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Surat Basin Rail Project
SEIS – Construction Water Response
Surat Basin Rail Pty Ltd

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Contents

1. Introduction

1.1 Background

The Surat Basin Rail Project, herein referred to as 'the Project', is a proposed open access, multi-user railway connecting the Western Railway System, situated 230 km west of Toowoomba, with the Moura Railway System, located near Banana 130 km west of Gladstone. The Project covers a linear distance of approximately 210 km, with a corridor width of approximately 60 m.

The Project has been optimised for coal freight traffic and can accommodate the follow operating scenarios:

- Narrow gauge coal railway
- Narrow gauge coal freight railway
- Dual gauge coal freight

The Project consists of a single track with up to eight passing loops. Provisional allowance in the Project's design has been made to allow for future electrification of the rail line.

The Project will have a minimum design life of 50 years and is expected to reach full operational capacity within five to ten years of construction.

1.2 Purpose of report

This document has been prepared as an appendix to the Surat Basin Rail Project Supplementary Environmental Impact Statement (SEIS) document to address the issues raised during the Project Environmental Impact Statement (EIS) consultation period pertaining to construction water supply for the Project.

This report provides information additional to that provided in the Water Resource chapter of the EIS as well as clarification of issues raised during the submission and public consultation process (refer to Appendix A of the Supplementary EIS).

1.3 Scope

Information provided in this report includes the following:

- Water supply review
  - Incorporated the revised earthworks volumes and geotechnical parameters to determine a revised water demand
- Construction water supply sources
  - Based on the revised water demands and construction methodology potential water supply sources were assessed
- Water Supply programme
  - Utilising a conceptual construction programme and the required water demands a water supply programme was assessed

2. Water supply review

2.1 Water demand estimates

Water demand estimates have been revised for the SEIS from EIS estimates due to an update of the proposed earthworks quantities and scheduling data for the Project. Earthworks quantities now better reflect the proposed railway alignment and likely ground conditions. Dust suppression volumes have also been updated to reflect likely haul distances and road widths based on preliminary designs.

Initial scheduling has also been undertaken to enable a conceptual project timeframe to be completed. Other water demands (eg concrete, pavement, camps) have not been modified from those stated in the EIS, however it is assumed that during the detailed design process, these water requirement figures will be further refined.

Geotechnical studies have been undertaken along the Project route, where a number of drill holes and test pits were installed and seismic surveys undertaken. Samples collected from test pits and drill holes were tested in a NATA accredited laboratory for their compliance with Queensland Railways (QR) and Queensland Department of Main Roads (QDMR) specifications for construction materials and sub-grade (SBR Pty Ltd JV, April 2009)

The field moisture content (FMC) of each compaction sample was evaluated and graphed against the respective Standard Optimum Moisture Content (SOMC) determined by the Standard Compaction Test. This figure indicates that the field moisture content of the majority of samples is between 5 % and 10 % dry of SOMC. Only five samples tested had a FMC/OMC ratio in excess of 90 % (SBR Pty Ltd JV, April 2009).

A statistical assessment of the optimum moisture content was undertaken using the results of the compaction sampling programme. These results indicate that for a 68 % confidence interval, an additional 14.2 % moisture equivalent will be required to be added to fill to allow for appropriate compaction.

The initial scheduling has also allowed for a far more accurate dust suppression volume to be calculated with a greater understanding of haul distances and potential quarry locations.

Revised SEIS water totals are outlined in Table 1.

Table 1: SEIS Water Construction Requirements

Description	**Maximum Water Required (ML)**
Bulk Earthworks	1,662
Concrete	18
Pavement	246
Dust Suppression	910
Misc	465
Camps	80
Subtotal	**3,382**
Contingency	800
Total (est.)	**4,200**

2.2 Water supply schedule

A water supply schedule utilising the revised water demands was developed with the aid of the conceptual construction schedule. This enabled water demand and quality to be calculated for chainages along the proposed route.

A summary of peak water requirements over the Project route is outlined in Table 2.

Table 2 Peak water requirements

Chainage (m)	Peak Water Requirement (ML/d)
0 – 9,000	1.1
9,000 – 19,280	2.5
19,280 – 63,000	1.9
63,000 – 96,000	2.3
96,000 – 125,000	1.4
125,000 – 168,000	1.7
168,000 – 213,000	2.5

Peak water requirements were used to undertake an impact assessment of the proposed water supply sources, most notably groundwater extraction, along the Project route. A conceptual water supply schedule has been attached in Appendix A.

Water requirements peak in areas of high construction activity. The construction camps are proposed to be located at Chainages 35,000, 75,000 and 165,000. The major bridge crossing of Downfall Creek is located at Chainage 90,000. Significant earthworks are also required in Chainages 19,280 to 96,000, with a number of bridge crossings and undulating topography.

2.3 Water quality

Based on the construction demands and processes, it has been identified that potentially three water quality types will be required. The three types are:

- Potable water for construction camps
- Water with medium quality suitable to be used in the concrete batching plants
- Water of relatively poor quality suitable for earth works and dust suppression

2.3.1 Potable supplies

Drinking water (potable) is defined as water intended primarily for human consumption, either directly, as supplied from the tap, or indirectly, in beverages, ice or foods prepared with water. Drinking water is also used for other domestic purposes such as bathing and showering (ADWG, 2004).

The Australian Drinking Water Guidelines (ADWG) provides the minimum requirements for drinking water of good quality, both aesthetically and from a public health viewpoint. Water suppliers should adopt a preventive risk management approach, as stipulated in the ADWG, to maintain the supply of water at the highest practicable quality (Class A+).

The *Water Supply (Safety and Reliability) Act 2008* includes new provisions that regulate drinking water quality to protect public health in Queensland. Under the Act, a drinking water supplier must have an approved drinking water quality management plan in place before being able to provide drinking water. The drinking water quality management plan must state how the supplier will store, treat and transmit or reticulate water for drinking.

However, a drinking water service provider does not include the owner of infrastructure where only the owner or the owner’s employee’s or guests use the service. The camps would only accommodate those personnel employed to work on the Project, therefore would be exempt under the Water Supply Act.

During the detailed design phase, negotiations with local councils (Western Downs Regional Council and Banana Shire Council) will be continued to ensure that a common agreement regarding the potential supply of potable water to the camps from the existing town supplies can be reached.

2.3.2 Concrete

Water for the concrete batching plant is required to at least meet the Australian Standards 1379 (AS1379) (refer to Table 3). These standards set limits for water being used in the manufacture of concrete, including oils, acids, alkalis, salts, organic material and other substances harmful to concrete, reinforcement or embedded items.

Table 3 Limits for impurities in mixing water

Impurity	Maximum concentrations	Test method
Sugar	100 mg/L	AS 1141.35
Oil and grease	50 mg/L	APHA 5520
pH	> 5	AS/NZS 1580.505.1
Chloride as Cl	> 1,000 mg/L	APHA 4500
Total dissolved solids	> 1,000 mg/L	AS 3550.4

Source: AS1379 Specification and supply of concrete

The pH of the water should be greater than 5, have a chloride-ion content of less than 1,000 milligrams per litre (mg/L). The maximum dissolved solids should be no more than 1,000 mg/L.

