HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

G2 Surface Water

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Hancock Prospecting Pty Ltd

Alpha Coal Project (Rail)

Surface Water

September 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Glossary of Terms

BFD	Burdekin Falls Dam
BHWSS	Burdekin-Haughton Water Supply Scheme
BoM	Bureau of Meteorology
BROP	Burdekin Resource Operations Plan 2009
COAG	Council of Australian Government
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEWHA	Department of the Environment, Water, Heritage and the Arts
DEM	Digital Elevation Model
DERM	Department of Environment and Resources Management
EPA	Environmental Protection Agency
EIS	Environmental Impact Statement
EV	Environmental Values
EPP Water	Environmental Protection (Water) Policy 2009
GIS	Geographic Information System
GBRWHA	Great Barrier Reef World Heritage Area
GHD Pty Ltd	Gutteridge Hasking and Davey
HPPL	Hancock Prospecting Pty Ltd
TSPP	Temporary State Planning Policy

1. Introduction

1.1 Project background

This section describes the existing environment for water resources that may be affected by the Alpha Coal Project (Rail) (herein referred to as the Project) in the context of environmental values as defined in such documents as the *Environmental Protection Act 1994, Environmental Protection (Water) Policy 2009* [EPP (Water)], ANZECC 2000, the National Water Quality Management Strategy (NWQMS), the EPA Guideline: Establishing draft environmental values and water quality objectives and the Queensland Water Quality Guidelines 2006. The definition of waters in the EPP (Water) includes the bed and banks of waters, so this section should address impacts on benthic environment, as well as the water column.

1.2 Scope of the study

GHD has been commissioned by Hancock Prospecting Pty Ltd (HPPL) to undertake an Environmental Impact Statement (EIS) for the Project. It is a requirement of the Project Terms of Reference (TOR) to investigate the potential impacts of the Project upon surface water and to prescribe corresponding mitigation measures. As such, this report aims to investigate the surface water values of the Project study area. This involves the following:

- Describing the environmental values of the surface water systems;
- Identifying water use in the study area;
- Identifying potential impacts of the project on surface water systems; and
- Describing relevant mitigation and management strategies for protecting the environmental values and water users.

1.3 Study Area and Project Footprint

The current Project corridor runs from the Alpha Coal Mine, 38 km northwest of the Township of Alpha, and ends at the Port of Abbot Point coal export terminal, 25 km north of Bowen. Through an initial assessment, pre-feasibility study and structural engineering studies the preferred railway alignment was determined. The current EIS alignment avoids all Reserves, National Parks and State Forests and minimises the potential for sterilisation of other resource areas. For further information regarding the railway option refinement refer to Volume 3, Section 2.3.4 of this EIS.

The current EIS alignment includes 495 km of greenfield railway, extending from the Alpha Coal Mine in a north-easterly direction to Eaglefield and Newlands. It then runs adjacent to the existing QR Newlands line to join the Abbot Point rail corridor. The final approach to the Port of Abbot Point would be on a greenfield track. The total length of the Project corridor is 495 km.

For the purposes of this assessment, the Project footprint comprised of:

- an easement of 495 km long and 500 m[1] wide;
- a series of laydown areas and construction nodes;
- local construction access tracks (that will be used during construction only); and
- local maintenance access tracks (that will be used and maintained through the operational phase).

For the purposes of this assessment, the *study area* refers to all waterways and related catchments that are intersected by the Project, both upstream and downstream.

1.4 Methodology

The study area was identified using topographic information sources showing elevation data and waterways. Elevation data [25 meter intervals] was used to create a Digital Elevation Model (DEM) and to identify waterways. All surface waterway intersections with the Project alignment were determined. Each crossing was given a crossing ID numbered sequentially from South to North (from Alpha to Abbott Point) along the rail alignment. For all waterway crossings the upstream catchment area and the stream order were determined. Results were used to classify each catchment as shown in table 1. Noted is that the alignment for the Project used concerns draft alignment number 6 dated May 2010. By the end of July alignment 9 was the latest alignment. No recalculations have been executed since the differences in the alignment will not lead to different outcomes of the assessment. To show the differences in the alignments both are included in drawings.

Table 1 Waterway Classification

Waterway Classification	Catchment Area (ha)	Stream Order	Channel Definition
Major Waterway	> 2,000	Third order and higher	Defined channel > 10 m wide
Moderate Waterway	500 to 2,000	Second to third order	Defined channel 5 to 10 m wide
Minor Waterway	100 to 500	First to second order	Defined channel < 5 m wide
Drainage Line	< 100	Unmapped to first order	No defined channel

Results of the waterway classification are presented in Appendix A and B.

[1] A 60m wide corridor will be required for the construction of the Project so as to accommodate for all access tracks and supporting construction infrastructure. For only the purposes of this assessment a 500m corridor was used. This corridor width allows for a more accurate assessment of the surface water.

The waterway classification was used to determine the locations of the preferred waterway crossing for inspection during a field inspection. The inspection locations were further specified by accessibility (physical and land access permission). Twenty two field assessment sites were selected. The objective of the site assessment was to assess the potential impact of construction and operation of the Project on waterway stability.

The field investigation was undertaken between 15 and 21 April 2010. The timing of the field assessments are considered to represent post wet season conditions. This period is considered to deliver the best physical evidence of waterway instability.

Rrecorded key information concerning the morphology of each waterway includes:

- Channel dimensions;
- Bed substrate;
- Channel (bed) stability;
- Bank stability;
- Adjoining land use;
- In-stream features;
- Features indicative of flow levels (eg debris); and
- Contextual notes.

Results of the site assessment are included in Appendix C.

Waterways to be intercepted were identified, and catchments delineated. The Rational method was used to determine flood peaks in each catchment depending on the size of the sub catchment. Culvert design to convey flood events was not undertaken since the alignment used was a draft and actual culvert design is considered to be part of later project phases.

A desktop study was executed to collect and process all available data. Results of the field assessment and the desktop study were combined and processed together with GHDs technical and local topographic knowledge of the aspects of the study area. All data sources are listed in the References.

2. Surface Water Legislation and Guidelines

An array of legislation and guidelines are relevant for the Burdekin and Don River basins. It would exceed the scope of this study to describe them all. Therefore only the most relevant are included in the sections below.

2.1 Water Act 2000

The *Water Act 2000* (WA) defines a watercourse as:

- *River, creek or stream in which water flows permanently or intermittently in a natural channel, whether artificially improved or not;*
- *Or in an artificial channel that has changed the course of the watercourse. It also includes the bed and banks and any other element of a river, creek or stream confining or containing water*.

Based on this definition, all surface water confined within a channel that will be crossed by the Project alignment falls under this definition.

The WA has been developed to fulfil Queensland's responsibilities under the 1994 Water Resources Policy of the Council of Australian Government (COAG). It aims to address legislative requirements for the majority of Queensland's non tidal waters. The WA basically sets out the law with respect to rights to surface and groundwater; also the control of works with respect to surface and groundwater conservation and protection; and irrigation, water supply, drainage and flood control.

The WA will require HPPL to obtain the relevant approval/licence for any works which may affect surface and groundwater. The following permits may be required under relevant sections of the WA:

- Section 237 – taking water from a watercourse, lake, spring or underground water source;
- Section 286 – destroy vegetation, place fill or excavate in a watercourse (Riverine Protection Permit); and
- Section 280 – taking, getting, removing or otherwise interfering with quarry material in or from a watercourse or lake.

2.2 Sustainable Planning Act 2009

The purpose of the *Sustainable Planning Act 2009* (SPA) is to seek to achieve ecological sustainability by:

a) *Managing the process by which development takes place, including ensuring the process is accountable, effective and efficient and delivers sustainable outcomes; and*

b) *Managing the effects of development on the environment, including managing the use of premises; and*

c) *Continuing the coordination and integration of planning at the local, regional and State levels.*

Advancing SPA's purpose includes ensuring the sustainable use of renewable natural resources and the prudent use of non-renewable natural resources by, for example, considering alternatives to the use of non-renewable natural resources.

The definition of natural resources used within the SPA includes water resources that are important to economic development because of their contribution to employment generation and wealth creation.

The SPA will be applicable to the delivery of the study objectives.

2.3 Environmental Protection (Water) Policy 2009

The Environmental Protection (Water) Policy 2009 (EPP Water) identifies Environmental values and water quality objectives for waters within Queensland. The EPP Water serves to protect Queensland's environment while allowing for ecologically sustainable development. The policy provides a framework for (Part 2, Section 6):

a) identifying environmental values for Queensland waters; and

b) deciding and stating water quality guidelines and objectives to enhance or protect the environmental values; and

c) making consistent and equitable decisions about Queensland waters that promote efficient use of resources and best practice environmental management; and

d) involving the community through consultation and education, and promoting community responsibility.

Part 3, section 7, sub-section 1 of the policy states: The "environmental values" of waters to be enhanced or protected under this policy are:

a) for a water in schedule 1, column 1—the environmental values stated in the document opposite the water in schedule 1, column 2; or

b) for another water—the qualities in subsection (2).

Part 3 section 7, Sub-section 2: the qualities are:

a) if the water:

    i) is a pristine water - biological integrity of a pristine aquatic ecosystem; or

    ii) is not a pristine water - biological integrity of a modified aquatic ecosystem; and

b) suitability for recreational use; and

c) suitability for minimal treatment before supply as drinking water; and

d) suitability for agricultural use; and

e) suitability for industrial use.

Part 3 section 7, Sub-section 3: However, if a natural property of the water precludes enhancement or protection of a particular environmental value, subsection (1)(b) does not apply to the value.

Part 3 section 7, Sub-section 4: For subsection (1)(a), a document is taken to state environmental values for a water if it states 1 or more values (however described) that are equivalent to a quality or qualities in subsection (2).

2.4 Great Barrier Reef World Heritage Area

The waterways of the Burdekin Basin and Don River Basin drain into the Great Barrier Reef World Heritage Area (GBRWHA). The significance of the GBRWHA is recognized by its World Heritage listing but also includes Marine Parks, Fish Habitat Areas and Dugong Protection Areas. One of the main threats to the GBRWHA concerns water quality. To address issues of water quality the Reef Water Quality Protection Plan has been endorsed.

The immediate goal of the Reef Plan is to halt and reverse the decline in water quality entering the Reef by 2013. Currently land derived contaminants, including suspended sediments, nutrients and pesticides are still present in the Reef at concentrations likely to cause environmental harm. In 2007, an estimated 6.6 million tonnes of sediment reached the waters of the Reef lagoon (Reef Plan 2009). The Burdekin catchment is the largest single source of sediment to the Great Barrier Reef lagoon. Annual sediment discharge from the catchment is estimated to range between 0.2 and 20 million tonnes, with the average being 3.8 million tonnes.

Major sediment discharges are associated with extreme rainfall events during cyclones and only occur every 5-10 years. Sediment plumes from such events may be dispersed as far north as Cairns (CSIRO 2002). Considering this Sediment and run-off will therefore require careful consideration within the water resource and water quality aspects of the Project.

2.5 Water Resource (Burdekin Basin) Plan 2007

The *Water Resource (Burdekin Basin) Plan 2007* has the following purposes:

- to define the availability of water in the plan area;
- to provide a framework for sustainably managing water and the taking of water;
- to identify priorities and mechanisms for dealing with future water requirements;
- to provide a framework for establishing water allocations;
- to provide a framework for reversing, where practicable, degradation that has occurred in natural ecosystems;
- to regulate the taking of overland flow water.

The plan applies to:

- water in a watercourse or lake; and
- water in springs; and
- overland flow water.

By prescribing ways of sustainable water management the plan is relevant for the Project.

2.6 Burdekin Resource Operation Plan

The Burdekin Resource Operations Plan 2009 (BROP) implements the provisions made by the *Water Resource (Burdekin Basin) Plan 2007 (WRP)*. BROP implements the WRP by specifying rules and operational requirements for managing surface water resources in:

- the Burdekin Haughton and Bowen Broken water supply schemes;
- the Lower Burdekin, Haughton and Bowen River water management areas; and
- other areas within the Burdekin Basin

The BROP sets out rules that guide supplemented water management in the two water supply schemes, flow access rules and volumetric limits for un-supplemented water, and how water allocations can be traded and changed in other ways.

The BROP also implements strategies to support a range of ecological outcomes and the water and ecosystem monitoring requirements that will be used to assess the effectiveness of the implemented WRP.

2.7 Temporary State Planning Policy 1/10 Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments

The Strategy for the conservation and management of Queensland's wetlands 1999 (EPA 1999) lists all the major legislation or agreements applicable for Wetlands.

Together with international agreements more than 50 pieces of legislations and agreements are applicable at the time. It would exceed the scope of this study to describe them all. Therefore only the latest Temporary State Planning Policy (TSPP), effective since 2 May 2010, is described. The temporary State Planning Policy: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments (SPP) is intended to be replaced by a permanent SPP in future.

The TSPP supports the objective of the *Environmental Protection Act 1994* and existing related policies under other legislation, including the:

- *Vegetation Management Act 1999;*
- *Water Act 2000;*
- *Fisheries Act 1994;*
- *Coastal Protection and Management Act 1995;* and
- *Sustainable Planning Act 2009*.

The policy outcome sought by the State Planning Policy can be stated as follows: Development in or adjacent to wetlands of high ecological significance in Great Barrier Reef catchments is planned, designed, constructed and operated to minimise or prevent the loss or degradation of the wetlands and their values, or enhances these values.

Wetlands are considered crucial for the economic productivity of the state as they provide breeding grounds for fish and other native and migratory animal species; provide natural protection against storm tides and cyclones; act as kidneys and filter pollutants from fluvial water and are an essential component of the water cycle. Further loss or degradation of coastal wetlands is to be avoided and impacts of coastal wetlands prevented, minimized or mitigated (in order of preference) (EPA 1999).

Developments, like this Project, that have the potential to cause loss or degradation of wetlands, introduce pollutants and nutrients to wetlands, or changes the natural water regimes of wetlands are subject to the TSPP.

