1. Introduction

ODH was commissioned to prepare a review and assessment of the scale and location of potential mining within the Central Queensland Galilee Basin with a focus on potential implications for surface water resources within the Belyando-Sutton Rivers sub-catchment of the Burdekin River Basin.

The Galilee Basin is a 247,000km² sedimentary basin in central Queensland which was deposited during the Late Carboniferous to Middle Triassic period (Parsons et al. 2014). It is underlain by the Carboniferous Drummond Basin and overlain by the Cretaceous-Jurassic Eromanga Basin, with the younger sediments of the Galilee Basin forming the basal sequence of the Great Artesian Basin drainage basin (Parsons et al. 2014; Scott et al. 1995). It is located approximately 200km west of the Bowen Basin, extending north to Hughenden, south to Charleville and spanning approximately 550km from east to west (see Figure 1).

The Basin contains one of the largest known thermal coal reserves on the planet, however, it is only in the last decade that interest in the location has substantially increased. The successful exploration and production of Coal Seam Gas (CSG) in the Bowen and Surat Basins, combined with the plans for major transport links have led to a significant increase in exploration activity.

Review of the status of the range of proposed, planned or approved mining projects within the Galilee Basin was undertaken based on publicly available information and data. Potential mine water demands were obtained from project planning documentation where available or estimated on the basis of water demand information for similar projects where direct data was not available.

Hydrological assessment was undertaken using recorded rainfall and streamflow data for the area, as well as hydrological information from the Departmental model for the Belyando-Sutton sub-catchment of the Burdekin Basin (i.e. developed in the IQQM software) as used in the development of the Water Plan and WMP. Current model set-up for the Belyando-Sutton sub-catchment upstream and downstream of the potential mining projects include both the main trunk of the Belyando River as well as the significant tributaries within or proximal to potential mining such as Alpha Creek and Native Companion Creek.

It is important to note that, to date, there has been no cumulative impact assessment of the overall mining take in the Galilee Basin. Such an undertaking would therefore be beneficial prior to progressing with a set of projects with high water demand within a region which exhibits significant natural hydrological variability (short periods of larger flows separated by long periods of little to no rainfall/streamflow) which will potentially be further exacerbated by ongoing climate change.
Figure 1: Galilee Basin (source: IESC 2014)
2. **Mining projects in the Galilee Basin**

In order to differentiate between projects at different stages of planning/development, the information in this report, three (3) broad categories of project ‘status’ have been adopted based on the level of formal approvals having been achieved.

The approvals process for coal mining projects in Queensland can be broadly divided into three stages:

1. **Attainment of Exploration Permit (Coal) (EPC)**
   a. Allows for the more advanced exploration of the quantity and quality of minerals present. Approved methods include prospecting, conducting of geophysical surveys, drilling and sampling and testing of materials.

2. **Granting of a Mineral Development License (MDL)**
   a. Allows for evaluation of the development potential of the defined resource through the conducting of geoscientific programs, mining feasibility studies, metallurgical testing and marketing and environmental, engineering and design studies.

3. **Mining Lease approval (MLA) and Environmental Authority (EA) issued**
   a. Approval of a mining lease is contingent on the issuing of an EA. The type of EA depends on the resource project’s level of environmental risk – with projects requiring either a standard EA application, a variation application or a site-specific application. The EA assessment process typically requires submission of an Environmental Impact Statement (EIS) by mining companies. EAs are granted by the Department of Environment and Science (DES) under the Environmental Protection Act 1994.
   b. Allows for the conducting of larger scale mining operations: including machine-mining for specific minerals and other activities associated with mining or promoting the activity of mining.

On this basis, adopted project status categories have been adopted as summarised in Table 1 below.

<table>
<thead>
<tr>
<th>Status category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved</td>
<td>EIS completed and EA issued.</td>
</tr>
<tr>
<td>High likelihood</td>
<td>EIS completed. Approved by Coordinator General. Postponed MLA process. Potential to use existing Carmichael infrastructure</td>
</tr>
<tr>
<td>Moderate likelihood</td>
<td>EIS completed, MLA under application</td>
</tr>
<tr>
<td>Low likelihood</td>
<td>MLA under application, EIS not completed.</td>
</tr>
<tr>
<td>Least likely</td>
<td>EPC only.</td>
</tr>
</tbody>
</table>
2.1 Galilee Basin mining projects

There are nineteen (19) mining projects in various stages of development located within the Galilee Basin. Of these:

- Sixteen (16) are located within the Burdekin River Basin which drains towards the east coast and into the Coral Sea near Townsville.
- Two (2) in the Cooper River Basin which drains south and west, ultimately to Lake Eyre; and
- One (1) in the Flinders River catchment of the Gulf Rivers which drains west and north into the Gulf of Carpentaria near Karumba.