2.3.3 Earthworks

Water used for both ground conditioning, dust suppression and other construction activities throughout the project area is not required to meet as high a standard as for the water to be supplied for concrete and camp supplies. However, water supplies should still meet standards outlined in the '*Guide to workplace use of non-potable water including recycled waters*' developed by the Department of Employment and Industrial Relations (DEIR) to minimise the risk to health and the environment.

These guidelines provide manufacturers, suppliers, and users of non-potable water with workplace health and safety information about the safe use, handling, storage and transport of non-potable waters.

Department of Environment and Resource Management (DERM) also provides guidelines for non-potable water use which state that water for dust suppression shall have levels of Total Dissolved Solids (TDS) below 2,000 mg/L and a pH between 6 and 9. Nevertheless, if higher TDS levels are used, it is necessary to apply for a 'Beneficial Reuse Agreement' through DERM which provides guidance on when and how the Project may use the water.

2.4 Breakdown of water quality and demand

Based on the three water uses and the water demand breakdown, a comparison of water quality and volumes for the duration of the project has been undertaken and is outlined in Table 4.

Table 4 Water requirement breakdown

Water Use	Volume (ML)
Dust Suppression, Ground Conditioning	3,800
Concrete, Pavement, Camps (Non-potable)	355
Potable	45
Total	**4,200**

Concrete and potable water requirements are significantly less than the potentially poorer type of water required to be used in dust suppression and ground conditioning.

3. Construction water supply sources

3.1 Project area

The Project is located in central Queensland between the towns of Wandoan and Banana. From Wandoan the alignment travels north, passing to the west of Cracow, and continues to join the Moura Railway System near Banana. The Project is wholly contained within the catchment of the Dawson River and intercepts a number of valleys between a series of hills and ridge lines that extend from the western side of the Great Dividing Range.

The Great Artesian Basin (GAB) can be found in the south of the project area between Wandoan and Downfall Creek. The GAB that is in the project area forms part of the Surat North Management Area.

The GAB is made up of numerous sedimentary formations with some formations producing large supplies of good quality water.

3.2 Water supply sources

The Project can be divided into two areas based on the availability of water supplies. The two areas are:

- Area 1
  - Chainage 0 to 90,000
- Area 2
  - Chainage 90,000 to 210,000

This division is based on the availability of groundwater within Area 1 and a higher availability of surface and other water supply sources to groundwater in Area 2.

Area 1 is within the Great Artesian Basin (GAB) declared area where groundwater has previously (SBR EIS, 2009) been identified as a potential water supply source. At the southern extent of Area 1 are the Scotia and Peat Coal Seam Gas (CSG) fields whilst in the north the Glebe Weir on the Dawson River is within 13 km of proposed railway (Chainage 78,000). The Glebe Weir is a significant storage on the Dawson with a capacity of 17,700 ML.

Approximately 2,700 ML will be required to be sourced in Area 1 for the duration of the project (33 months). Major water use is required for the earthworks, dust suppression, bridges and the two camps.

Area 2 is within the vicinity of the Dawson River. Groundwater within Area 2 is limited to extraction from sub artesian aquifers and the Moura CSG field at the northern extents of the project area. Water from mine voids used as storages may also be available for use.

Approximately 1,500 ML will be required to be sourced in the area 2 for the duration of the project. The most reliable and feasible supply sources in the north is purchasing / leasing water allocations from the Dawson River Water Supply Scheme in conjunction with potentially purchasing water from mine voids.

3.2.1 Groundwater

There are two primary sources of groundwater within the project area:

- Great Artesian Basin (GAB)
- Sub artesian aquifers

The GAB is located in the southern water supply area, while unconfined, subartesian aquifers are located within the GAB and Fitzroy Basin catchments.

Great Artesian Basin

The southern water supply area encompasses approximately 90 km of the proposed railway, and is located in the GAB catchment.

The GAB covers an area of approximately 1.7 million km^2, extending from Cape York to the north to Dubbo in the south. It is estimated that the GAB stores approximately 64,900 million ML (Australian Department of Natural Resource and Water, 2006). Artesian aquifers within the GAB are the primary source for groundwater in the region.

The GAB has been divided into management areas to assist in the long term resource management and planning of the GAB. The SBR project is located within the Surat North Management Area.

There are three formations that artesian groundwater can be drawn from in the GAB within the Project:

- Precipice Sandstone
- Evergreen Formation
- Hutton Sandstone

The Precipice Sandstone is groundwater composed of Early Jurassic quartzose braided stream deposits and sandstone. These units are overlain by tight siltstone/shale unit, which acts as a seal. The Precipice Formation is desired because of its high yields and good water quality. Yields have been estimated as ranging from 20 – 30 L/s.

The Evergreen Formation overlies the Precipice Sandstone and acts as a seal for upper sandstone sequences within the Precipice Sandstone. The Evergreen Formation includes the Boxvale Sandstone, which consists of reservoir quality sandstone.

The Hutton Sandstone consists of Mid Jurassic quartzose braided stream sandstones. The Hutton Sandstone is heavily tapped for stock water supplies because of its shallowness compared to other aquifers. Yields in this aquifer are considered moderate, ranging from 6 - 13 L/s.

Unconfined Aquifers

The principal subartesian aquifer in the project area is the Dawson River alluvium, which is present in both the southern and northern project areas. The Dawson River alluvium is typically composed of soils ranging from unconsolidated clays, silts, sands and gravels.

Although the water-bearing sands and gravels have relatively high yields, and are shallower than GAB groundwater, they are not as reliable because their water source is primarily the Dawson River, and are dependent on rainfall.

Water supplies from Coal Seam Gas

There are three major CSG fields located within a 20 km radius of the project area.

- Dawson Valley
- Scotia
- Peat

All three are located within the Bowen Basin Gas Field.

The Dawson Valley field is located in the north of the Project (Area 2) and is near the town of Moura. It includes both the Moura and Mungi project areas. The Dawson Valley Coal Mine is located next to the CSG field and both are operated by Anglo Coal (Dawson) Limited.

The Scotia and Peat fields are located to the south of the project area, near the town of Wandoan. The Scotia Field is located approximately 18 km north east of Wandoan and within 10 km of the project area. Scotia consists of approximately 25 production wells and is operated by Santos, whilst the Peat field consists of approximately 26 production wells and is operated by Origin.

Water production from these fields in 2007 - 2008 has been identified in Table 5.

Table 5 CSG Water Production 2007-08

Field	Water Production (ML/a)	Owner
Dawson Valley	29.1	Anglo Coal (Dawson) Limited
Peat	20.1	Origin Energy
Scotia	0.0	Santos

Source: DME, 2008

The Dawson Valley field produced 29.1 ML of water in 2007-2008 whilst the Peat field produced 20.1 ML. The Scotia field did not produce any water in 2007/08 according to DME reports.