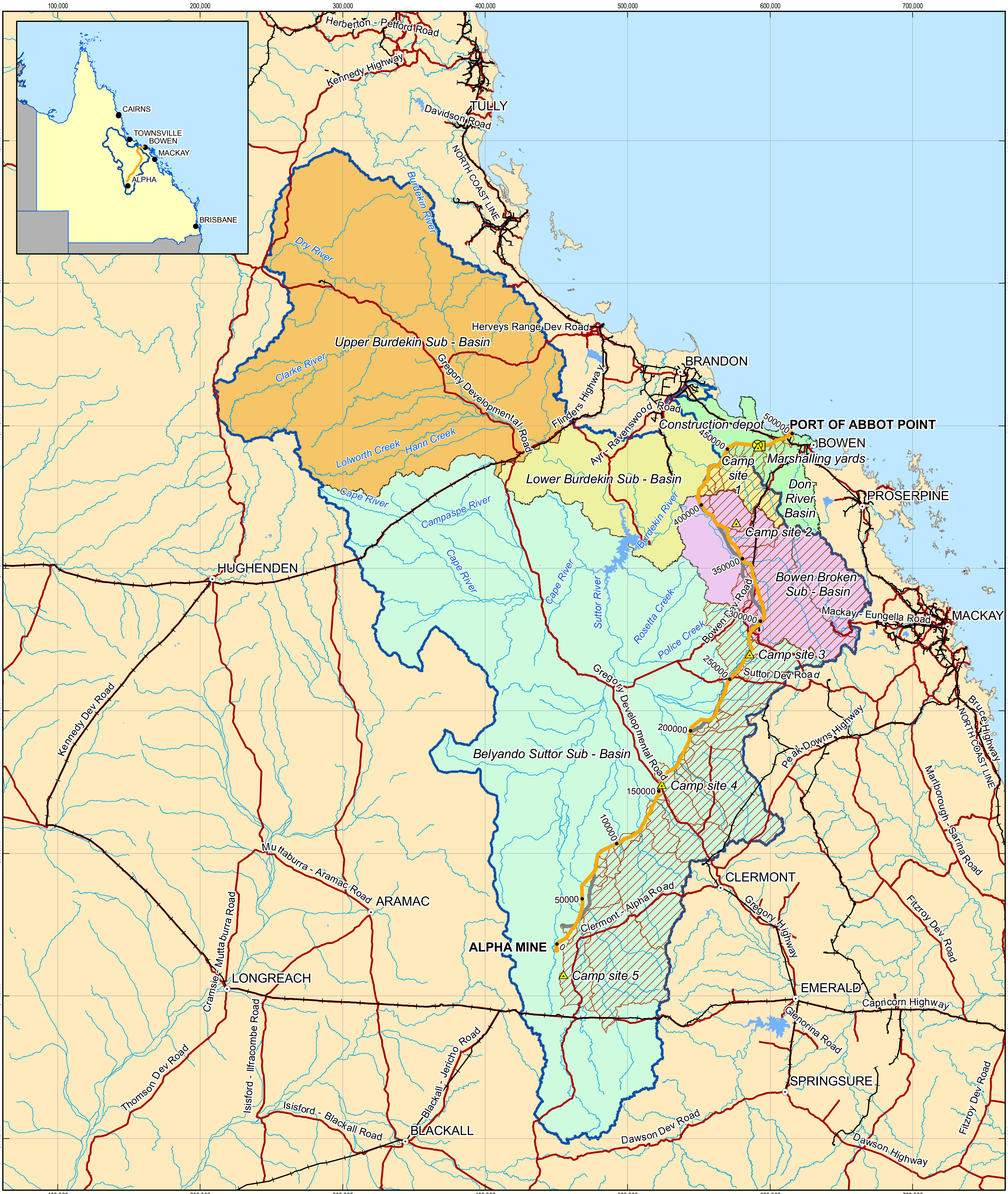
3. Description of Environmental values

3.1 Introduction

The majority of the rail corridor is located within the approximately 130,000 km^2 Burdekin Basin catchment. The Northern part of the rail corridor is located within the much smaller Don River catchment (3,885 km^2). The Burdekin Basin catchment is divided in six sub-catchments or sub-basins, of which the alignment crosses the following three sub-basins:

- Belyando Suttor sub-basin;
- Bowen Broken sub-basin; and
- Lower Burdekin sub-basin.

Due to distinctive differences in their general characteristics relevant environmental aspects are described for each of these sub-basins and the Don River Basin separately. Figure 1 shows the sub-basins of the Burdekin River.



LEGEND

Town	Proposed Alignment (Version 9)	Waterbody	Don River Basin	Lower Burdekin Sub Basin
Camp	Proposed Alignment (Version 6)	Subcatchment (Derived for Project)	Belyando Suttor Sub Basin	Upper Burdekin Sub Basin
Marshalling Yards	State Road	Burdekin River Basin	Bowen Broken Sub Basin	
Depot	Existing Railway			
	Watercourse			

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1:2,500,000 (at A3)

0 50 100

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Alpha Coal Project
Environmental Impact Statement

BURDEKIN BASIN - SUBCATCHMENTS

Job Number 41-22090
Revision A
Date 09-08-2010

Figure: 1

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The Belyando River rises just west of Emerald and flows northwards till it crosses the Suttor River. From the confluence (just upstream of the intersection with the Gregory Development Road) the river continues as the Suttor River, which flows into the Burdekin Falls Dam (BFD). The Burdekin River continues north-eastwards to the Gorge Weir and the Blue Valley Weir. At the Blue Valley Weir the Bowen River, coming from the south, joins with the Burdekin River and continues towards the coast in a north-eastward direction.

Table 2 shows an overview of the sub-catchments and their major tributaries and streams.

Table 2 Burdekin Sub-catchments and major tributaries and streams

Sub-catchment	Major tributaries and streams
Belyando/Suttor	Belyando, Cape, Suttor, and Rollston Rivers, Mistake, Diamond and Logan Creeks.
Bowen/Broken	Bowen and Broken Rivers, Pelican Creek. Lower Burdekin
Lower Burdekin	Bogie, Burdekin
Don River	Haughton, Don and Elliot Rivers, Majors Creek

3.2 Wetlands

Within the Burdekin Basin and Don Basin several wetlands can be found. Wetlands in the vicinity or downstream of the Project alignment are mentioned and described in the following sections that describe each of the sub-basins. For all wetlands the most pressing problem for conservation is to redress the continuing loss and degradation resulting mainly from localised land-use decisions associated with rural, urban and industrial developments and accompanying land management practices. Common forms of disturbance include alterations to water regime and water chemistry, siltation and weed invasions.

Special attention has been given to the Calley Valley wetland that the Project alignment will have to cross (refer to Section 3.7.1). Because of the national importance of the wetland HPPL decided to create a hydrologic model to detail any surface water (including storm tide aspects) related consequences. The modeling exercise has been separately reported.

3.3 Belyando and Suttor sub-basins

3.3.1 Characteristics

The majority of the rail corridor is located within the Belyando (35,000 km^2) and Suttor sub-basins (approximately 18,000 km^2). See figure 3 Belyando and Suttor sub-basins. The Belyando and Suttor sub-basins represent a dry, variable and typically semi-arid landscape producing markedly seasonal stream flow and contributing comparatively less to the overall discharge from the Burdekin Basin than other sub-basins within the basin. It is not uncommon for more than 80% of the annual stream flow of the waterways in the Belyando/Suttor sub-basins to occur between December and April, with no flow between May and November.

Stream flow data (DERM online) from Belyando River at Gregory Development Road confirm the above mentioned rainfall pattern (refer to Figure 2).

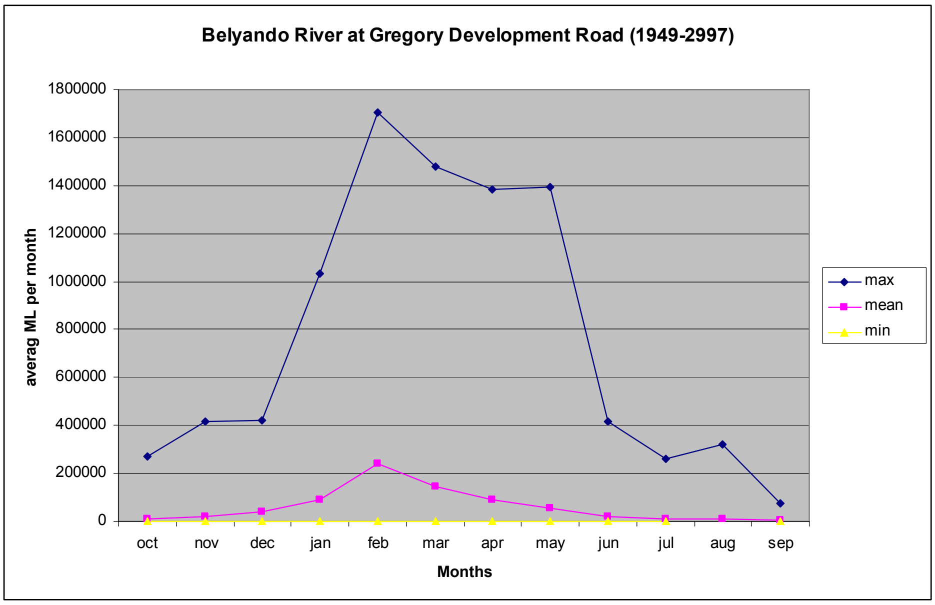
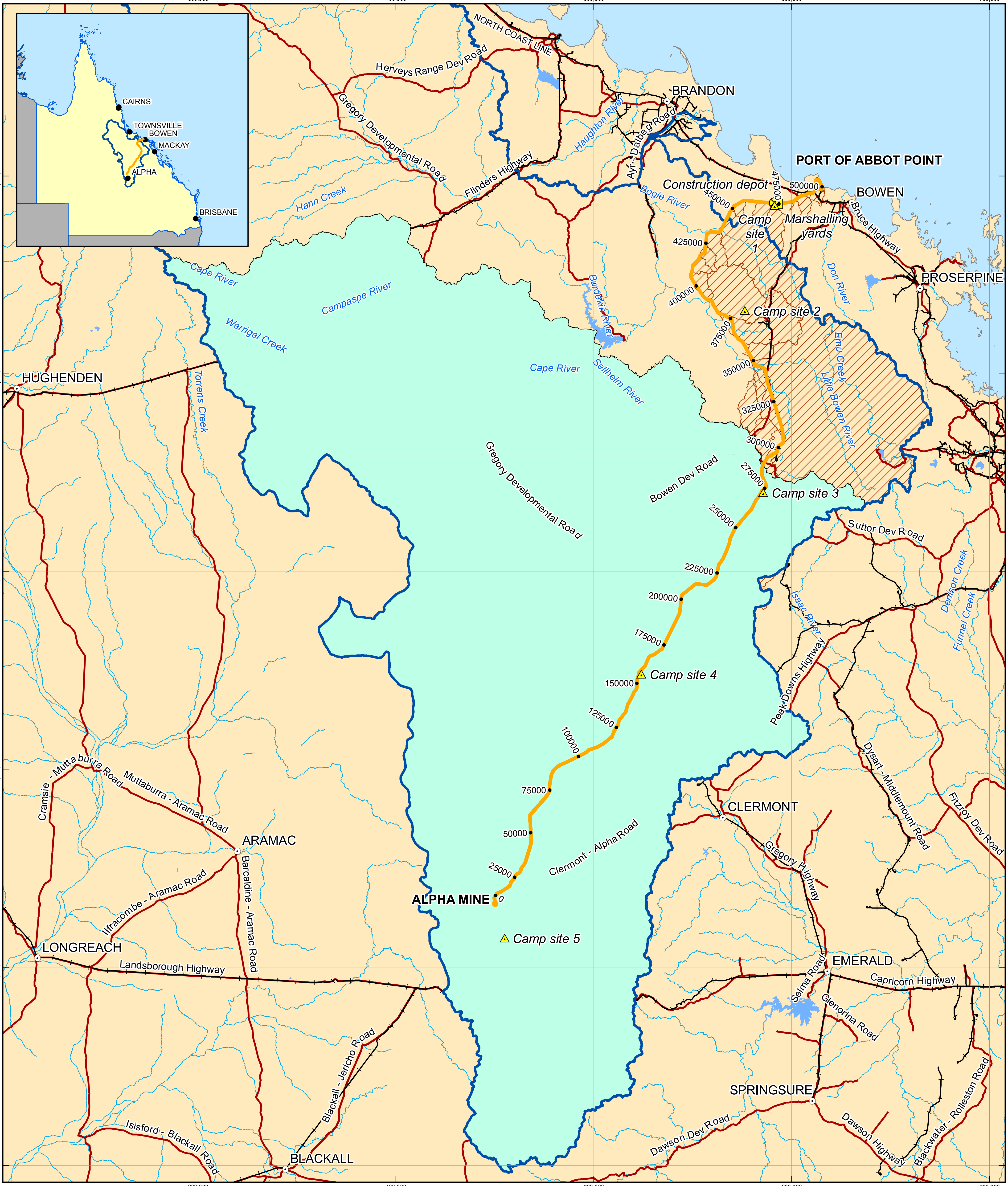


Figure 2 Stream flow data Belyando River at Gregory development Road

Land use is dominated by grazing on natural pastures. Less than 5% of the land area is set-aside for conservation and minimal use, or given over to forestry. The condition of riparian habitats throughout the basin have undergone a major decline over the last 30 years, principally due to floodplain clearing, and is mostly assessed to be very poor.

There is no existing major water infrastructure located within the sub-basin and there are no significant wetlands in the vicinity or downstream of the Project alignment.



LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Proposed Alignment
- State Road
- Existing Railway
- Watercourse
- Waterbody
- Burdekin River Basin
- Belyando Suttor Sub Basin
- Subcatchment (Derived for Project)

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1:1,800,000 (at A3)

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Kilometres

Map Projection: Universal Transverse Mercator
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Grid: Map Grid of Australia, Zone 55

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HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

BELYANDO SUTTOR SUB BASIN

Job Number 41-22090
Revision A
Date 05-08-2010

Figure: 3

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3.3.2 Geomorphologic situation

Most of the Belyando/Suttor sub-catchment consists of a series of remnant sedimentary basins. In the Suttor River alluvial deposits of Quaternary age (less than 1.8 million years) consisting of sand, gravel and soil are present. Sedimentary formations and isolated granite intrusions occur over many thousand square kilometres. The relatively low rainfall and high evaporation typical of this region largely eliminate leaching in all but the most permeable coarse-textured soils. The accumulation of organic matter (including nitrogen) is low due to seasonal aridity, high temperatures and low humidity. Cracking clay soils predominate throughout the sub-catchment due to the presence of basic igneous rocks, clay-containing sedimentary rocks and fine textured hill slope and river bank deposits. Soils include grey/brown clays and red/yellow earths, widespread throughout the Belyando and Suttor River catchments. However, large areas remain without any detailed soil information. This is of concern because of the relatively high incidence of salinity hazard in the south-eastern section of the Belyando/Suttor sub-catchment.

