measures
Operations	Vegetation will be managed to ensure adequate clearances to transmission lines is provided in accordance with contemporary industry standards. 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 bushfire by removing fuel build up.

Table 9-14 summarises potential construction phase impacts to water resources and water quality including unmitigated and mitigated risk ratings.

Table 9-14 Construction phase risk assessment summary

Construction Activities	Associated Potential Impacts	Unmitigated Risk Rating	Mitigated Risk Rating
Vegetation clearing and mulching	Erosion and sedimentation from exposed soils due to vegetation clearing causing elevated turbidity and total suspended solids (TSS).	Moderate	Low
	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.	Moderate	Low
	High nutrient runoff (i.e. mulch stockpiles leachate) entering surface water features stimulating algae and aquatic plant growth.	Moderate	Low
	Organic material (e.g. mulch and other cleared vegetation) entering waterways and impacting on water quality (e.g. depletion of dissolved oxygen levels).	Moderate	Low
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).	Moderate	Low
Construction and maintenance of access tracks	Erosion and sedimentation from exposed soils/scouring due to access track construction causing elevated turbidity and TSS.	Moderate	Low
	Surface water contamination from accidental spills/leaks from plant and equipment.	Moderate	Low
	Modification/removal of surface water feature terrestrial and aquatic fauna habitat due to deposition of sediment as a result of erosion and sedimentation.	Moderate	Low
	Surface water contamination from poor quality water used in dust suppression.	Low	Low
	Acute and chronic effects on aquatic flora and fauna due to degradation of downstream water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).	Moderate	Low
Earthworks including stockpiling of soils, use of riverine materials (e.g. aggregate)	Erosion and sedimentation from exposed soils causing elevated turbidity and total suspended solids (TSS) in surface water.	Moderate	Low
	Modification/removal of surface water feature terrestrial and aquatic fauna habitat due to deposition of sediment as a result of erosion and sedimentation.	Moderate	Low



Construction Activities	Associated Potential Impacts	Unmitigated Risk Rating	Mitigated Risk Rating
	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.	Low	Low
	Surface/groundwater from poor quality water used in dust suppression.	Low	Low
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).	Moderate	Low
	Extraction and use of surface water feature riverine material affecting existing users' rights.	Moderate	Low
Construction of towers, substations, CEV huts, etc.	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.	Low	Low
	Surface/groundwater contamination (e.g. pH imbalance) from concrete waste/washouts used in construction of footings.	Moderate	Low
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).	Moderate	Low
	Alteration of existing flood/stormwater behaviours (e.g. concentration of flows) impacting local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure.	Moderate	Low
Temporary camps/ laydowns	Erosion and sedimentation from exposed soils causing elevated turbidity and total suspended solids (TSS) in surface water.	Moderate	Low
	Modification/removal of surface water feature terrestrial and aquatic fauna habitat due to deposition of sediment as a result of erosion and sedimentation.	Moderate	Low
	Surface/groundwater contamination from accidental spills/leaks from plant and equipment.	Low	Low
	Surface/groundwater contamination from poor quality water used in dust suppression.	Low	Low
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).	Moderate	Low
	Flood/stormwater damage to temporary camps/laydowns e.g. refuelling, storage, waste, wash bay area resulting in offsite surface water and/or underlying groundwater contamination.	High	Low

Construction Activities	Associated Potential Impacts	Unmitigated Risk Rating	Mitigated Risk Rating
	Alteration of existing flood/stormwater behaviours (e.g. concentration of flows) impacting local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure.	Moderate	Low
	Surface/groundwater water contamination from improper treated effluent irrigation from construction camp STPs	Moderate	Low
Surface water use in construction and temporary camps	Altered surface water flow regimes (volumes and quality) for surface water features affecting existing user rights (e.g. local Council and their customers, landholders and industry).	Low	Low
	Altered surface water flow regimes (volumes and quality) for surface water features affecting ecological processes and cultural values (i.e. environmental values and water quality objectives)	Low	Low
Groundwater use in construction and temporary camps	Altered groundwater flow regimes (volumes and quality) for aquifers affecting existing user rights (e.g. local Council and their customers, landholders and industry).	Moderate	Low
	Altered groundwater flow regimes (volumes and quality) for aquifers affecting ecological processes and cultural values (i.e. environmental values and water quality objectives).	Moderate	Low

Table 9-15 summarises potential operational phase impacts to water resources and water quality including unmitigated and mitigated risk ratings.