The low water production from these bores is due to the age and location of the fields. All fields have been established for some time and therefore water production has decreased substantially.

CSG fields outside the Project such as the Fairview and Spring Gully fields near Injune and the Berwyndale South located south of Miles produce higher quantities of water, with production of 2,007 ML/a, 1,976 ML/a and 1,955 ML/a respectively (DME, 2008).

Fairview and Spring Gully are located over 85 km to the west of the Project whilst Berwyndale South is 80 km to the south of the Project.

The groundwater dewatered during CSG production is typically a sodium-bicarbonate type water having a higher salinity and more sodium relative to other cations than local surface waters (Parsons Brinckerhoff, 2004).

The salinity of CSG water is variable; TDS values can range from 200 mg/L to more than 10,000 mg/L. More common TDS values are in the range from 1,000 mg/L to 6,000 mg/L.

Typical coal seam gas water quality parameters are summarised below:

- pH: 8.5 to 9.4
- TDS: 1,000 mg/L to 6,000 mg/L
- Total Alkalinity (as $CaCO_3$): 980 – 2,250 mg/L
- Chloride: 390 mg/L – 2,800 mg/L
- Sulphate: <2 mg/L

The poor quality of groundwater extracted during CSG production means that if not managed appropriately, there is the potential to cause environmental harm if released to land or waters. Due to the adverse water quality parameters from water extracted with CSG for beneficial use, the majority of extraction requires treatment. In most cases treatment involves using a reverse osmosis (RO) plant to remove salts from the extracted groundwater. The by-product of CSG water treatment is a highly saline brine.

Initial investigations of water demand indicated that whilst CSG water was available within the Project, the probability of use would be low due to the low yields and elevated salinity levels.

If CSG water was used for the Project, it would most likely be restricted to soil conditioning and dust suppression and would only occur if the water was to a suitable quality (electrical conductivity of <2500 µS/cm). Water that does not meet this requirement could not be utilised within the project area unless subject to prior treatment.

Depending on the quality of supply CSG water may require treatment to enable use in the Project. If treatment is required it is desirable that it will be undertaken by the CSG producer on their site. It is currently government policy that CSG producers are responsible for treating and disposing of CSG water, as CSG water is considered to be an industrial waste and just as other industries are responsible for appropriate management and disposal of their wastes, so are the CSG producers (DIP, 2009).

If CSG water is utilised as a water supply source, storages separate to other water sources will be required to be constructed in the project area. These storages will be sized accordingly, to limit overtopping during large rainfall events. At most, the storages will hold approximately two days supply.

If required, water from CSG could then be mixed with other water sources to lower the TDS concentrations to sustainable and environmentally sound levels for use in dust suppression and ground conditioning. All CSG storages would need to be lined, if the short term storage of CSG water potentially creates an unacceptable risk due to increases in salinity from evaporation.

A water licence or permit issued by DERM may also be required, to enable the CSG producer to supply the project with CSG water. This may be dependent on the commercial agreement reached between the CSG producer and the Project.

3.2.2 Surface water

Suitable surface water sources for construction water supply consist of:

- Water from the Dawson River
- Ephemeral tributaries of the Dawson River (eg Juandah Creek, Cockatoo Creek etc) and localised watercourses
- Overland flow
- Disused mine water

The Dawson River is a major tributary of the Fitzroy River and originates in the Carnarvon Gorges north of Injune. From the gorges the Dawson meanders approximately 640 km to the east to combine with the Mackenzie River to form the Fitzroy River. Within the project area the Dawson is characterised by lower alluvial plains and gorges (Taroom to Gyranda Weir) whilst downstream (of the Gyranda Weir), the Dawson is characterised by higher alluvial plains which widen significantly around the confluence of major tributaries. Anabranches and multiple river channels with associated 'islands' are common in this reach.

The Dawson River is located within 25 km of the Project, between Cracow and Banana. Outside of these areas the Dawson is up to 35 km from the Project.

The Project intersects a number of small creeks and drainage lines which are tributaries of the Dawson River, including Juandah, Roche, Bullock, Bungaban, Cockatoo, Cabbage Tree, Downfall, Ross, Cracow, Delusion, Oxtrack, Boam, Castle, Lonesome, Banana, Orange, Pigeon, Kianga, Spring, Bottle Tree and Stakeyard Creeks.

All of the watercourses intersected by the Project either drain from south to north or east to west towards the Dawson River. Being ephemeral systems, major flow within these watercourses is experienced only during times of heavy rainfall and is often associated with overbank flooding.

Overland flow is the movement of water over land, either before it enters a water course or after it leaves a water course as floodwater. Overland flow within the project area is most likely to occur after a significant rainfall event where runoff from the small localised catchments is most likely to flow towards the smaller tributaries of the Dawson. Most properties within the Dawson Catchment have constructed overland flow type storages to collect and store water for stock.

There is also the potential to utilise mine waste water from the nearby Dawson coal mine. This water is from the disused open pits where water collects after rainfall. Often groundwater is also intercepted by these voids, although this is dependent on the surrounding groundwater levels. The availability of this supply is dependent on internal mine demands and the quality of water within the voids at the time.

Dawson River

Upstream of the weir pool of the Glebe Weir, the Dawson River is an unregulated system with minor control works. Downstream of the Glebe Weir pool, the Dawson is a regulated system controlled by a series of weirs. The regulated section of the Dawson includes the Dawson Valley Water Supply Scheme (DVSS) which extends 338 km from Glebe Weir pond to the downstream end of the Boolburra waterhole approximately 18 km upstream of the Fitzroy River junction.

The DVSS is divided into two sub-schemes. The upper Dawson sub-scheme includes Glebe, Gyranda, Orange Creek, Theodore, and Moura weirs and the Moura Offstream Storage, while the lower Dawson sub-scheme includes Neville Hewitt Weir. The Project is within the upper Dawson sub scheme.

It is proposed that construction water could be sourced from the Dawson River in the north of Project. Water allocations could be leased and/or purchased for the duration of the project. A number of allocation holders have indicated that they are willing to lease their entitlements to the project over the period of construction, which will enable water to be supplied (if available, depending on rainfall and river flows) to the Project area.

Water allocations have been issued with a priority group depending on the use of the allocation. An allocation can either be in the high, medium or medium A priority group. A water allocation with a high priority has a high level of performance in terms of reliability of providing water (95 % to 100 %) when compared to medium (82 % to 88 %) and medium A (82 % to 88 %) priority water allocations. High priority water allocations are mostly used for urban and industrial purposes.

For the upper Dawson, the current announced allocations (1/07/2009) are:

- High Priority 100 %
- Medium 80 %
- Medium A 80 %

The Dawson River Supply Scheme operates over a water year which runs from 1 October to 30 September. At the end of each water year, the allocation holder is entitled to, in most situations, reset the balance of their water allocation account. A summary of water allocations within the upper Dawson is outlined in Table 6. A detailed water allocation location and volume outline is listed in Appendix B.