Hill slope erosion is identified as the major source of sediment and particulate nutrients affecting water quality within the Belyando sub-basin, while gully erosion is also identified as a significant contributor. Information regarding sediments is contradictive. NRM 2002 states that the rate of soil loss is predicted to be moderate and above the Basin average, while the total amount of soil loss from the sub catchment to waterways is comparatively high. While CSIRO 2002 states that the Belyando and Suttor rivers contribute relatively little suspended sediment because of extensive lowland floodplains and lower sediment supply to streams. Given their catchment area low sediment transport capacities are predicted in the Belyando and Suttor rivers as a result of both low slope and low discharge.

An important (artificial) factor in the sediment delivery process of the Belyando / Suttor sub-basin is the Burdekin Falls Dam (BFD). It is predicted that 90% of the sediment delivered to the BFD is trapped by the dam (CSIRO 2002).

3.3.3 History of Flooding

BoM online provides summary data of flood events. A period of 30 years, from 1980 to 2009 has been checked for flood events. In Appendix E all flood events are listed. The Belyando and Suttor rivers have only flooded three times in this period. The flood events were consistent with rainfall occurrence statistics and took place in the months of December to April.

3.3.4 Field assessment

In the Belyando and Suttor sub-basin 8 waterways where assessed on site. It concerns:

1. Native Companion Creek
2. Belyando River
3. Star of Hope Creek
4. Sixteen mile Creek
5. Mistake Creek
6. Myra Creek
7. Eagle Field Creek
8. Suttor River

The actual field assessment locations are shown in Appendix A.

Figure 4 Belyando River

European land clearance has resulted in altered hydrological regimes which have had an impact on the morphological character of many of the waterways within the vicinity of the Project.

Land clearance can have impacts on catchment and waterway character and behavior. Catchment responses to land clearance include increased runoff, increased drainage density, increased erosion and sediment yields within the catchment. In response to altered hydrological regimes channel morphology changes can occur as the result of bank erosion, channel incision and floodplain scour which are generally associated with increasing stream power and sediment transport capacity.

All waterways along the Project (within the Belyando and Suttor sub-basin) are considered to be relatively geomorphologically stable. This is a reflection of the landscapes and type of waterway systems the proposed railway traverses.

Banks are generally stable under the current flow regimes, many of which are stabilised by pasture grasses. Some limited bank instabilities are evident at all waterways, but in particular at the upstream end of the sub-basin. Native Companion Creek and Belyando river show the worst signs of erosion. More downstream waterways like Eagle Field Creek and Suttor River show less signs of erosion. All waterways show signs of degradation from cattle causing bank erosion.

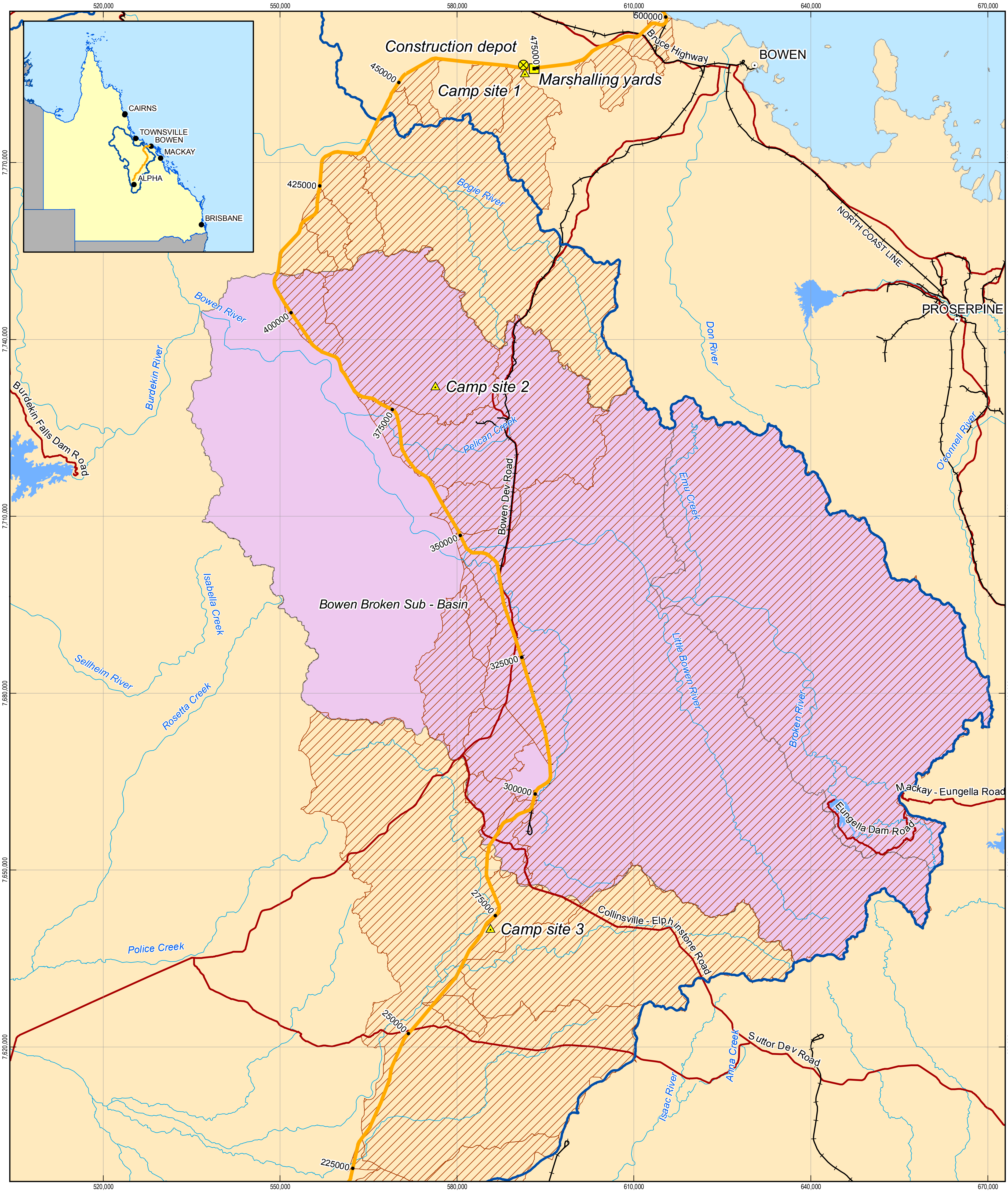
The assessed waterways show no or limited signs of headward erosion. Headward erosion (‘headcut’) is erosion which occurs along a channel in the opposite direction to water flows. This causes down cutting or incision of the bed of a stream and can alter the longitudinal profile of the waterway. Erosion can result in increased rates of sediment to be transported downstream.

3.4 Bowen Broken sub-basin

3.4.1 Characteristics

The section of the Project alignment around Collinsville is located in the north-western part of the Bowen Broken sub-basin (approximately 11,700 km^2). Refer to Figure 5 Bowen Broken sub-basin. Most land use is dominated by grazing on natural pastures. However, approximately 24% of the land area is set aside for conservation and minimal use, most of which lies within the Broken River sub-catchment. While the condition of riparian habitat varies markedly between sub-catchments, from good (A) to very poor (D), there has been a general decline in condition over the last 30 years, principally due to clearing along streams and floodplains. Similarly, there is great diversity in the value of aquatic habitats, and knowledge of their condition and ecology between sub-catchments. Waterways vary between largely sandy, dry ephemeral creek systems to perennial clear-water rivers and creeks that originate in mountain rainforest of the Eungella and the Paluma Range (BDT online).

Although covering only 7% of the total Burdekin catchment area, the Bowen/Broken catchment contributes substantially to stream flows at Clare (approximately 11%). It should be noted, however, that contributions from different sub catchments vary considerably throughout the year, and from year to year, and are dependent on rainfall patterns, particularly cyclonic and monsoonal activity across the catchment (NRM, 2002).



LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Proposed Alignment
- State Road
- Existing Railway
- Watercourse
- Waterbody
- Burdekin River Basin
- Bowen Broken Sub Basin
- Subcatchment (Derived for Project)

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HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

BOWEN BROKEN
SUB BASIN

Job Number	41-22090
Revision	A
Date	09-08-2010

Figure: 5

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The Broken River drains some of the high rainfall country in the Clarke Range to the north-east, and the lower rainfall country in the Broken River Range to the south-west. The average rainfall for at the catchment is 760 mm. (BoM online)

There are 5 water storages located along the Bowen/Broken river with a total storage capacity of approximately 230,000 ML. Eungella Dam, some 40 km west of Mackay on the Broken River, is the largest with a capacity of 112,400 ML. It covers an area of 890 hectares when full.

Located approximately 50 km downstream of the crossing with the Bowen River is the Bowen River the Birralee - Pelican Creek Aggregation wetland (QLD 198). This wetland has been classified as an important wetland in Australia. In concerns a 15 km section of the Bowen River approximately 27 kilometres west of Collinsville. This wetland provides outstanding representative examples of a range of riverine wetlands. A large permanent waterhole is likely to be of importance as a drought refuge. Eight species of conservation significance have been recorded on the site. Of these two are listed as vulnerable in state and/or federal legislation (DEWHA Online).

At the junction of the Burdekin and the Broken River is the 'Burdekin-Bowen Junction and Blue Valley Weir Aggregation' (QLD205) wetland. This wetland is downstream of the Project alignment and of national importance. The wetland provides an outstanding example of a large tropical river emerging from a valley incised into a mountain range onto its terminal floodplain. The site and its surrounds constitute the largest and least impacted natural area remaining on the lower Burdekin (DEWHA Online)

3.4.2 Geomorphologic situation

The Bowen/Broken sub-catchment contains sedimentary and volcanic rocks. Sandstones, mudstone, siltstone and conglomerates are the main rock layers in the sedimentary basins, while conglomerates and quartz-rich sandstones form ridges and escarpments. Formations containing a high proportion of easily weathered minerals result in the gentle rises and rolling plains common to the lower Bowen valley. Limestone, originating from marine reefs formed by corals, juts out prominently and has subsequently been cut into rugged gorges. Prominent soil types along the eastern margin are the red-brown earths and yellow podsolics/soloths. On the drier western slopes of the Clarke Ranges around Dalrymple Heights, the strongly undulating landscape is covered by yellow soils derived from weathered intermediate rocks. Much of the eastern slopes of the Leichhardt Ranges to the west are covered by shallow, gravely/sandy soils associated with granite or sandstone parent material. Areas of black earths lie between Collinsville and the Burdekin and Bowen Rivers, with smaller isolated areas at Exe Creek near Redcliffe and the Broken River at Emu Plains.

Hill slope erosion is identified as the major source of sediment and particulate nutrients affecting water quality within the Bowen Broken Bogie Basin, while gully and stream bank erosion are also identified as significant contributors. The rate of soil erosion for the Basin, overall, is predicted to be high and well above the regional average, with individual sub-catchments losing up to almost three times the regional average. The Bowen River is considered to be one of the dominant sources of sediment at the catchment outlet. (CSIRO 2002)

3.4.3 History of Flooding

BoM online provides summary data of flood events. A period of 30 years, from 1980 to 2009, has been checked for flood events. No flood events occurred along the Bowen/Broken Rivers in this period.

3.4.4 Field assessment

In the Bowen Broken sub-basin three waterways where assessed on site. It concerns:

1. Pelican Creek;
2. Table Mountain Creek; and
3. Cattle Creek.

The actual field assessment locations are shown in Appendix A.

Figure 6 Pelican Creek

Grazing intensity is, as might be expected due to differences in climate, higher in the Bowen Broken sub-basin compared with the Belyando Suttor sub-basin. These extensive changes in land use have had an impact on the morphological character of many of the waterways within the vicinity of the Project.

Land clearance for the Project can have impacts on catchment and waterway character and behavior. Catchment responses to land clearance include increased runoff, increased drainage density, increased erosion and sediment yields within the catchment. In response to altered hydrological regimes channel morphology changes can occur as the result of bank erosion, channel incision and floodplain scour which are generally associated with increasing stream power and sediment transport capacity.

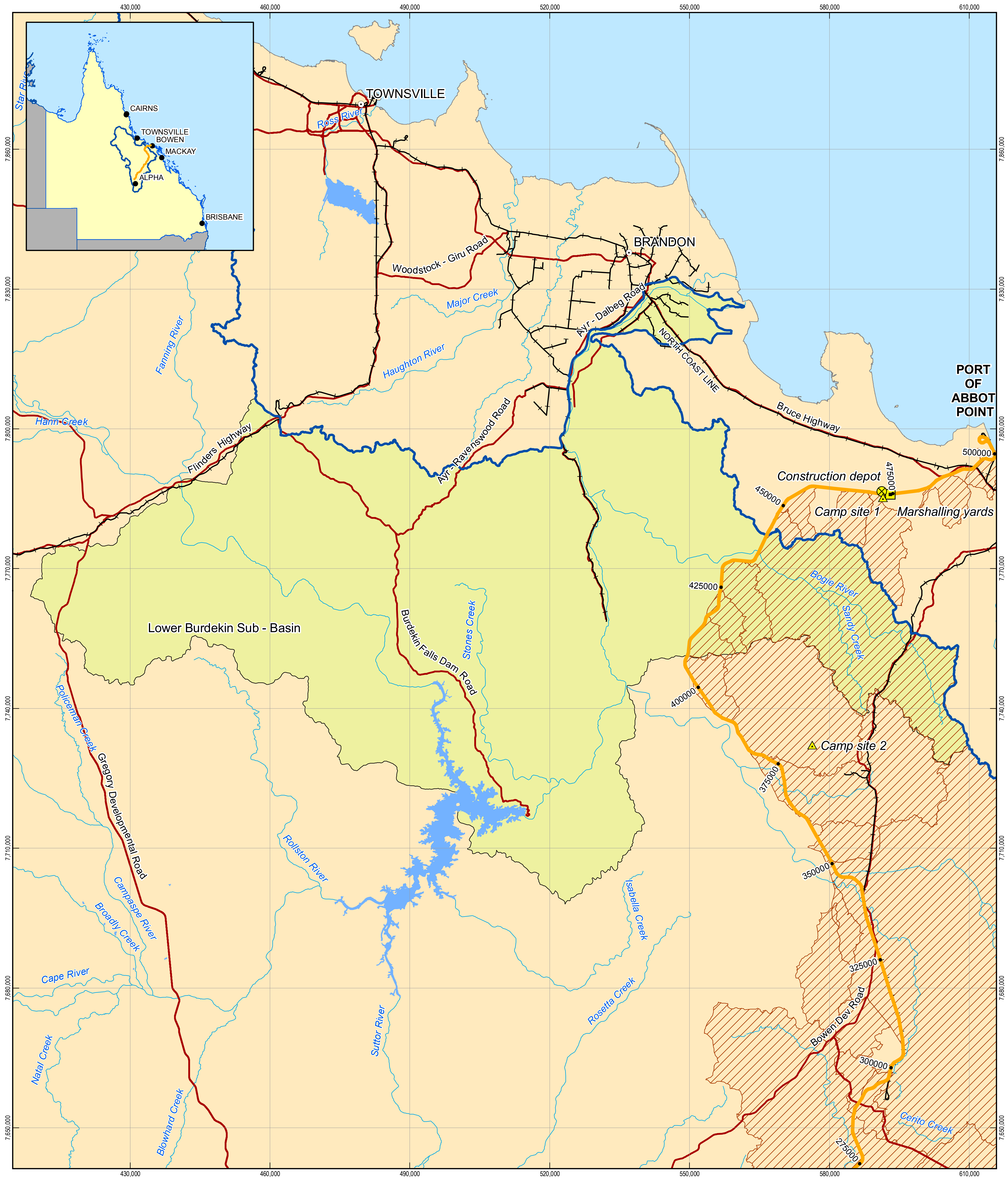
All waterways along the Project (within the Bowen Broken sub-basin) are considered to be relatively geomorphologically stable under current flow regimes. This is mainly due to extensive vegetation cover of the banks. All waterways show signs of degradation from cattle causing bank erosion.