Of the sixteen located in the Burdekin River Basin:

- Eleven (11) are located in an approximately north-south line, some 250 km in length, immediately proximal to the Belyando River and several of its tributaries (The first map shows all potential mines with summary details of individual projects). Of these projects, six (6) represent the most advanced projects with an MLA under application or completed, EIS submitted or completed and EA in application or approved.
- Five (5) are located in the Cape-Campaspe sub-catchment of the Burdekin Basin, all of which are in the relatively early stages of planning/development and as yet to be granted an MLA.

Review and assessment has been undertaken with an initial focus on the eleven mining projects within the Belyando-Sutton sub-catchment (as shown in Map 1 in Attachments) due to the more advanced state of the majority of these projects.

**Table 2: Current statuses of mines in the Galilee Basin (Belyando-Sutton sub-Basin)**

<table>
<thead>
<tr>
<th>Status</th>
<th>Mine</th>
<th>Resource (mt)</th>
<th>Throughput (Mt/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved</td>
<td>Carmichael Coal Mine and Rail</td>
<td>&gt;10,000</td>
<td>Up to 60</td>
</tr>
<tr>
<td>High likelihood</td>
<td>China Stone</td>
<td>&gt;1,000</td>
<td>Up to 60</td>
</tr>
<tr>
<td>Moderate likelihood</td>
<td>Alpha</td>
<td>&gt;1,000</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Galilee Coal Project</td>
<td>&gt;1,000</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Kevin’s Corner</td>
<td>500-1,000</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>South Galilee</td>
<td>&gt;1,000</td>
<td>15-17</td>
</tr>
<tr>
<td>Low likelihood</td>
<td>Alpha North</td>
<td>&gt;1,000</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Alpha West</td>
<td>&gt;1,000</td>
<td>16-24</td>
</tr>
<tr>
<td>Least likely</td>
<td>Degulla</td>
<td>Not available</td>
<td>20-40</td>
</tr>
<tr>
<td></td>
<td>Hyde Park</td>
<td>&gt;1,000</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Yellow Jacket</td>
<td>&lt;500</td>
<td>10</td>
</tr>
</tbody>
</table>
2.2 Adopted mine water demand

Estimated water demand for the eleven (11) mining projects in the Belyando-Suttor sub-Basin have been defined based on two forms of information.

1. Where available, reported demand values within EIS documentation have been adopted.

2. For projects without reported demand information, a relationship between mine throughput and peak demand was developed on the basis of available information for a range of Australian coal mines, as shown in Figure 2.

Peak water demands effectively represent the overall water requirements associated with underground mine supply, dust suppression, Coal Handling Processing Plant (CHPP) activities, potable water and water needed for workshops and vehicle washing.

![Graph showing throughput vs peak water demand for Australian coal mines](image)

**Figure 2: Throughput vs Peak water demand for Australian coal mines**

Table 3 below summarises adopted mine water demands for projects located within the Belyando-Suttor sub-Basin, with a total cumulative demand of greater than 110,000 ML/a.

Table 4 summarises mine water demands for additional projects used to defined the relationship between mine throughput and water demand (as shown in Figure 2).

An important point to note is that tabulated demand figures below represent estimated peak demands, which will be influenced by the operational status of the mine (i.e. throughput at any given time in the project life) and climatic conditions (i.e. higher demands during dry periods).

Noting that the demand for water external to the projects will be greatest during ongoing dry conditions, and that the potential impacts of project water capture and water harvesting on local flows will also be greatest under these conditions, estimated peak water demand has been adopted as a reasonable metric to assess potential total mine water demands for the region.
### Table 3: Adopted peak water demands for mining projects (Belyando-Sutor sub-Basin)