Table 6 Upper Dawson Water Allocation Summary

Priority Group	Volume (ML)
High	4,581
Medium	26,299
Medium A	19,309

The Dawson Valley Water Management Area overlaps the DVSS. The Dawson Valley Water Management Area consists of a number of unsupplemented water harvesters who hold water licences. These water licences enable the harvesting of flows during a specified flow event as outlined in the Fitzroy Resource Operation Plan (ROP). Currently, these licences can't be traded or seasonally assigned.

There may be an opportunity to utilise these water harvesting rights through the existing infrastructure, however in all cases permission from DERM would be required.

Table 7 Final allocation announcements for the Upper Dawson (2002 – 2008)[1]

Year	Priority Group	Announced Allocation (%)
2002-2003	High	100
	Medium – High	100
	Medium	100
2003 – 2004	High	100
	Medium - High	100
	Medium	100
2004 - 2005	High	100
	Medium	88
	Medium A	0
2005 - 2006	High	100
	Medium	86
	Medium A	0
2006 - 2007	High	100
	Medium	68
	Medium - A	48
2007 - 2008	High	100
	Medium	100
	Medium - A	100

Source: Sunwater Online (www.sunwater.com.au) Viewed 17/08/09

Approximately, 600 ML/a has been set aside for projects of State Significance on the Dawson River. This water is available, if a number of stringent conditions are met, as outlined in Section 6.7.3 in the Fitzroy ROP. It is unlikely that this water would be made available for the project based on a review of these conditions, however an application should not be ruled out.

Water quality measurements from the Dawson River have been outlined in the EIS. Results indicate that water would be suitable for all purposes, however if supplied for potable water supplies additional testing and treatment may be required.

Ephemeral watercourses

Whilst there are numerous small ephemeral tributaries and watercourses that are within the project area, the majority of these are low yielding. In times of high rainfall, however there may be an opportunity to take water temporarily, from these watercourses.

An ‘Application for a Water Permit’ would need to be lodged with DERM to enable extraction during periods of high water availability (eg high flows), however at this stage it is not proposed to extract water from these smaller water courses due to their low reliability.

Overland Flow

The topography of the project area varies from being relatively flat to slightly undulating to the steep ridges of the Auburn Range. Overland flow is therefore most likely to be able to be captured within the majority of the project area during rainfall events.

[1] Before the 2004/2005 irrigation season Medium allocations were known as Medium – High allocations

Overland flow is captured by local landholders for stock and domestic and/or irrigation use in large storages. In the majority of cases these storages consist of embankments erected across a flow path to allow capture of overland flow. Embankments upstream may have also been installed to assist in the diversion of overland flow to the storage.

Rainfall within the Central Queensland region is summer dominant, with almost half of rainfall falling in the months of December, January and February (40 % of average annual rainfall). Therefore, the majority of overland flow will be captured in these months during the higher rainfall events.

Regulations (Water Resource (Fitzroy Basin) Plan 1999) limit the construction of overland flow storages to a maximum of 5 ML capacity for purposes other than stock and domestic or unless an Environmental Authority has been issued by the DERM under the *Environmental Protection Act 1994*.

However, there are a number of situations where overland flow storages can be constructed with a greater storage volume than the 5 ML for purposes other than stock and domestic:

- Reconfiguration of existing notified works
  - Landholders have previously given notice to DERM outlining the size, location and purpose of the storage
  - Storages would be required to be surveyed to calculate a total volume
  - Application is made to DERM to allow for reconfiguration of existing storages into a single storage with the same storage capacity of those storages to be reconfigured
  - DERM approves application, new storage is constructed whilst other storages are decommissioned
- Construction of a stock and domestic storage with a volume greater than 5 ML
  - Application to DERM for a water permit to use water in the storage for purposes other than stock and domestic
  - Approval by DERM for a water permit. Once construction of project has been finalised, storage will revert back to a stock and domestic storage.

It is therefore proposed that, with prior approval by landholders and DERM, to construct a number of overland flow storages throughout the project area. These storages will be sited in locations that minimise the impact to the environment and downstream landholders.

Storages will be returned to landholders for stock and domestic use once construction of the railway has finished.

3.2.3 Disused mine water

The water quality in disused mining pits is variable and is often dependent on rainfall to aid with dilution. Currently this water is used for dust suppression around the mine site, equipment washdown and in the coal handling and preparation plant.

Depending on availability, there is the potential to utilise this water for ground conditioning, dust suppression and equipment washdown in the Project. This water may also be suitable to be used in the concrete batching plants. Water quality would need to be constantly monitored during extraction to ensure that it meets the required standard for its desired purpose.

An existing pipeline has been installed down the length of the mine site for mine use. It is possible that a connecting pipeline could be constructed from this existing pipeline to the Project (subject to approval), where a raw water storage would be required to be constructed. Pumping infrastructure and the pipeline would need to be sized according to peak water requirements. The pipeline could be operated as a rising main arrangement potentially reducing the operating costs of water supply.

A conceptual pipe size would be 250 NB, to enable the pipeline to be operated to allow for higher flows with shorter operating times. At the end of the railway construction the pipeline and all pumping equipment would be dismantled and salvaged from the site.

3.3 Construction water storage

To provide a suitable supply for construction, a number of water supply storages will be required at key locations. Where possible, overland flow type storages will be constructed, to enable landholders to utilise these storages once the Project has finished. However where these storages are unable to be constructed due to legislation restrictions or unsuitable locations (eg flat ground), turkey nest type storages will be developed. These will only be used to store construction water and in most cases be removed once construction has been finalised.

In most cases, storages will be required to be constructed where the average supply of water is lower than peak demands. An example of this will be where a storage is constructed to enable the storage of groundwater and the average supply from the bore/s is a lot less than peak demand required for construction.

Storages will be sized to allow for at least two days supply (~5 ML) at peak demand. Before each storage is constructed, an environmental and geotechnical assessment will be undertaken to ensure that best practice environmental and construction methods are utilised.

4. Reliability analysis

4.1 General

A risk matrix (reliability) was developed in order to quantify the reliability of each water source identified in Section 3.2. Cost estimates were assessed using prices developed from similar projects. The sources were then ranked according to reliability, as shown in Table 8.

Table 8 Water supply reliability matrix

Source	Yield	Quality	Cost	Rank
Surface Water: Dawson River	Medium	Medium - High	Low - High	1
Surface Water: Ephemeral Watercourses	Low	Low - Medium	Low	3
Surface Water: Overland Flow	Low	Low - Medium	Medium	4
Groundwater: GAB	Medium - High	Medium - High	Medium - High	1
Groundwater: Sub Artesian	Low - Medium	Medium	Low	5
Water from industry	High	Medium	Low	2
CSG Water	Low	Low	High	6

4.1.1 Surface water

Surface water, including overland flow, has been assessed as a suitable supply source which when used in conjunction with water from GAB will provide a reliable and cost effective water supply for the construction programme.