The assessed waterways show no or limited signs of headward erosion. Headward erosion ('headcut') is erosion which occurs along a channel in the opposite direction to water flows. This causes down cutting or incision of the bed of a stream and can alter the longitudinal profile of the waterway. Erosion can result in increased rates of sediment to be transported downstream.

3.5 Lower Burdekin sub-basin

3.5.1 Characteristics

The Burdekin Falls Dam and three weirs greatly modify the river flow regime. Before construction of the dam (1987), the Burdekin River at Clare Weir flowed for around 95% of the time; however, it now flows all year round. In addition to flowing all year round, low flows below the dam have been elevated, while medium to high flows have been reduced. See figure 7 Lower Burdekin sub-basin. For example, before the dam was constructed, for 20% of the time flows were 2 m^3/s or less. However, after construction of the dam, for 20% of the time flows are now 10 m^3/s or less, an increase of around 8 m^3/s during low flow periods. Consequently, the river has changed from an intermittently flowing river into a perennial system with elevated dry season flows and a reduced magnitude of flood flows.



LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Proposed Alignment
- State Road
- Existing Railway
- Watercourse
- Waterbody
- Burdekin River Basin
- Lower Burdekin Sub Basin
- Subcatchment (Derived for Project)

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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LOWER BURDEKIN SUB BASIN

Figure: 7

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The land use of the lower Burdekin and the Coastal plains contains extensive agriculture which is centred on intensive irrigation. The region is well known for its sugar, cotton and horticulture production, with sugar the dominant crop. About 20% of Australia’s sugar production is located within the Lower Burdekin sub-basin (NRM 2002).

The Burdekin Catchment flows into the Bowling Green Bay Ramsar Wetland via the Haughton River. The Bowling Green Bay Wetland is located 21 km north east of Ayr and has a total area of 35 500 ha. The wetland aggregation contains a diversity of habitats including: seagrass beds; coastal sand dues; tidal flats; mangrove forests; highly saline supra-tidal salt pans; brackish to freshwater marshes; and lakes. The Bowling Green Bay Wetland is an internationally significant habitat for wader birds and provides important breeding and nursery habitat for commercially and recreationally important fish species such as barramundi (DEWHA Online). The Bowling Green Bay Wetland is located more than 100 km from the northern end of the proposed rail alignment.

3.5.2 Geomorphologic situation

The Lower Burdekin and Coastal Plain study areas consist mainly of volcanic and sedimentary rocks. Superficial sand, gravel, silt and mud form plains in the Bowen coastal area, while small dissected table-lands of old basalt occur in the Bowen Basin. Higher rainfall in the coastal region has produced areas of deep, strongly weathered fine-textured soils on the foot-slopes. Many soils here have been subjected to intense weathering and/or leaching, severely affecting their nutrient value. Within the Burdekin floodplain, soils are derived from very variable river deposits and include black cracking clays, sands and a range of duplex soils, some with a dispersive nature. Sand dunes, marine plains, deltas and sand bars form unique landforms close to the coast.

A rate of 300,000 m^3/a was established as being representative of the actual rate of sediment transport prior to the construction of the Burdekin Falls Dam (BFD). Construction of the dam in 1987 has reduced sediment supply to downstream reaches through the physical trapping of material from upstream of the dam. This is likely to have a significant impact in the long term (greater than 50 years). It is estimated that the Bowen and Bogie Rivers, which are downstream of BFD, yield up to 60,000 m^3 of sediment annually (GHD, 2000).

In the short to medium term, GHD (GHD, 2000) found that the main impacts of BFD would occur upstream of the confluence of the Burdekin and Bowen Rivers. It was estimated that impacts to sediment transport rates at the mouth of the Burdekin River would be relatively small - in the order of 7,500 m^3/a - with a corresponding decrease at Clare Weir of about 15,000 m^3/a.

3.5.3 History of Flooding

BoM online provides summary data of flood events. The data provided by BoM concerns both the Upper and the Lower Burdekin River. As might be expected Lake Dalryple (Burdekin Falls Dam) reduces peak flows coming from the Upper Burdekin. Most lower Burdekin floods therefore tend to be of medium to low severity. Over a period of 30 years, from 1980 to 2009, 13 flood events where recorded by BoM.

3.5.4 Field assessment

In the Lower Burdekin sub-basin 5 waterways where assessed on site. It concerns:

1. King Creek
2. Herbert Creek
3. Capsize Creek
4. Bogie River
5. Brigalow Creek

The actual field assessment locations are shown in Appendix A.

Figure 8 Bogie River

Land use surrounding the waterways all show signs of moderate grazing. Land clearance for cattle has resulted in altered hydrological regimes which have had an impact on the morphological character of many of the waterways within the vicinity of the Project.

Land clearance for the Project can have impacts on catchment and waterway character and behavior. Catchment responses to land clearance include increased runoff, increased drainage density, increased erosion and sediment yields within the catchment. In response to altered hydrological regimes channel morphology changes can occur as the result of bank erosion, channel incision and floodplain scour which are generally associated with increasing stream power and sediment transport capacity.

All waterways along the Project (within the Lower Burdekin sub-basin) are considered to be relatively geomorphologically unstable. Waterways show signs of high channel sinuosity, diversion channels and island forming.

Banks are generally stable under the current flow regimes, mainly due to good vegetation cover. Although all waterways show signs of degradation from cattle, which can lead to bank erosion.

The assessed waterways show no or limited signs of headward erosion.

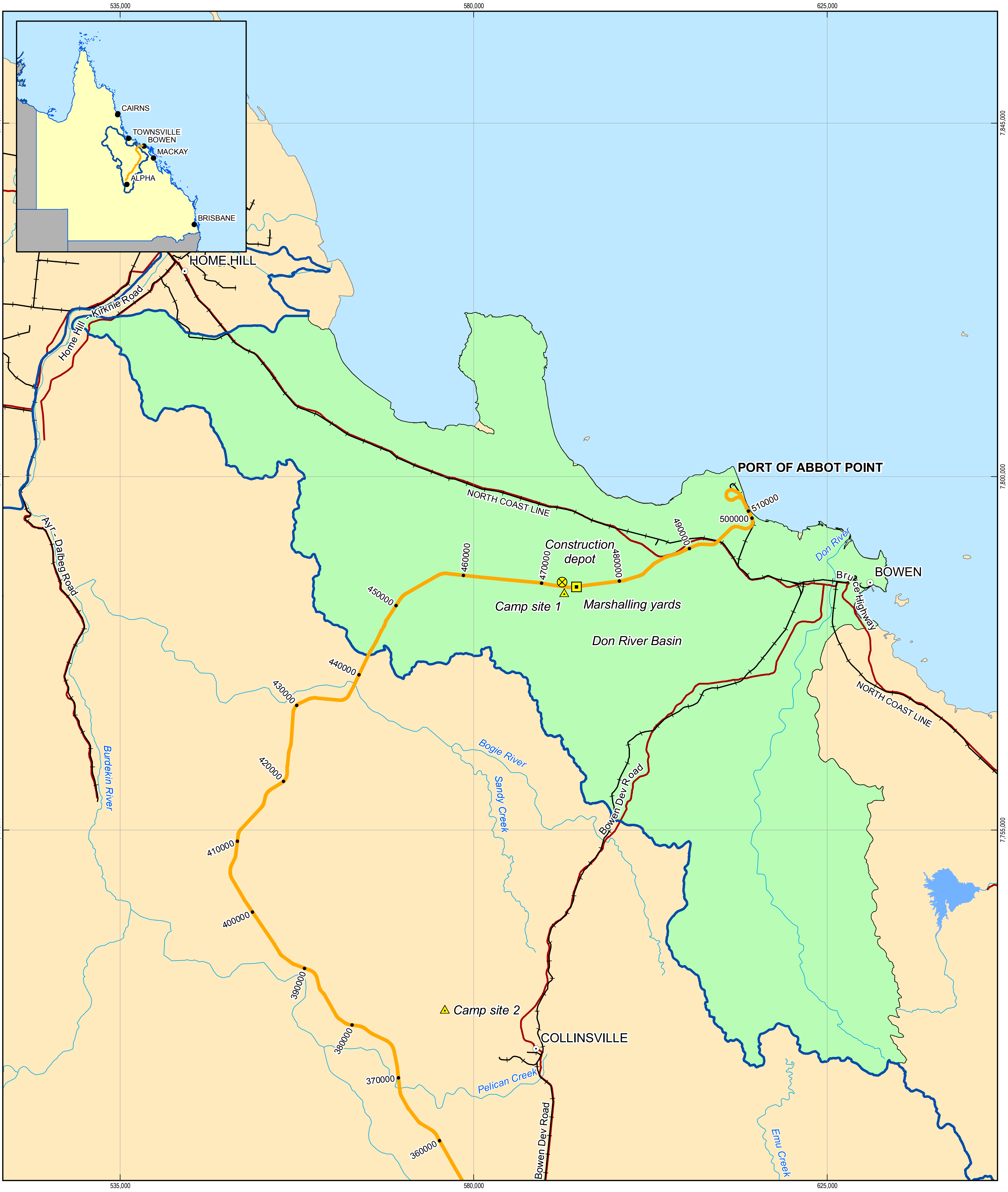
3.6 Don River Basin

3.6.1 Characteristics

The northern part of the rail corridor is located in the Don River basin. It is a small basin with an area of approximately3,885 Km^2. The Don River Basin in North Queensland is bounded by the Clarke Range and the catchment contains medium to scattered vegetation. The major town, Bowen, is located at the mouth of the Don River.

There are no major water storages in the basin. The major streams in the catchment are the Don River, Elliott River and Euri Creek. See figure 9 Don River Basin

Water is used for urban and horticultural purposes on the coastal flats. Mean annual rainfall ranges from 1000 mm to 1600 mm across the catchment. (ANRA online) Water is used for urban and horticultural purposes on the coastal flats.



LEGEND

Town	Proposed Alignment	Waterbody
Camp	State Road	Don River Basin
Marshalling Yards	Existing Railway	Burdekin River Basin
Depot	Watercourse	

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Kilometres

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Date 05-08-2010

DON RIVER BASIN

Figure: 9

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The Project alignment does not cross the Don River or its floodplain, but does cross with the Elliott River (within Don Basin). Stream-flow data (DERM online) from Elliott River at Guthalungra (intersection Elliott River with Bruce Highway) shows a clear peak in flows during the wet season which occurs between November and April (see figure 10).

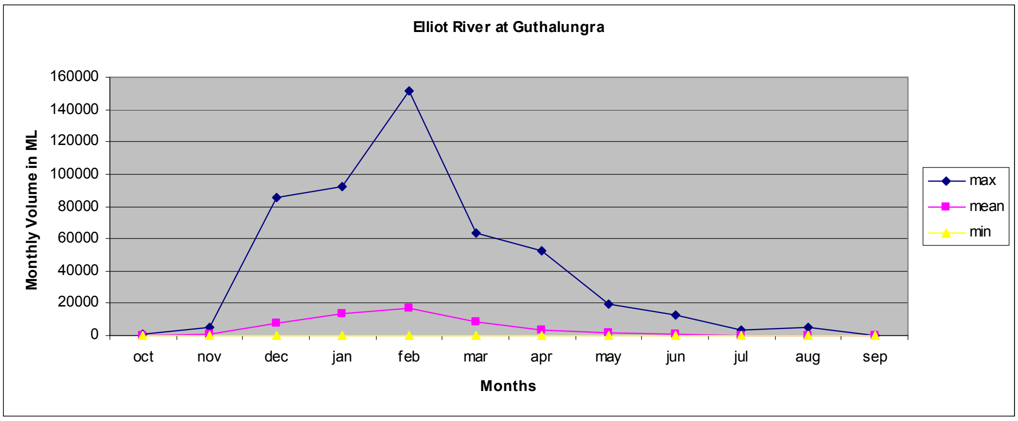

Figure 10 Streamflow Elliott River at Guthalungra (DERM online)

The last section of the Project alignment crosses the Abbot Point – Caley Valley wetland. The Directory of Important Wetlands in Australia (DEWHA online) includes this wetland. This wetland, which is 18 km long and up to 6 km wide, covers an area of approximately 5 000 ha and comprises "a complex continuous wetland aggregation of sub-tidal and intertidal marine and estuarine wetlands, with large fresh and brackish water wetlands within an artificial impoundment". The wetland contains a number of major habitats, including shallow water marine systems, beach ridges, mangrove creeks, intertidal and supra-tidal saline flats, fresh and brackish lake waters, and swamps. The impounded waters and the seasonal richness of the area as waterfowl and waterbird habitat justify the wetland's significance in Australia, and it is also considered one of the most important waterfowl localities in North Queensland. (DEWHA online)

The Project alignment will end at Abbot Point and has to cross the Calley Valley wetland. At Abbot Point extensive port facilities exist. Due to the high demand for Queensland's resources several developments are planned surrounding Abbot Point (eg. the Port of Abbot Point Multi Cargo Facility Project – the MCF). The MCF involves the construction of a protected harbour at Abbot Point capable of handling multiple cargoes. The vision for the Port of Abbot Point is to become North Queensland's and northern Australia's premier port servicing northern Australia's major industrial hub (DIP online).