Table 9-15 Operational phase risk assessment summary

Construction Activities	Associated Potential Impacts	Unmitigated Risk rating	Mitigated Risk Rating
Project infrastructure including towers, CEV huts and substations	Alteration of existing flood/stormwater behaviours (e.g. concentration of flows) impacting local or State controlled roads and railways or other adjoining properties and their buildings and infrastructure.	Moderate	Low
	Flood/stormwater damage to Project infrastructure resulting in damage to surface water features (scour of bed and banks).	Moderate	Low
	Acute and chronic effects on terrestrial and aquatic flora and fauna due to degradation of downstream or underling water quality (e.g. elevated turbidity, contaminants) (i.e. environmental values and water quality objectives).	Moderate	Low
Substations	Flood/stormwater damage to Project infrastructure including substation (oil and fire response) resulting in localised offsite surface water and/or underlying groundwater contamination.	High	Low
	Inadequate management and disposal of Substation sewage and greywater resulting	Moderate	Low

Construction Activities	Associated Potential Impacts	Unmitigated Risk rating	Mitigated Risk Rating
	in offsite surface water and/or underlying groundwater contamination.		

9.5 Conclusions

The Project traverses a number of important water features in central and northern Queensland providing aquatic and human use environmental values. 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. The majority of impacts relating to water resources and water quality have potential to occur during the construction phase of the Project. Operations and maintenance activities will generally be limited to vegetation management, access track maintenance and life cycle replacement.

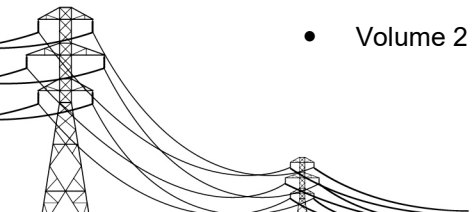
Commitments to manage potential impacts to water resources and water quality can be generally summarised as follows:

- Careful consideration of site constraints and placement of towers and associated infrastructure to avoid/minimise direct disturbance to water features.
- Utilise existing access tracks wherever possible for access to the Project and when crossing waterways comply with DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works.
- Use existing licensed and authorised sources of construction material (e.g. aggregate) from local suppliers.
- Implement best practice erosion and sediment controls during construction.
- Design temporary and permanent infrastructure with industry standard stormwater management controls.
- Locate infrastructure away from flood prone areas where practicable or provide appropriate flood immunity.
- Utilise existing licenced and authorised water sources during construction in consultation with Council, DNRME and landholders.
- Transport, store, use and dispose potentially contaminating substances in accordance with manufactures specifications, legislative requirements and industry best practice.
- Design, construct, operate and decommission STPs in accordance with manufactures specifications, legislative requirements and industry best practice.

Planning and design response measures will provide the greatest benefit to Project impact mitigation. These will require further refinement through completion of technical studies such as flood modelling during the detailed design phase and further consultation with key stakeholders including Council, State Government departments and landholders will be undertaken at this stage. Indicative layouts and siting plans for temporary and operational phase infrastructure is provided in Volume 3 Appendix I Indicative Infrastructure Layout and Cross-section Drawings and Volume 3 Appendix H Tower Siting Plans.

Construction phase controls will be best practice with key commitments addressing identified impacts listed herein. These will require further consideration and refinement by the Construction Contractor following completion of detailed design phase. Key reference documentation in this regard includes:

- Volume 2 Chapter 12 Waste Management



- Volume 3 Appendix Q Framework and Environmental Management Plan
- Volume 3 Appendix S Concept Erosion and Sediment Control Plan
- Volume 3 Appendix T Concept Rehabilitation Plan
- Volume 3 Appendix U Concept Biosecurity Plan.

Based on the risk assessment completed within this chapter, it is expected that potential impacts of the construction and operation of the proposed project will be minimal, provided that the recommended mitigation measures are implemented during all phases of the Project.