An analysis of allocation announcements in the project area, indicate that the Dawson River may provide year round access to construction water whilst the smaller tributaries may only provide the ability for opportunistic take during the wet season. Water Allocation Security Objectives (WASOs) as outlined in Schedule 3 of the WRP are summarised in Table 9. These objectives outline the simulated reliability of the priority group.

Table 9 Fitzroy Basin Water Allocation Security Objectives

Priority Group	Mandatory Median Monthly Reliability (%)	Upper Bound target Median Monthly Reliability (%)
High	≥ 95	≥ 100
Medium	≥ 82	≥ 88

Source: Schedule 3 Fitzroy Basin WRP

Allocations from the Dawson would be required to be purchased / leased from allocation holders to enable a suitable construction supply during the construction programme. Initial discussions indicate that a number of high priority allocations are available throughout the scheme to be utilised for the Project, however negotiations with allocation holders will continue to ensure that an adequate supply can be sourced. It is proposed that a greater volume of allocations will be purchased then required to ensure supply and availability.

There is also currently 3,210 ML of existing, predominantly unutilised, Medium A priority allocation located in the Theodore section of the Dawson (Zone I) that could be leased/purchased for the project (Glebe Weir Raising and Pipeline Impact Assessment, Sunwater 2008).

The raising of the Glebe Weir would potentially increase the reliability of allocations throughout the DVSS and therefore increase water availability for construction. However, significant environmental studies are required to be undertaken before commitment to the project can proceed.

Surface water has been ranked equally with GAB water as a supply source due to its suitable yield and appropriate water quality parameters, however this is dependent on future inflow conditions.

4.1.2 Groundwater

Groundwater is the potential main source in the southern Project area (Area 1) due to the high yield and suitable quality. The lack of reliable yield and poor water quality from the majority of sub artesian aquifers in Area 2, limits use for the Project and therefore ranks last in terms of providing a potential supply source.

An initial impact assessment on using GAB groundwater was undertaken by developing a groundwater model.

Groundwater impact assessment

A conceptual groundwater model of the project area was developed to assess the potential impacts that the supply of construction water may have on existing groundwater resources. The objectives of the model were to:

- To estimate the drawdown of groundwater in a well over a given period of time
- To define the region of influence that would be affected by groundwater extraction
- To identify any impacts that the project may have on surrounding land uses

An analytical model was used to assist in undertaking the impact assessment. The Theis equation (refer to Appendix C) is a tool that can conservatively estimate the impacts to aquifers within the Project area, by estimating the drawdown of groundwater in a bore and the extent of the area of influence.

The model is based on groundwater data obtained from DERM and procedures outlined in the GAB ROP (Sections 41 – 43). Groundwater extraction was only modelled in existing bores located along the 0 - 90,000 chainage of the Project, which represents the section of railway that lies within the GAB.

The railway was further broken down into the following chainages based on the proposed construction plan:

- 0 – 9,000
- 9,000 – 19,280
- 19,280 – 63,000
- 63,000 – 90,000

Three scenarios were modelled to evaluate the impacts to groundwater. The first scenario is the minimum predicted groundwater demand of the project (1,800 ML), the second scenario is the maximum predicted groundwater demand (2,700 ML) and the third scenario utilised a conservative demand of 3,500 ML as part of a sensitivity analysis.

Based on the results of the model, it is possible to meet the project's water demand using a minimum of 12 to 14 groundwater bores for the 1,800 ML and 2,700 ML scenarios, and 22 groundwater bores for the 3,500 ML scenario. By using multiple groundwater bores across the project area, it is possible to minimise adverse impacts to groundwater levels in adjacent bores, as well as the health of naturally-occurring recharge and Boggomoss springs.

A comprehensive overview of the groundwater water quality, the modelling procedure and results of the impact assessment is provided in "*Groundwater Impact Assessment, Surat Basin Rail Joint Venture*" (AECOM, 2009).

4.1.3 Coal Seam Gas water

Relying solely on CSG Water has a high risk due to the lack of consistent supply and quality within the Project area. However a number of CSG fields outside of the project (>80 km) could provide sufficient volumes of construction water and as such CSG water would need to be provided from these.

To supply the Project a pipeline would be required to be developed or a sharing arrangement with the proposed coal mines in the region established to enable a feasible supply to site. An agreement with other potential users would reduce infrastructure impact and maximise the feasibility of the pipeline.

Water from CSG would most likely need to be treated by the CSG producer before being pumped to site to meet the required construction water quality standards. This would alleviate the requirement to store potentially saline water on-site and reduce potential environmental impacts.

4.1.4 Water from industry

There are potentially large supplies of mine water collecting in the mine voids located in the north of the Project area (Area 2). This water is currently used on-site for such purposes as dust suppression and vehicle washdown.

A pipeline could be constructed from the mine to the Project to enable the supply and storage of this water. Due to the size of the mine voids, reliability of supply is high and therefore has been ranked second on the risk matrix.

5. Water supply programme

A conceptual water supply programme has been developed based on water demands and availability. The most likely sources of water within the project area are:

- Water supplied by the GAB aquifers
- Water supplied from the Dawson River

A number of other options have also been identified, however reliability and volumes may be restricted. These include:

- Water from disused mine voids
- Overland flow
- The construction of a pipeline from high yielding CSG fields like Fairview or Berwyndale South to the Project area
- The smaller ephemeral watercourses within and surrounding the project area

Approximately 4,200 ML will be required over the life of the Project (33 months) for construction. An estimated peak demand of up to 2.5 ML/d may be required during certain periods.

It is proposed that for the southern Project (Chainage 0 to 90,000) will be supplied with water from the GAB, the Dawson River and potentially with treated CSG water. Revised estimates of water requirements indicate that up to 2,700 ML would need to be supplied during the construction programme.

It is proposed that the northern Project area (Chainage 90,000 to 214,000) will be supplied with water from the Dawson River and/or potentially mine void water. Revised estimates indicate that up to 1,500 ML will be required. Overland flow will also be captured and used to minimise the volume taken from the GAB. If necessary water permits would be lodged to enable extraction (dependent on approval of applications) from the ephemeral watercourses within the Project area.

Initial impact assessments of groundwater extraction within the Project area indicate that for the proposed level of take, impacts will be within the limits outlined by in the GAB ROP. A number of landholders have indicated that they are willing to provide infrastructure to enable extraction of groundwater. Approvals would be required to be sourced from DERM.

Where possible, GAB use will be minimised for construction activities, such as ground conditioning and dust suppression.

There may be an opportunity to utilise CSG water if a pipeline is developed from the fields to north (Fairview) or to the south (Berwyndale South) for other projects within the region.

The potential raising of the Glebe Weir may also provide additional opportunities for water supply. Allocations would need to be purchased or leased to enable extraction, however reliability would also improve. Currently there has been no timeframe set for the raising of Glebe Weir.