As mentioned before, because of the national importance of the wetland and the combination of infrastructure developments HPPL decided to create a hydrologic model to detail any surface water (including storm tide aspects) related consequences. The modeling exercise has been separately reported:

3.6.2 Geomorphologic situation

The Don River basin contains acid volcanic, acid igneous and sedimentary rocks. A contiguous Quaternary coastal plain formed from superficial sand, gravels and silt deposits backed by coastal hills and mountain ranges, extends to the northern and southern margins of the region having its broadest expression at the lower Burdekin floodplain, which extends inland almost to the base of the Leichhardt Range.

Granite basement rock outcrops form isolated coastal hills, rocky capes and off shore continental islands and have their greatest expression in the isolated massif of Mt Elliot which lies between the Ross and Haughton River catchments and at 1234m represents the fifth highest peak in Queensland. Other coastal land forms of significance include extensive marine plains with salt pans, tidal creek channels and estuary complexes, elevated beach ridge and dune systems, beaches, sand spits and shallow embayments with off shore continental islands including Magnetic and the Palm group having fringing reefs. The edge of the continental shelf, 80-100km offshore, forms the foundation for the Great Barrier Reef enclosing the Great Barrier Reef lagoon which receives the discharge from the Burdekin River and the smaller coastal catchments (BDTNRMP, 2005).

3.6.3 History of Flooding

Of the major tributaries and streams within the Don River Basin the Project alignment only crosses the Elliott River. No historic flood information has been found for this river. However, the frequency of flood events in the nearby Don River (refer to Figure 11) suggests the occasional flood event

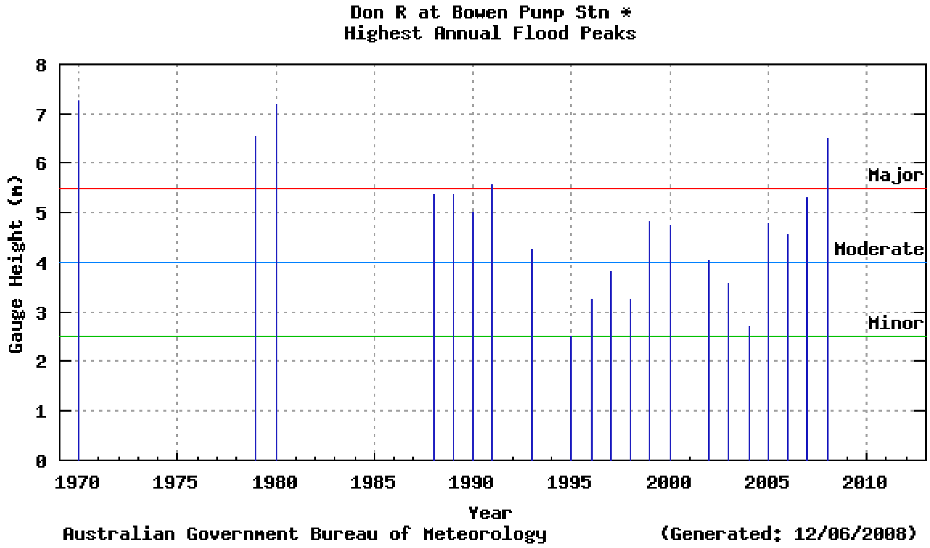

Figure 11 Floods in the DON River (BoM online)

3.6.4 Field assessment

In the Don River basin two waterways where assessed on site. It concerns:

1. Elliot River; and
2. Splitters Creek.

The actual field assessment locations are shown in Appendix A.

Figure 12 Elliot River

European land clearance has resulted in altered hydrological regimes which have had an impact on the morphological character of many of the waterways within the vicinity of the Project.

Land clearance can have impacts on catchment and waterway character and behavior. Catchment responses to land clearance include increased runoff, increased drainage density, increased erosion and sediment yields within the catchment. In response to altered hydrological regimes channel morphology changes can occur as the result of bank erosion, channel incision and floodplain scour which are generally associated with increasing stream power and sediment transport capacity.

All waterways along the Project corridor (within the Don River basin) are considered to be relatively geomorphologically stable.

Banks are stable under the current flow regimes, despite flood marks signalling high flood events. Both waterways show limited signs of degradation from cattle causing bank erosion.

The assessed waterways show no or limited signs of headward erosion.

4. Water use within the study area

4.1 Belyando and Suttor sub-basins

Within this sub-basin there is no existing major water infrastructure, however, a number of private weirs, pumps and off-stream storages licensed for water-harvesting and irrigation have been constructed to take advantage of the intermittent unsupplemented supplies.

Around 6,400 hectares is currently licensed for irrigation with about half of this in the Mistake Creek region in the Belyando/Suttor sub-basin. Licensed irrigators tend to be concentrated in areas with suitable alluvial plains adjacent to the Suttor and Belyando rivers and their tributaries. Most licences are for stream pumps with or without off-stream storages. Only around one third of this (i.e. 21,000 Ml/y) is actually used. Figure 13 shows an overview of the water users.

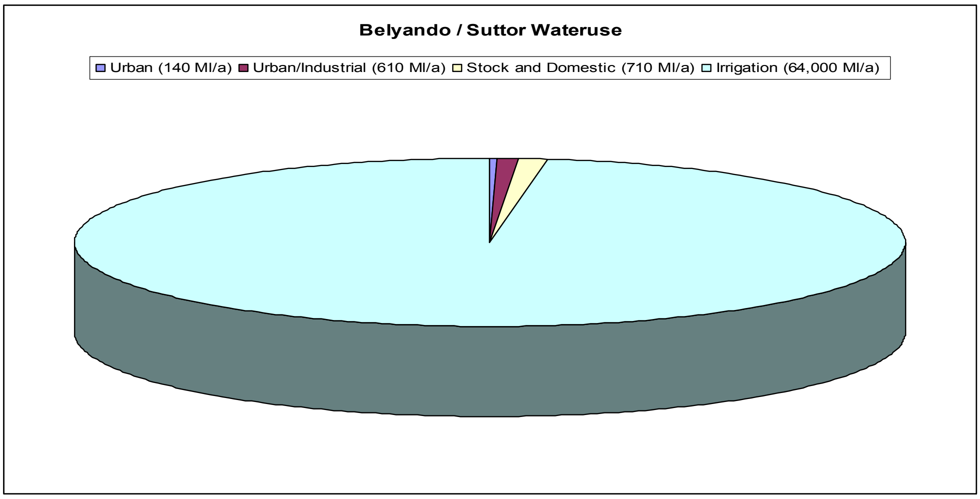

Figure 13 Water use Belyando/Suttor sub-basin (NRM 2002)

Present water-harvesting schemes are privately funded developments. Financial constraints within this sector may inhibit the effective utilisation of available water and land resources. Further land suitability, agro-economic assessments and water resource assessments will be necessary to define the true agricultural potential of the region (NRM 2002).

4.2 Bowen/Broken sub-basin

In contrast with other sub-basins, current water use within the Bowen/Broken is dominated by industrial use, principally associated with coal mining activities. Eungella Dam supplies coal or other mining developments and associated urban infrastructure within the Bowen Basin around Moranbah and Goonyella, while Collinsville Weir supplies mining operations at Newlands and Collinsville, irrigation users and urban demand of about 1,800 ML/a.

Irrigated agriculture in the Bowen/Broken sub-basin is generally limited to riparian lands adjacent to the upper reaches of the Broken River and to a lesser extent along lower Pelican Creek, south-west of Collinsville. Currently, licensed irrigation for both supplemented and un-supplemented use is some 12,600 ML/a. However, only about 7,800 ML/a is actually used. Of 5,800 ML/a licensed for supplemented users via Collinsville Weir only 1,800 ML/a is actually used (NRM 2002 > DNR, 1999a).

Water for coal mining developments within the Central Queensland Coal Fields is derived from a number of sources. In addition to the Eungella Dam pipelines, water to the region is sourced from the Braeside groundwater area (east of Moranbah) via the Riverside pipeline and the Bingegang Weir on the Mackenzie River via the Saraji pipeline.

Current commitments from Collinsville Weir total 15,900 ML per annum, while those from Eungella Dam total 21,600 ML per annum. Allocations from Collinsville Weir for both the Collinsville power station (2,500 ML per annum) and Newlands mine (3,900 ML per annum) are expected to be sufficient to cater for projected growth to 2030. Collinsville MIM mine is due to close in 2015, which will release about 1,100 ML whereas closure of the Newlands mine will provide an additional 3,900 ML from the system by 2020. (NRM 2002) Figure 14 shows an overview of the water users.

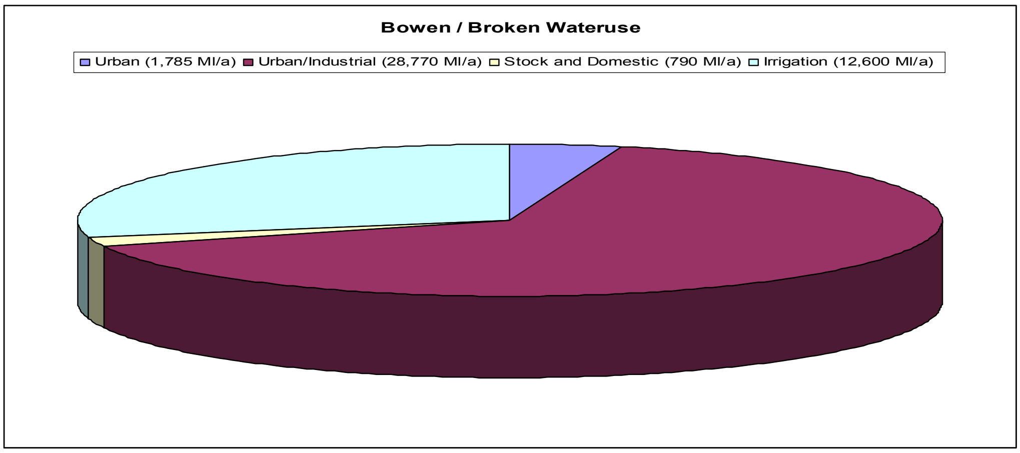

Figure 14 Water use Bowen/Broken sub-basin (NRM 2002)

4.3 Lower Burdekin sub-basin and Don River Basin

Water-use information for the individual basins of the Lower Burdekin and Don rivers has not been found. Most data sources combine the two basins in the Lower Burdekin and Coastal Plains region. The description below concerns this combined region.

The construction of Burdekin Falls Dam (BFD) and the subsequent development of the Burdekin-Haughton Water Supply Scheme (BHWSS) led to a significant area under irrigation in the Lower Burdekin catchment. The area is approximately 103,120 ha predominately comprising of 46,850 ha in the BHWSS and the North Burdekin Water Board and South Burdekin Water Board areas (37,200 ha). However, a significant proportion of the water from the Burdekin Falls Dam is released from Clare Weir and is directed to the North and South Burdekin water boards to supplement groundwater supplies. (NRM 2002)

There are also a number of industrial users including quarries and sugar mills. (Sunwater online) The Burdekin Falls Dam also provides a significant amount of urban water for the population centres in the Don River Basin. The urban and industrial water use in Townsville and Thuringowa is significant. Water use in Townsville and Thuringowa is approximately 55,800 ML/a (NRM 2002). Figure 15 shows an overview of the water users.

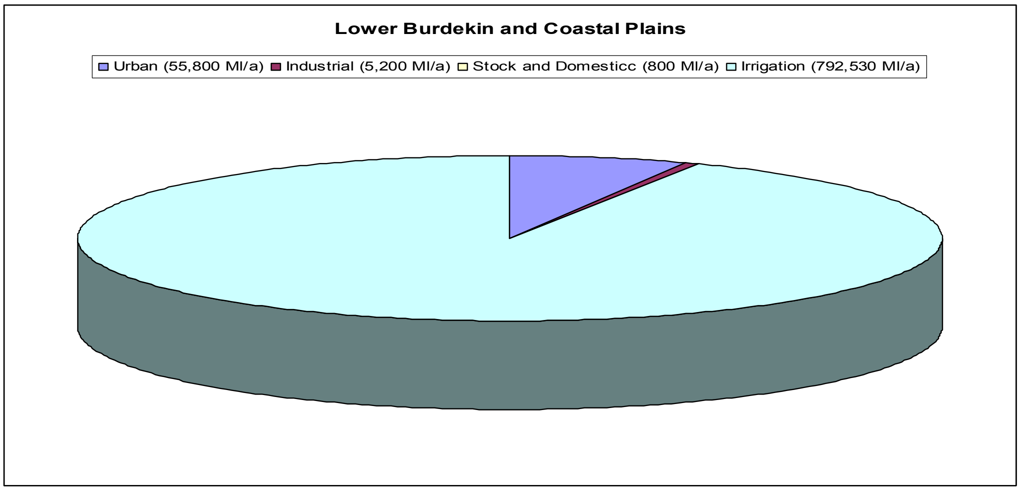

Figure 15 Water use Lower Burdekin and Coastal Plains (NRM 2002)

5. Potential Impacts

This section assesses potential impacts on the water resources and environmental aspects of the proposed alignment as described in the previous section. It will also define and describe practical measures for their protection or enhancement.

Since the potential impacts of the Project alignment are similar for all river basins and sub-basins through which it passes no distinction has been made between them.

5.1 Potential Impacts

The following potential impacts to surface water were indentified for the construction and operating phases:

- Increased sediment load in runoff;
- Stormwater discharge and flow redirection;
- Construction water use;
- Hydraulic impacts.

Potential impacts are discussed in the following sub paragraphs.

Despite the importance of surface water for various water users the potential impacts on them are covered by the potential impacts under 'Increased sediment load in runoff' and 'Stormwater discharge and flow direction'.