Overland flow storages will be constructed throughout the Project area, where possible, to enable runoff to be stored during opportunistic periods. These are periods where excess water is available, such as during high rainfall events and high flow periods.

As well as overland flow storages, turkey nest type storages will be constructed along the route to allow for additional storage. These storages will only enable the collection of either direct rainfall and/or the addition of either ground or surface water and be used where overland flow type storages are restricted.

6. Summary

Based on a review of water requirements during construction of the Project and analysis of current water availability, it is likely that the required construction water volumes will be able to be sourced from within the Project area.

Water requirements during the 33 month construction programme are estimated to be approximately 4,200 ML and will be used for such activities as ground conditioning, dust suppression, concrete production and camp supplies.

Water quality required on-site will range from good (~TDS 2,000 mg/L) to excellent (Class A+) and will be managed according to best practice.

Water supply sources include groundwater from the GAB and surface supplies from the Dawson River. Potential water supply sources include water from ephemeral watercourses within the Project area, water stored in old mining voids, overland flow and CSG water supplied from outside the Project area.

A number of legislative requirements will need to be met to enable the extraction and storage of water throughout the construction phase of the Project. Approvals from both DERM and DIP will be required to ensure that impact to existing users and the environment is minimal.

7. References

AECOM 'Groundwater Impact Assessment, Surat Basin Rail Joint Venture', 2009

Australian Drinking Water Guidelines (ADWG) 2004

Department of Employment and Industrial Relations (DEIR) Workplace Health and Safety, 'Guide to workplace use of non-potable water including recycled waters', 2007

Department of Environmental and Resources Management (DERM) 'Decision to approve a resource for beneficial use – Associated water', 2008

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Department of Environmental and Resource Management (DERM), 'Fitzroy Basin Resource Operations Plan 2004 (Amended July 2009)'

Department of Infrastructure and Planning (DIP), 'Management of water produced from coal seam gas production', Discussion paper, May 2009

Department of Mines and Energy (DME), 'Queensland's coal seam gas overview 2007-2008 update' (2008)

Parsons Brinckerhoff 'Coal Seam Gas (CSG) Water Management Study', 2004

Parsons Brinckerhoff 'Wandoan Coal Project Water supply and water management technical report', 2009

Sunwater 'Glebe Weir Raising and Pipeline Impact Assessment', 2008

Sunwater Online, www.sunwater.com.au

Surat Basin Rail Joint Venture Pty Ltd 2009, 'Stage 3 Geotechnical Report'

Water Act 2000

Water Resources (Fitzroy Basin) Plan 1999

Water Supply (Safety and Reliability) Act 2008

Appendix A

Conceptual Water Supply Schedule

Appendix A

SURAT BASIN RAIL CONCEPTUAL WATER SUPPLY SCHEDULE

Water Use	From	To	Jan-10 – Jun-12 (monthly)	Peak Daily Water Demand (ML/d)	Est. Water Demand (ML/d)	Total Water Demand (ML)	Peak Water Demand (ML/d) (+ Contingency (25%))
	0	9000					
Camp				0.00		0.00	
Ground Conditioning				0.75		91.50	
Dust Suppression - Capping				0.11		3.35	
Dust Suppression - Embankments				0.08		11.80	
Pavement				0.06		10.98	
Total			0.89 0.89 0.89 0.89 0.89 0.168		0.89	117.63	1.1
	9000	19280					
Camp				0.00		0.00	
Ground Conditioning				1.76		107.36	
Dust Suppression - Capping				0.12		7.50	
Dust Suppression - Embankments				0.09		5.49	
Concrete				0.02		7.71	
Pavement				0.10		12.20	
Total			0.023 0.023 0.023 0.023 0.023 0.023 0.023 0.023 0.023 0.023 0.023 1.95 1.95 1.983 0.223		1.98	140.26	2.5
	19280	63000					
Camp				0.07		55.35	
Ground Conditioning				0.85		336.60	
Dust Suppression - Embankments				0.37		89.91	
Dust Suppression - Capping				0.46		70.38	
Dust Suppression - Camp				0.01		7.38	
Concrete				0.01		2.45	
Pavement				0.12		51.12	
Total			0.08 0.08 0.08 0.08 0.09 0.09 0.09 0.09 1.43 1.43 1.43 1.43 1.42 1.42 1.42 1.42 1.05 1.51 1.51 1.51 1.51 0.66 0.08 0.08 0.08 0.08 0.08		1.51	613.19	1.9
	63000	96000					
Camp				0.07		38.95	
Ground Conditioning				1.36		330.23	
Dust Suppression- Capping				0.34		20.50	
Dust Suppression- Embankments				0.28		119.28	
Dust Suppression - Camp				0.01		5.19	
Concrete				0.00		2.70	
Pavement				0.07		38.10	
Total			0.08 0.08 0.08 1.80 1.80 0.43 0.43 0.43 0.43 0.43 0.43 0.43 1.80 1.80 1.80 1.80 1.80 1.86 0.15 0.41		1.86	554.94	2.3
	96000	125000					
Camp							
Ground Conditioning				0.76		277.91	
Dust Suppression - Capping				0.47		29.02	
Dust Suppression- Embankments				0.25		76.00	
Concrete				0.00		0.00	
Pavement				0.07		33.50	
Total			1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 0.83 0.83 0.83 0.79 0.54 0.54		1.08	416.42	1.4
	125000	168000					
Camp				0.07		47.18	
Ground Conditioning				0.80		292.00	
Dust Suppression-Capping				0.28		25.39	
Dust Suppression- Embankments				0.37		68.08	
Dust Suppression - Camp				0.01		6.57	
Concrete				0.01		2.74	
Pavement				0.12		49.60	
Total			0.08 0.08 0.08 0.08 0.99 1.36 1.37 1.37 1.00 1.00 1.00 1.28 1.00 1.37 1.37 1.37 0.84 0.47 0.08 0.08 0.08 0.08 0.08		1.37	491.56	1.7
	168000	213000					
Camp							
Ground Conditioning				1.25		264.14	
Dust Suppression - Capping				0.54		64.80	
Dust Suppression - Embankment				0.39		70.97	
Concrete				0.02		5.17	
Pavement				0.17		51.68	
Total			1.82 1.82 1.82 1.82 1.82 1.82 1.97 0.73 0.73 0.73		1.97	456.8	2.5

Note: Conceptual Water Supply Schedule does not include additional water required for miscellaneous use/ contingency. Water requirements and programme are subject to vary and will be dependent on a number of factors

Appendix B

Dawson Valley Water Supply Scheme Allocation Summary

Appendix B

Appendix B.1: High priority water allocations (COB 21/07/09)

Location	AMTD	Description	Current Volume (ML)
Zone Dawson G	150.2 - 167	Moura Weir to effective upstream limit of Moura Weir	3,319
Zone Dawson H	167 – 228.5	Effective upstream limit of Moura Weir to Theodore Weir	0
Zone Dawson I	228.5 - 242	Theodore Weir to effective upstream limit of Theodore Weir	862
Zone Dawson J	242 – 270.7	Effective upstream limit of Theodore Weir to Orange Creek Weir	0
Zone Dawson K	270.7 - 311	Orange Creek Weir to effective upstream limit of Gyranda Weir	400
Zone Dawson L	311 – 326.2	Effective upstream limit of Gyranda Weir to Glebe Weir	0
Zone Dawson M	326.2 – 356.5	Glebe Weir to upstream limit of Glebe Weir	0
Total			**4,581**

Appendix B.2: Medium priority water allocations (COB 21/07/09)

Location	AMTD	Description	Current Volume (ML)
Zone Dawson G	150.2 - 167	Moura Weir to effective upstream limit of Moura Weir	8,431
Zone Dawson H	167 – 228.5	Effective upstream limit of Moura Weir to Theodore Weir	6,384
Zone Dawson I	228.5 - 242	Theodore Weir to effective upstream limit of Theodore Weir	1,974
Zone Dawson J	242 – 270.7	Effective upstream limit of Theodore Weir to Orange Creek Weir	5,850
Zone Dawson K	270.7 - 311	Orange Creek Weir to effective upstream limit of Gyranda Weir	2,500
Zone Dawson L	311 – 326.2	Effective upstream limit of Gyranda Weir to Glebe Weir	0
Zone Dawson M	326.2 – 356.5	Glebe Weir to upstream limit of Glebe Weir	1,160
Total			**26,299**

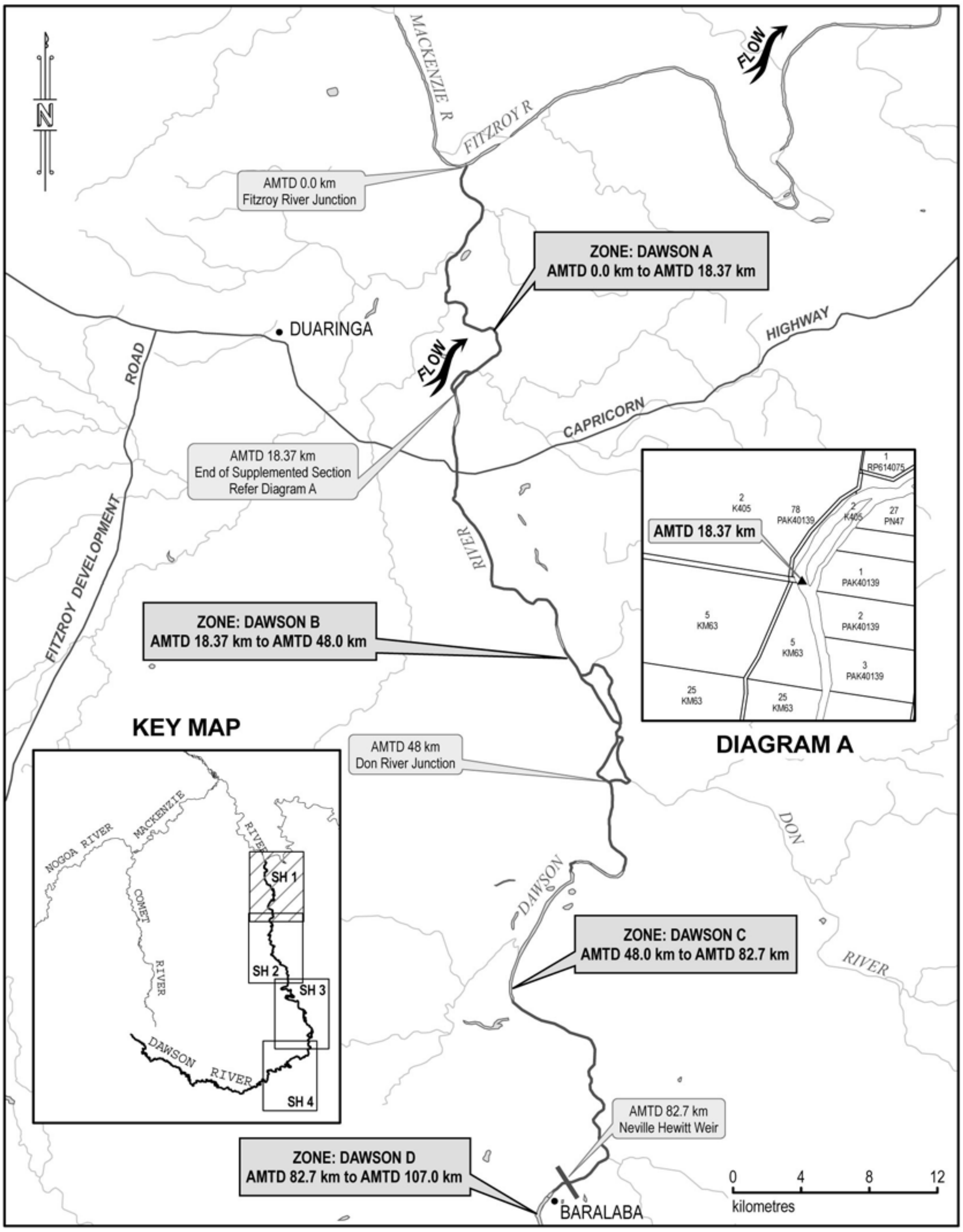
Appendix B.3: Medium-A priority water allocations (COB 21/07/09)

Location	AMTD	Description	Current Volume (ML)
Zone Dawson I	228.5 - 242	Theodore Weir to effective upstream limit of Theodore Weir	19,309
Total			**19,309**