5.2 Increased sediment load in runoff

Construction phase activities include the clearing of vegetation, cut and fill, construction of waterway crossings, drainage and other earth works. These activities will disturb the soil surface and increase the potential for erosion. Once soil is de-stabilised erosive processes have the potential to transport sediment to receiving waters. If a waterway is dry during construction impacts to water quality, as a result of sedimentation, may be delayed until the on-set of rainfall events, when there is sufficient water to cause erosion from disturbed banks, soil stockpiles and cleared areas.

Besides a possible mobilisation of sediment, cut and fill activities have the potential to alter the natural flow path of a waterway either temporally or permanently. In all cases this is considered a negative impact.

Trapping and redirection of overland flow (diversion drains) may alter the functioning of downstream ecosystems. Overland flow may also transport contaminants into downstream environments. An increase in sediments and contaminants has the potential to have a negative impact on the environmental values of a waterway.

Any construction work in the waterway bed or on waterway banks is potentially a high risk activity. Works in these areas are likely to create instability and erosion which in it turn leads to sedimentation. Especially significant are construction activities at waterway crossings (bridges or culverts). The construction of these has the potential to destabilise the bed and banks causing scour and erosion around the structures. Culverts have the potential to change the slope of the stream bed and can cause changes in stream flow direction and velocity, resulting in erosion upstream (local whirlpools) and downstream of culverts (increase in velocity).

All construction activities in or within the vicinity of a waterway have the potential to impact on the quality of the downstream receiving environment. An increase in the sediment load will have a negative impact on water users, for instance by causing extra maintenance work to channels and structures.

5.3 Stormwater discharge and flow redirection

Temporary or permanent changes to the hydrology of the area surrounding the Project alignment may impact on the quantity and quality of freshwater influx in downstream areas. Fresh water influx is important to the health of aquatic ecosystems and riparian zones and the Belyando and Suttor rivers are a major contributor to the Burdekin Falls Dam. Alteration or impediment to flow through the creation of an (temporary) impoundment will alter the physical dynamics of the aquatic system and will have an impact on water users (Water Supply Schemes).

5.4 Construction water use

During construction water will be required for several activities, including

Water of reduced quality:

- Moisture conditioning of earthworks;
- Dust suppression; and
- Vehicle wash down.

High quality water:

- Concrete batching; and
- Construction campsite and offices.

Estimates of water requirements for Construction were not available whilst writing this report. However, based on previous experience, it will concern several tens of thousands mega litres.

As long as the construction water does not interfere with the natural waterways impacts on surface water will be none existent. However, while washing down vehicles weed seeds and other contaminants are easily released. Surface water run-off can carry these seeds and contaminants into a waterway.

During the operational phase water supply for operating the rail will be minimal. However, the use of chemicals for weed and vermin control may impact on surface water.

5.5 Potential hydraulic Impacts (operating phase)

The construction and the subsequent presence and operation of the railway are likely to impact natural stream levels (afflux[2]) and may cause local erosion (scouring). Selection of the final crossing type for waterways will need to take cognisance of the need to protect the integrity of the watercourse.

A preliminary drainage assessment study was undertaken and included the following:

- Identification and location of waterways intercepting the Project alignment;
- Establishment of local drainage catchments for each waterway intercepting the Project alignment;
- Determination of peak flood discharges at each intersection using the Rational Method;
- Hydraulic analysis of waterway crossing requirements;

It should be noted that the actual amount of waterway crossings, especially culverts will be much higher. The preliminary drainage assessment only considered the major waterways. Small local drainage lines and diversion drain requirements will be identified in later project phases. The actual number of culverts is at this stage expected to be in the hundreds. In Appendix D an overview of potential flows is given.

[2] Afflux is defined as the change in water surface levels due to the presence of a structure as a bridge or a culvert.

6. Mitigation Measures

Potential surface water impacts during the construction and operational phases will be managed primarily through the Erosion and Sediment Management Control Plan and the implementation of appropriate mitigation measures as outlined in Table 3.

Table 3 Construction Phase Mitigation Measures

Potential Impact	Mitigation Measure
Increase in sediment loads in runoff.	Where practicable undertake the major earthworks during the dry season. Minimize the period for which the soil is left open to erosion. Keep approved clearing areas as small as possible and demarcate them clearly. Install temporary bunding or sediment traps during major earthworks. Stockpile earth materials away from waterways, floodplains and overland flow paths. If not possible protect them sufficiently from overland flow. Stabilise stockpiles that are left exposed for any period longer than 2 weeks. Isolate and remediate existing erosion areas in the vicinity of the construction works to prevent further damage. Restrict the area of vegetation and soil disturbance during the construction works to the smallest possible areas or to already disturbed areas. Minimise the amount of work within the bed or banks of a watercourse or a riparian zone. Where possible use existing (access) tracks to avoid new ground and soil instability problems. Where required, prevent and/or slow overland flow run-off by using sediment or silt barriers. E.g. sand bags, straw bales (not containing weed seeds) grass filter strips, diversion bunds, etc. Install erosion control structures in the following areas: - Down slope of disturbed soil; - Around soil stockpiles; and - At discharge point from construction sites and roads. Minimise the erosion potential by diverting flows away from disturbed areas. For construction sites: install erosion and sediment control measures in accordance with the Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites. Completed areas shall be stabilised and rehabilitated as soon as possible but at least within one week of completion. Restrict access to recently revegetated areas to allow for new vegetation to become established. Sites are to be re-contoured to a stable form that resembles the surrounding landscape. Periodically check the condition of any erosion/stormwater control structures during construction. Especially after rainfall to ensure effectiveness. Regularly remove sediment from sediment control devices. Reuse uncontaminated material, dispose of contaminated material.

Stormwater discharge and flow redirection.	Minimise any filling, draining, damming or alteration of waterways. Develop and implement a Stormwater Management Plan for the construction phase of the project.
Construction water use.	Prevent any construction water flows from interfering with natural waterways. Protect washing down plants from any overland flows.
Hydraulic impacts.	Undertake detailed hydraulic modelling at the design stage to minimise the effects of increased flood heights and local flow velocity as the result of new bridges and culverts.

Table 4 Operation Phase Mitigation Measures

Potential Impact	Mitigation Measure
Increase in sediment loads in runoff.	Wetlands and riparian vegetation will be left undisturbed. Stormwater management measures will capture and filter runoff without significant compromising overland flows. This includes the creation of a: - Erosion and Sediment Control Management Plan - Waste Management Plan
Erosion and Scouring	Detailed scour analysis and design will be executed to minimise and erosion and scouring in the vicinity of the intersections between waterways and Project. All erosion and sediment control structures will be regularly inspected and maintained when necessary. All drainage structures will be regularly inspected and maintained when necessary.
Existing water users	Bridges and culverts will convey flows under the proposed rail line

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GHD (Gutteridge Haskins and Davey), 2000, 'Burdekin River Extraction and Sediment Management Plan' (GHD 2000);

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CSIRO Land and Water December 2002, 'Overview of the key Natural Resource Management Issues in the Burdekin Catchment, with particular reference to Water Quality and salinity'. (CSIRO 2002b);

Riverconsulting 2006, 'Streams and Wetlands in the Burdekin Dry Tropics Region' – (RC 2006)

GHD, Cleveland Bay Purification Plant: Effluent Re-Use Strategy Report Scheme, Townsville City Council, 1994 (GHD 1994);

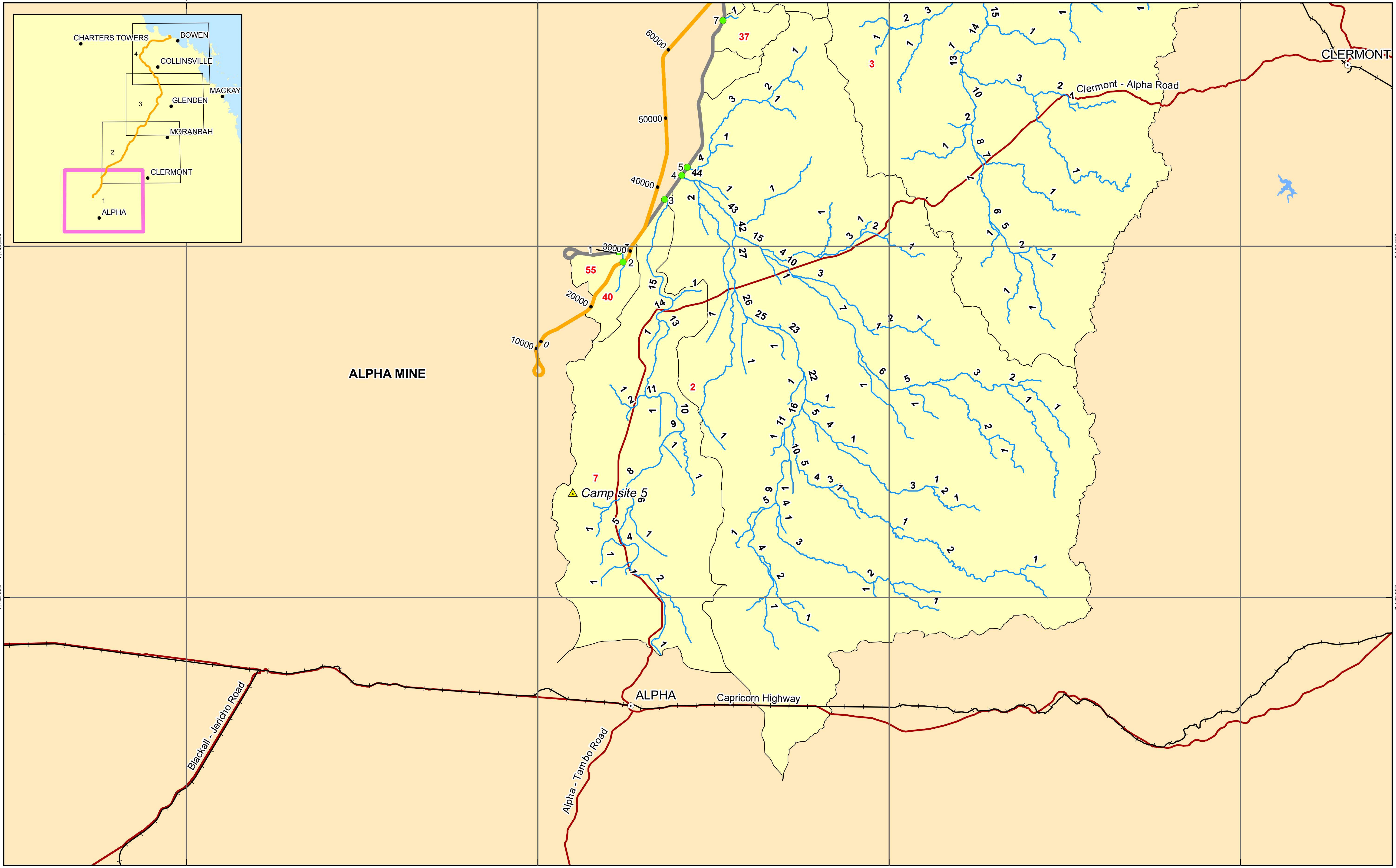
Environmental Protection (Water) Policy 2009 Queensland Subordinate Legislation 2009 No. 178 (EPP Water 2009);

State of Queensland: Sustainable Planning Act 2009;

State of Queensland / Australian Government: Reef Quality Protection Plan 2009 (Reef Plan 2009); and

Environmental Protection Agency 1999, ‘Strategy for the conservation and management of Queensland’s wetlands 1999’ (EPA 1999).

Appendix A
Waterway Classification (map)



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Crossing Point (v6)
- Proposed Alignment (Version 9)
- Proposed Alignment (Version 6)
- State Road
- Existing Railway
- Watercourse
- Waterbody
- Subcatchment

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SUB-CATCHMENTS AND INTERSECTION OF PROPOSED ALIGNMENT WITH CREEKLINES

Job Number	41-22090
Revision	A
Date	04-08-2010

Figure: 17
Sheet 1 of 4

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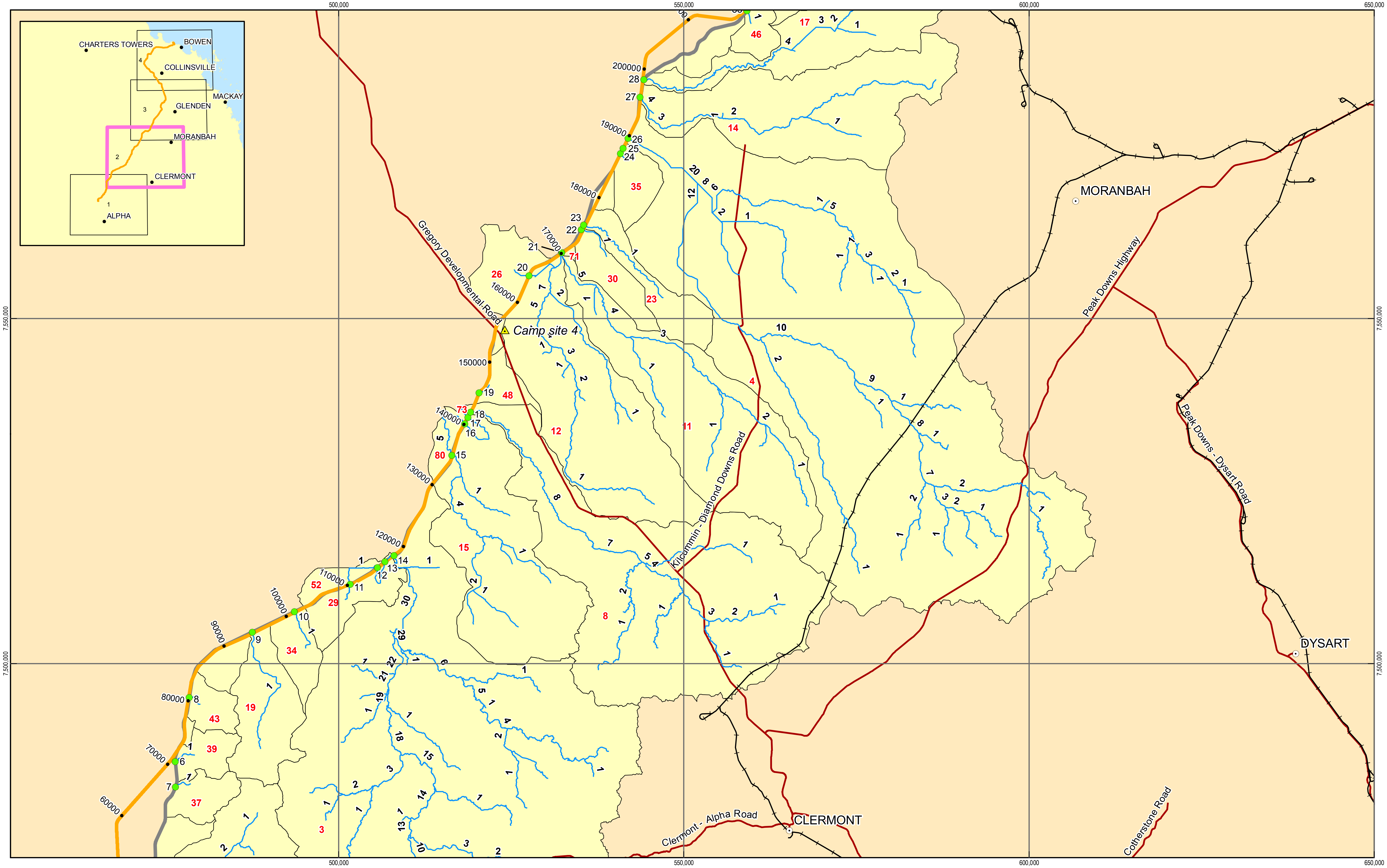

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
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Figure: 17
Sheet 2 of 4

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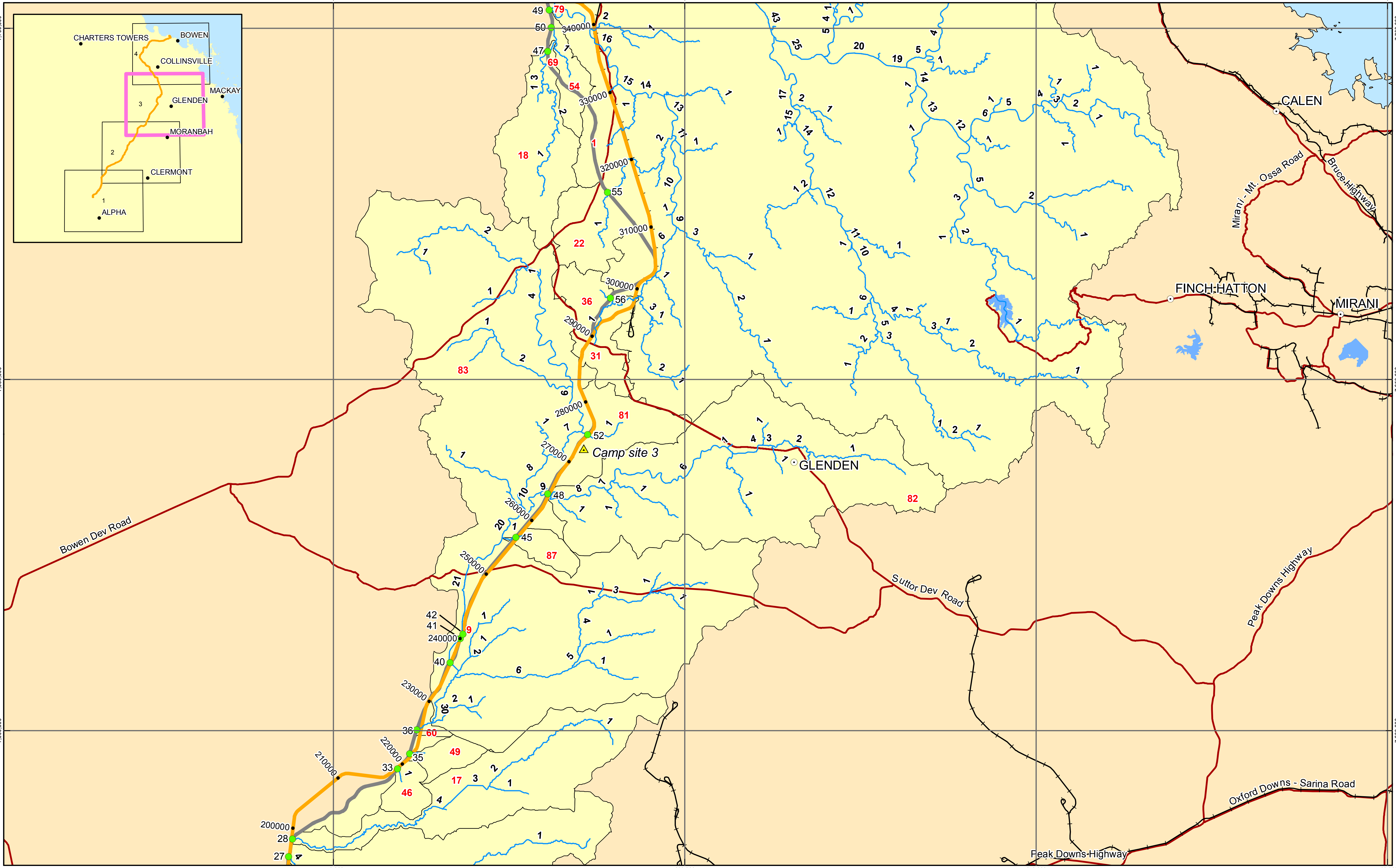

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Kilometres

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Horizontal Datum: Geocentric Datum of Australia 1994
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Figure: 17
Sheet 4 of 4

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Appendix B

Waterway Classification (spreadsheet)

CROSSING POINT	AREA__HA_	STREAM ORDER	CLASSIFICATION	WATERWAY NAME	COMMENTS
1	3,090	1	4		
2	4,764	1	4		
3	99,716	15	2	Native Companion Creek	
4	369,775	46	1	Belyando River	
5	31,126	4	2		
6	4,966	1	4		
7	5,538	1	4	Star of Hope Creek	
8	4,454	1	4	Sandy Creek	
9	16,247	1	3	Sixteen Mile Creek	
10	6,129	1	4	Lascelles Creek	
11	3,766	1	2		
12		1	4		considered equal to 13
13	11,014	1	4		
14	265,651	31	1	Mistake Creek	
15	46,840	5	3		
16	15,071,350	5			
17	3,154	5	4		
18	98,589	8	2	Miclere Creek	
19	3,818	1	4		
20	8,782	1	4		
21	105,075	14	2	Brown Creek	
22	7,171	1	4		
23	10,044	1	3	Logan Creek	
24					considered equal to 25
25	5,953	1	4		
26	238,074	20	1		
27	47,191	4	3	Diamond Creek	
28	35,894	4	3	Myra Creek	
29	3,952	1	4		
30	3,810	1	4		
31	289,019	32	4	Eagle Field Creek	
32					considered equal to 34
33					considered equal to 34
34	291,573	21	1		
35	3,675	1	4		
36	78,677	9	2	Suttor Creek	
37	12,012	1	3		
38	5,708	1	4		
39	10,421	1	3	Plum Creek	
40	19,008	3	4	Cockatoo Creek	
41	8,901	4	4	Cockatoo Creek	
42	575,765	68	4	Bowen River	
43	9,991	2	3		
44					considered equal to 45
45	60,683	8	2	Pelican Creek	
46	61,485	8	2	Rocky Creek	Table Mountain and Cattle Creek are upstream
47	9,211	1	4		
48	5,276	1	4	King Creek	
49	6,188	1	4	Herbert Creek	
50	11,590	1	3	Capsize Creek	
51	101,872	12	2	Bogie River	Brigalow Creek is upstream
52	2,970	1	4	Glen Blazes Creek	
53	4,732	1	4		
54	8,280	1	4		
55	946.4	1	4		
56	15,154	2	3	Elliot River	
57	6,139	2	4	Splitters Creek	
58		1	4		considered equal to 59
59	4,464	1	4		

Appendix C

Site Assessment Results

Waterway Crossing – 3	
Waterway	Native Companion Creek / adjacent to chainage 32000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Major Waterway
Land Use	Low intensity grazing
Catchment Area	approximately 99,716 ha
Stream Order	15
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 5m; width to top of bank approximately 30 m; average bank height approximately 4 m
Bed substrate	80% silt/clay; 15% gravel; 5% sand
Channel Sinuosity	Low
Channel Stability	Channel is stable with cohesive soils and extensive vegetation on the banks.
Banks	Unstable, banks 50% bare of vegetation and high cattle degradation.
Instream Features	Featureless trapezoidal channel.
Flow levels	Debris marks on a rope hanging high across the waterway.
Contextual Notes	Erosion channels enter creek on right bank.

Waterway Crossing – 4	
Waterway	Belyando River / Chainage 44000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate to heavy grazing
Catchment Area	approximately 369,775 ha
Stream Order	46
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 3 m; width to top of bank approximately 8 m; bank height approximately 2.5 m
Bed substrate	100% silt/clay
Channel Sinuosity	Low
Channel Stability	Channel is unstable with pools in the channel.
Banks	Unstable, small riparian zone and medium density bank vegetation.
Instream Features	Trapezoidal channel with in channel islands and pools.
Flow levels	No flood marks observed.
Contextual Notes	Moderate erosion; some silt/clay deposition on banks

Waterway Crossing – 7	
Waterway	Star of Hope Creek / Adjacent to chainage 72000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Minor Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 5,538 ha
Stream Order	1
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 8m; width to top of bank approximately 40 m; average bank height approximately 2 m
Bed substrate	Fine gravel/sandy creek with some areas of pebble and cobble.
Channel Sinuosity	Low
Channel Stability	Channel is stable.
Banks	Stable, small riparian zone and medium density bank vegetation.
Instream Features	Trapezoidal channel with in channel islands and pools.
Flow levels	Flood debris observed approximately 2.5 m above low flow channel bed.
Contextual Notes	Moderate erosion; some silt/clay deposition on banks.

Waterway Crossing – 9	
Waterway	Sixteen Mile Creek / Adjacent to chainage 72000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Minor Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 16,247 ha
Stream Order	1
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 25 m; width to top of bank approximately 30 m; bank height approximately 2 m
Bed substrate	50% sand; 25% gravel; 25% pebble
Channel Sinuosity	Low
Channel Stability	Channel is stable
Banks	Stable, banks are dominated by grass and extend into open woodland
Instream Features	Trapezoidal channel with in channel islands and pools
Flow levels	Flood debris observed approximately 1.5 m above low flow channel bed
Contextual Notes	Some erosion; little sand/gravel deposition

Waterway Crossing – 14	
Waterway	Mistake Creek
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	approximately 265,651 ha
Stream Order	31
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 30 m; average width to top of bank approximately 50 m; average bank height approximately 3 m
Bed substrate	40% bedrock; 2% cobble; 25% pebble; 30% gravel; 3% sand
Channel Sinuosity	Low
Channel Stability	Channel is stable
Banks	Stable, moderate grass and tree cover, some bare ground, little shrubs
Instream Features	Trapezoidal channel
Flow levels	No flood marks observed
Contextual Notes	Some erosion on banks; little sand/gravel deposition

Waterway Crossing – 28	
Waterway	Myra Creek / Adjacent to chainage 207000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	approximately 35,894 ha
Stream Order	4
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 5 m; width to top of bank approximately 6 m; bank height approximately 0.5 m
Bed substrate	95% silt/clay; 5% gravel/pebble.
Channel Sinuosity	Medium
Channel Stability	Low
Banks	Extensive grass coverage.
Instream Features	Creek splits downstream of assessment area into three smaller channels
Flow levels	No flood marks observed.
Contextual Notes	Little erosion; little sand deposition.

Waterway Crossing – 31	
Waterway	Eagle Field Creek / Chainage 223000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	approximately 289,019 ha
Stream Order	32
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 10 m; width to top of bank approximately 15 m; bank height approximately 2 m
Bed substrate	95% silt/clay; 5% sand.
Channel Sinuosity	Medium
Channel Stability	Channel is stable
Banks	Banks contains some areas of bare ground, particularly around tree roots, but predominately grass covered
Instream Features	Highly variable trapezoidal channel
Flow levels	High abundance of flood debris on banks approximately 2 m above water level at assessment date.
Contextual Notes	Little erosion; little sand deposition.

Waterway Crossing –	
Waterway	Suttor River / Adjacent to chainage 248000
Catchment	Belyando and Suttor sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	approximately 78,677 ha
Stream Order	9
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 25 m; width to top of bank approximately 50 m; bank height approximately 6 m right bank, approximately 12 m left bank
Bed substrate	50% silt/clay; 50% sand
Channel Sinuosity	Medium
Channel Stability	Stable.
Banks	Stable banks, with extensive vegetation, and some erosion signs.
Instream Features	Sand deposits observed downstream at bend where a shallow run is created adjacent
Flow levels	No flood marks observed.
Contextual Notes	Little erosion; moderate silt/clay deposition on banks; sand deposition at bend.