AMTD: Average Middle Thread Distance

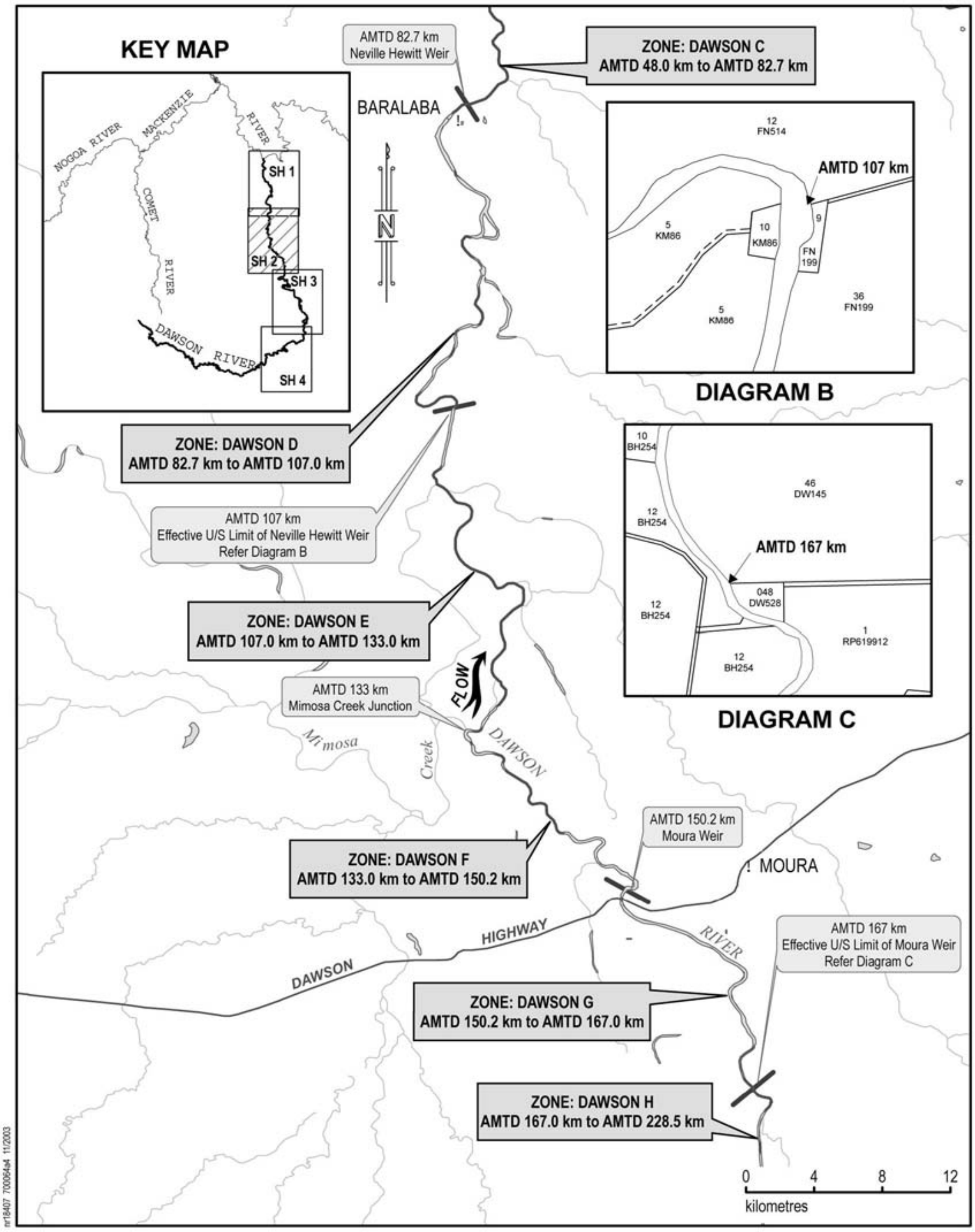
Appendix B.2: Dawson Valley Water Supply Scheme Zones

Zones: Dawson A, B, C



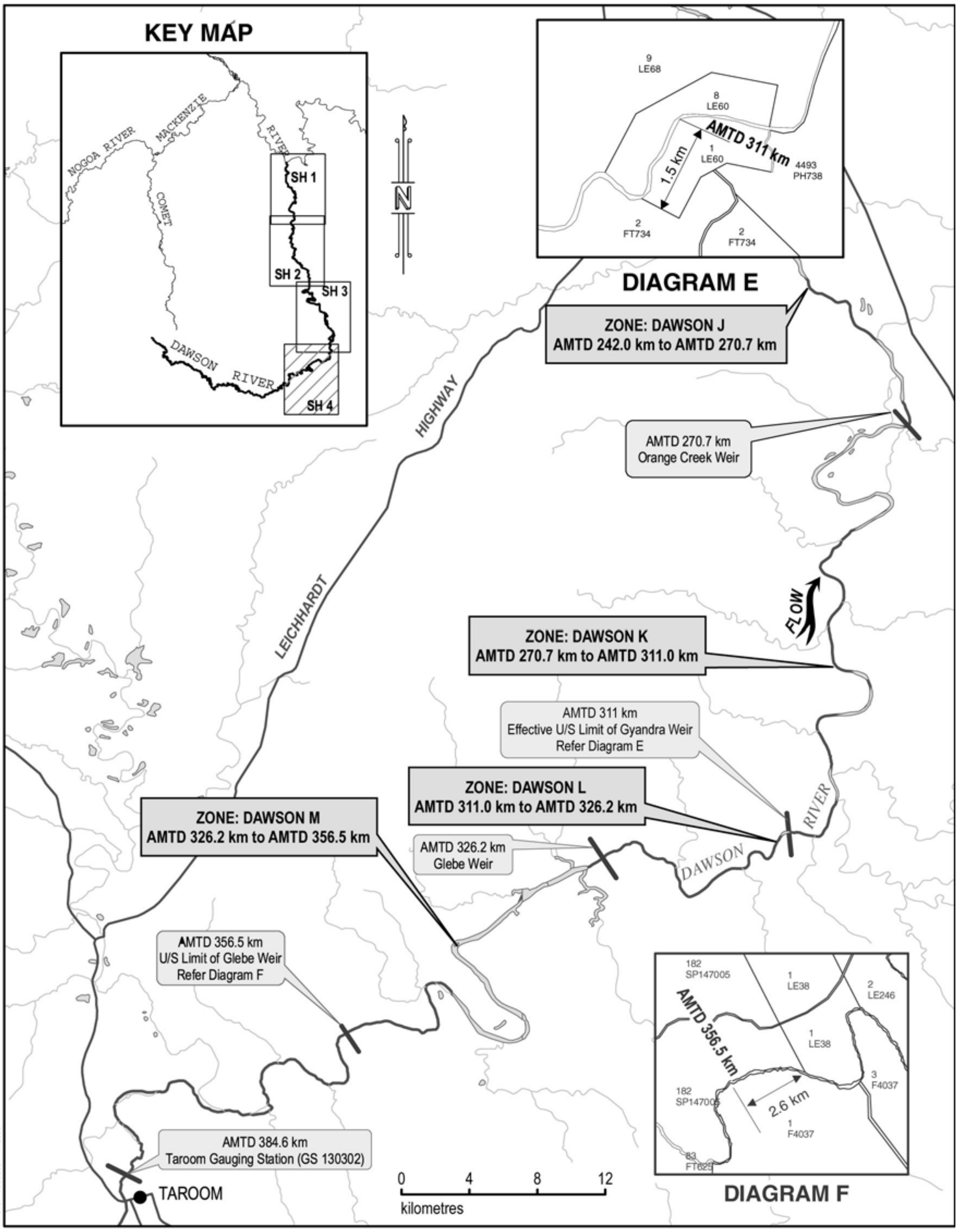
Sheet No 1

Zones: Dawson D, E, F, G



Sheet No 2

Zones: Dawson K, L, M



Sheet No 4

Appendix C

Theis Equation

Appendix C

The Theis equation is:

$$s = (QW(u)) / (4\pi T)$$

where:

- s = drawdown
- Q = extraction rate
- $W(u)$ = well function
- $u = (r^2 S) / (4Tt)$
- T = transmissivity
- r = distance from bore to observation bore or spring
- S = storage coefficient
- t = time