Waterway Crossing – 39	
Waterway	Pelican Creek / Chainage 375000
Catchment	Bowen Broken sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	approximately 60,683 ha
Stream Order	22
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 50 m; width to top of bank approximately 80 m; bank height approximately 4 m left bank, approximately 10 m right bank
Bed substrate	80% gravel; 15% pebble; 5% cobble
Channel Sinuosity	Medium
Channel Stability	Some in channel sinuosity
Banks	Highly stable due to extensive grass cover
Instream Features	Multiple vegetated islands within creek channel
Flow levels	Some debris marks !1,5 m above channel level
Contextual Notes	Erosion and deposition – little

Waterway Crossing – 34	
Waterway	Table mountain Creek / Adjacent to chainage 380000
Catchment	Bowen Broken sub-basin
Waterway Classification	Minor Waterway
Land Use	Heavy grazing
Catchment Area	N/a (approximately 61,485 ha for whole catchment)
Stream Order	3
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 25 m low flow channel, 8 m high flow channel; width to top of bank approximately 40 m; bank height approximately 3 m
Bed substrate	50% sandy gravel; 50% bedrock and boulder
Channel Sinuosity	Low
Channel Stability	High
Banks	Stable
Instream Features	Boulders
Flow levels	No flood marks observed
Contextual Notes	Little erosion; little deposition

Waterway Crossing – 34	
Waterway	Cattle Creek / Adjacent to chainage 380000
Catchment	Bowen Broken sub-basin
Waterway Classification	Minor Waterway
Land Use	Heavy grazing
Catchment Area	N/a (approximately61,485 ha for whole catchment)
Stream Order	2
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 3 m; width to top of bank approximately 12 m; bank height approximately 4 m left bank, approximately 2 m right bank
Bed substrate	80% gravel; 10% pebble; 10% sand
Channel Sinuosity	Medium
Channel Stability	High
Banks	Stable due to extensive grass cover
Instream Features	Stream splits into small channels
Flow levels	Some debris marks approximately 1 m above channel level
Contextual Notes	Likely to only flow during flooding

Waterway Crossing – 29	
Waterway	King Creek / Adjacent to chainage 410000
Catchment	Lower Burdekin sub-basin
Waterway Classification	Minor Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 5,276 ha
Stream Order	1
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 6 m low flow channel, 8 m high flow channel; width to top of bank approximately 35 m; bank height approximately 5 m
Bed substrate	70% gravel; 20% pebble; 10% cobble
Channel Sinuosity	Medium
Channel Stability	Stable
Banks	Stable due to good grass cover
Instream Features	Some pool and island forming
Flow levels	Debris marks approximately 3 meters above water level at site visit
Contextual Notes	Little erosion; little deposition in high flow channel

Waterway Crossing – 31	
Waterway	Herbert Creek
Catchment	Lower Burdekin sub-basin
Waterway Classification	Minor waterway
Land Use	Moderate grazing
Catchment Area	approximately6,188 ha
Stream Order	1
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 4 m; width to top of bank approximately 6 m; bank height approximately 3 m left bank, approximately 4 m right bank
Bed substrate	60% gravel; 38% pebble; 2% bedrock
Channel Sinuosity	Low
Channel Stability	High
Banks	Stable due to high vegetation density
Instream Features	Variable trapezoidal channel
Flow levels	Debris marks approximately 2 meter above channel
Contextual Notes	Little erosion; little deposition

Waterway Crossing – 32	
Waterway	Capsize Creek
Catchment	Lower Burdekin sub-basin
Waterway Classification	Minor Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 11,590 ha
Stream Order	1
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 4 m; width to top of bank approximately 10 m; bank height approximately 3 m left bank, approximately 5 m right bank;
Bed substrate	75% gravel; 20% pebble; 5% cobble
Channel Sinuosity	Low
Channel Stability	High
Banks	Stable due to good vegetation cover
Instream Features	Pools, steep left bank, some erosion due to cattle entering
Flow levels	Debris marks approximately 3 meter above channel
Contextual Notes	Little erosion; some fine gravel deposition

Waterway Crossing – 37	
Waterway	Bogie River / Adjacent to chainage 430000
Catchment	Lower Burdekin sub-basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 101,872 ha
Stream Order	12
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 100 m; width to top of bank approximately 150 m; bank height approximately 10 m right bank, approximately 12 m left bank
Bed substrate	90% fine sandy gravel; 10% boulder, cobble and pebble
Channel Sinuosity	High
Channel Stability	Low
Banks	Stable due to good vegetation cover
Instream Features	Island forming, much channel diversion
Flow levels	No flood marks observed
Contextual Notes	Little erosion and deposition

Waterway Crossing – 37	
Waterway	Brigalow Creek / Chainage 437000
Catchment	Lower Burdekin sub-basin
Waterway Classification	Minor Waterway
Land Use	Moderate grazing
Catchment Area	N/a (part of Bogie River catchment)
Stream Order	n/a
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 5 m; width to top of bank approximately 7 m; bank height approximately 1 m left bank, approximately 0.5 m right bank
Bed substrate	50% sand; 50% gravel
Channel Sinuosity	Low
Channel Stability	High
Banks	Stable due to good vegetation cover
Instream Features	Some pools.
Flow levels	No flood marks observed
Contextual Notes	Little sand deposition

Waterway Crossing – 54	
Waterway	Elliot River / Adjacent to chainage 471000
Catchment	Don River basin
Waterway Classification	Major Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 15,154 ha
Stream Order	2
Flow Frequency	Ephemeral
Site Inspection	
Channel Dimensions	Width of stream channel approximately 25 m; width to top of bank approximately 100 m; bank height approximately 15 m right bank, approximately 10 m left bank
Bed substrate	80% gravel; 10% pebble; 10% sand
Channel Sinuosity	Medium
Channel Stability	Medium
Banks	Stable
Instream Features	High and low flow channels
Flow levels	Debris marks approximately 2 meter above channel
Contextual Notes	Little erosion; deposition – sand

Waterway Crossing – 57	
Waterway	Splitters Creek / Chainage 483000
Catchment	Don River Basin
Waterway Classification	Minor Waterway
Land Use	Moderate grazing
Catchment Area	Approximately 6,139 ha
Stream Order	2
Flow Frequency	Continuous
Site Inspection	
Channel Dimensions	Width of stream channel approximately 6 m; width to top of bank approximately 25 m; bank height approximately 4 m left bank, approximately 6 m right bank
Bed substrate	90% sand; 5% gravel; 5% pebble
Channel Sinuosity	High
Channel Stability	High
Banks	Stable due to good vegetation cover
Instream Features	None
Flow levels	Debris marks up till approximately 4 meters above channel
Contextual Notes	Little erosion on upper bank; some sand deposition on banks

Appendix D

Potential Flows

Crossing number	Waterway name	50 year ARI flow rates (m^3/s)
1		481
2		380
3	Native Companion Creek	820
4	Belyando River	3100
5		554
6		499
7	Star of Hope Creek	700
8	Sandy Creek	634
9	Sixteen Mile Creek	366
10	Lascelles Creek	341
11		347
12		
13		321
14	Mistake Creek	2223
15		732
16		228878
17		27
18	Miclere Creek	1045
19		514
20		1091
21	Brown Creek	1247
22		377
23	Logan Creek	218
24		
25		50
26		2985

27	Diamond Creek	532
28	Myra Creek	367
29		523
30		492
31	Eagle Field Creek	2282
32		
33		
34		2304
35		531
36	Suttor Creek	820
37		730
38		982
39	Plum Creek	445
40	Cockatoo Creek	352
41	Cockatoo Creek	156
42	Bowen River	5012
43		485
44		5028
45	Pelican Creek	1235
46	Rocky Creek	1115
47		1605
48	King Creek	436
49	Herbert Creek	347
50	Capsize Creek	1144
51	Bogie River	1558
52	Glen Blazes Creek	454
53		1238
54		94
55		370

56	Elliot River	467
57	Splitters Creek	
58		356
59		481

Appendix E

Flood Information

Table 5 Belyando River Flood Overview (BoM Online)

Year	Month	Summary
1987	December	On 29th, in the lower reaches of the Paroo River, minor to moderate flooding, and minor flooding in the lower reaches of the Bulloo River. Both continued till the end of the month. On 30th, moderate flooding and traffic disabilities started in the Belyando and Cape rivers in the Burdekin Dam catchment and continued till 31st. Moderate flooding in the Georgina River around the Glenormiston area on 31st.
1988	January	Continuing from the previous month, minor flooding in the Paroo, Belyando and Cape rivers till 4th. Moderate flooding in the Georgina River till 7th and minor flooding continued in Eyre Creek till 14th.
1990	April	Further heavy rains fell over a wide area of western Queensland in the 3 days ended Friday 20th. Flood runoff from this rain on previously saturated catchments generated record flood levels in a number of western streams including Alpha creek in the Alpha Area.
2008	January	Very heavy rainfall occurred along the Queensland coast between Townsville and Mackay and inland over the Coalfields and Central Interior between the 10th and 20th January. This rainfall produced widespread flooding across Central Queensland including the Ross River, Haughton River, Don River, and Pioneer River, however the most pronounced and intensive rainfall occurred over the Nogoa River and Theresa Creek within the Fitzroy River Basin and the Belyando River within the Burdekin River Basin. Intense rainfall of 143 mm fell on Giru over 2 hours, whilst the heaviest daily rainfall totals exceeded 300 mm causing flash flooding in the Proserpine and Airlie Beach area. Bogantungun situated to the west of the city of Emerald recorded a 4-day rainfall total of nearly 700 mm.
2008	February	The low quickly moved out to sea allowing a strong high-pressure ridge to develop along the Queensland coast south of the monsoon trough. Conditions in Mackay deteriorated early on the 15th of February producing phenomenally intense rainfalls in the area and severe flash flooding in and around Mackay. The northward movement of the rainfall during the day of the 15th of February brought about intense rainfalls in the Townsville region that night. Major wind damage was sustained to marine craft in the Airlie Beach area just north of Mackay, and about 4000 homes were affected by flooding in the township of Mackay. This weather event resulted in a number of record floods along the Haughton River, Don River, and the Bogie River within the Burdekin Basin, as well as numerous near record floods across many other coastal catchments.

Table 6 Burdekin River Flood Overview (Upper and lower) (BoM Online)

Year	Month	Summary
1980	January	Other streams also to reach flood levels from heavy rains during the period when Cyclone "Paul" was on the synoptic charts were the Thomson River, Connors River and tributaries and the Burdekin River. Flood levels in these streams were minor to moderate, and apart from traffic disabilities, no damage reports were received.
1981	January	As the rain extended over the inland on 16th and 17th flooding commenced in the Burdekin River and Flinders River basins, the Thomson, Diamantina, Georgina rivers and Eyre Creek systems. Continued rains along the coast extended the flooding to include most streams as far south as the Pioneer River at Mackay by 20th.
1989	April	Major flooding occurred overnight and produced a peak of 7.8m at Mackay early on Wednesday 5th. Major flooding in the Proserpine River and moderate flooding in **the Don** River occurred during the 4th. Moderate flooding occurred in the Burdekin River below the dam from heavy tributary runoff causing a moderate flood peak of 10.0m at Inkerman Bridge.
1990	December	General southwest movement of Cyclone "Joy" and eventual landfall in the Ayr region, led to severe local flooding along the Central Coast. Major flooding occurred on the 27th in the Pioneer, **Don** and Haughton rivers, with minor flooding in the Lower Burdekin River.
1990	January	Continued heavy rainfalls caused by ex Cyclone "Joy" along coastal areas caused minor to moderate flooding to develop in all coastal streams between Cairns and Gladstone during January. Flooding in the Tully, Herbert, Haughton, Lower Burdekin, **Don**, and Pioneer rivers caused widespread traffic hazards, flooding of low lying properties and isolation of towns for several days. Serious flooding occurred in the small township of Giru on the HaughtonRiver as floodwaters broke their banks and flooded many houses and streets of the town in early January.

1991	February	During the first few days of February, very heavy rainfall occurred over the catchments of the Bowen and Bogie rivers and the **lower Burdekin system** downstream of the Burdekin Dam. River levels began rising overnight on Saturday 2nd and continued throughout Sunday 3rd. The river peaked at Inkerman Bridge at around midnight on Monday 4th at 12.43 metres, the third highest flood on record. Extensive flooding of the Home Hill and Ayr districts accompanied the peak. The township of Home Hill was flooded with depths of up to 0.6 metres in the main street. Evacuations of low lying residents were carried out in Home Hill and the small township of Clare. Widespread damage was caused to sugar cane crops in the district. Major flooding developed in the upper parts of the Burdekin River following rainfalls of 200 mm during the 18th to 20th. River rises and record flooding developed in the Burdekin River upstream of the Dam. The river at Sellheim peaked at 19.6 metres on the 20th, the second highest flood on record. The Burdekin Dam which was already spilling, rose to 6.85 metres above the spillway on the 21st. Moderate flooding occurred along the Lower Burdekin River downstream of the dam with river levels in the Home Hill district peaking about 1 metre lower than the flood of early February.
1997	February	The heavy rainfall from Cyclone "Ita" resulted in some heavy rainfalls in the headwaters of the Bowen River which resulted in some minor to moderate flooding in the Burdekin River **below Burdekin Falls Dam**.
1998	January	Very heavy rainfall in the upper Burdekin catchment caused rapid river rises and major flooding upstream of Burdekin Dam on 11th. The storage of the dam attenuated the flood peak and only **minor flooding was recorded downstream** to Inkerman Bridge, which experienced minor flooding from 12th to 18th.
2000	February	The initial flood warning was issued for the Burdekin River on 22nd February and was not finalised until the end of the month. During this period, minor flooding occurred in the Cape River, lower parts on the Belyando with some significant runoff from the upper Burdekin River. **Coupled with heavy local rainfall, this resulted in minor flooding in the lower reaches of the Burdekin River.**
2001	January	Heavy rainfall commencing towards the end of December resulted in river rises and minor **flooding in the lower reaches** of the Burdekin River during the first few days of January. Flood warnings were issued on the 1 January and finalised on the 4 January.
2002	February	Very heavy rainfalls were recorded in the upper Burdekin and Cape Rivers during the period 13th to 18th February with the highest total of just over 800 mm at Paluma with widespread falls between 300 and 400 mm. Major flooding resulted in the upper Burdekin and Cape River with the flooding in the Cape system being amongst the highest ever recorded. **Minor flooding occurred** along the lower Burdekin River from Monday 18th and continued to Thursday 21st February.

2005	January	Very heavy falls occurred in the catchment of the Burdekin River during 24 January, with over 400 mm recorded at Paluma for the 48 hours to 9 am 24 January. Minor to moderate flooding developed in the upper Burdekin River and Cape River and **minor flooding in the lower Burdekin River** and coastal tributaries during the 25 January. The Burdekin Falls Dam started spilling on 25 January and maintained the minor flood levels downstream at Inkerman Bridge until 28 January before easing.
2007	February	Widespread heavy rainfall across the upper Burdekin Basin and moderate rainfall elsewhere in early February resulted in major flooding quickly developing above the Burdekin Falls Dam, and **minor to moderate flooding downstream of the dam site**. Major flood warnings commenced on 2nd February. Inflows to the Burdekin Falls Dam reached a peak level of 3.8 metres above the spillway on 4th February. Downstream of the dam site floodwaters were controlled to a moderate flood level. Flood warnings continued to be issued until 9th February
2009	February	Several moderate to heavy rainfall events contributed to very much above average rainfall over the northern half of Queensland in January 2009. None of these rainfall events was sufficiently widespread to produce large river rises in the Burdekin River Catchment during this period. However, rainfall saturated the catchment, such that the first heavy rainfall event in February 2009, caused by the passage inland of Tropical Cyclone Ellie**, resulted in moderate to major flooding in both the upper and lower Burdekin** River. No record flood heights were recorded in this event, however Sellheim, which has over 130 years of record, recorded its equal 3rd highest river level of 20.5 metres.

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