<table>
<thead>
<tr>
<th>Mine</th>
<th>Adopted peak water demand (ML/a)</th>
<th>Information source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carmichael Coal Mine and Rail</td>
<td>16,500</td>
<td>Reported</td>
</tr>
<tr>
<td>China Stone</td>
<td>14,370</td>
<td>Reported</td>
</tr>
<tr>
<td>Alpha</td>
<td>10,775</td>
<td>Reported</td>
</tr>
<tr>
<td>Galilee Coal Project</td>
<td>17,750</td>
<td>Reported</td>
</tr>
<tr>
<td>Kevin's Corner</td>
<td>8,400</td>
<td>Reported</td>
</tr>
<tr>
<td>South Galilee</td>
<td>5,350</td>
<td>Reported</td>
</tr>
<tr>
<td>Alpha North</td>
<td>11,900 [1]</td>
<td>Estimated</td>
</tr>
<tr>
<td>Alpha West</td>
<td>7,400 [1]</td>
<td>Estimated</td>
</tr>
<tr>
<td>Degulla</td>
<td>11,900 [1]</td>
<td>Estimated</td>
</tr>
<tr>
<td>Hyde Park</td>
<td>3,500 [1]</td>
<td>Estimated</td>
</tr>
<tr>
<td>Yellow Jacket</td>
<td>3,500 [1]</td>
<td>Estimated</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>111,345</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4: Peak water demands for other Australian mines

<table>
<thead>
<tr>
<th>Mine</th>
<th>Adopted peak water demand (ML/a)</th>
<th>Information source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yan Coal</td>
<td>3,174</td>
<td>Reported</td>
</tr>
<tr>
<td>New Acland</td>
<td>3,300</td>
<td>Reported</td>
</tr>
<tr>
<td>Clermont</td>
<td>3,367</td>
<td>Reported</td>
</tr>
<tr>
<td>Caval</td>
<td>5,500</td>
<td>Reported</td>
</tr>
<tr>
<td>Byerwen</td>
<td>6,180</td>
<td>Reported</td>
</tr>
<tr>
<td>Olive Downs</td>
<td>5,216</td>
<td>Reported</td>
</tr>
<tr>
<td>Minyango</td>
<td>4,667</td>
<td>Reported</td>
</tr>
<tr>
<td>Moranbah South</td>
<td>4,807</td>
<td>Reported</td>
</tr>
<tr>
<td>Springsure Creek</td>
<td>1,247</td>
<td>Reported</td>
</tr>
<tr>
<td>Taroborah</td>
<td>1,294</td>
<td>Reported</td>
</tr>
<tr>
<td>Colton</td>
<td>625</td>
<td>Reported</td>
</tr>
<tr>
<td>Red Hill</td>
<td>2,772</td>
<td>Reported</td>
</tr>
<tr>
<td>Meteor Downs South</td>
<td>191</td>
<td>Reported</td>
</tr>
</tbody>
</table>

**Notes:**  
(1) Values have been estimated using the relationship as defined from Figure 2 and coal throughput values in Table 2.
3. Water planning framework

3.1 Water planning framework overview

Water resources within the Burdekin catchment are managed/regulated under the Water Amendment Plan (Burdekin Basin) 2019 (‘the Water Plan’), which defines the availability of water in the plan area, as well as provides a framework for the taking of water and dealing with future water requirements within the Burdekin Basin.

Implementation of the Water Plan is provided by the Burdekin Basin Water Management Protocol 2016 (‘the Burdekin WMP’) which sets out the specific rules and requirements for water use and water management in the plan area to meet the overarching objectives defined in the Water Plan.

Key elements of the Water Plan and WMP that apply to, or have implications for, mining projects within the Burdekin Basin include definition of:

- Unallocated water entitlements (Strategic and General) in the Belyando-Sutton and Cape Campaspe sub-catchments of the Burdekin Basin (Water Plan and WMP);
- Existing water entitlements in the Belyando-Sutton sub-catchment of the Burdekin Basin (Water Plan);
- Discrete water use ‘zones’ within each catchment which seek to group areas with similar hydrologic behaviour (Water Plan and WMP);
- Environmental Flow Objectives (EFOs) for specific locations within the Burdekin catchment (Water Plan); and
- Water Allocation Security Objectives (WASOs) for specific water entitlement types (Water Plan).

As a component of the approvals process, each project will need to be shown to be able to operate within the requirements of the above.

The eleven (11) mines within the Belyando-Sutton sub-Basin (‘Sub-catchment E’) form an approximately 250km long, north-south line. The water required for these mines will have implications for how much water may be available for existing and future users in this sub-catchment, as well as how water may be accessed (therefore affecting its performance/reliability).

An important point to note of direct relevance to this review/assessment is that the range of projects currently engaged in the approvals process have not assessed the potential impacts of downstream hydrological and environmental/ecological conditions under conditions of cumulative water demands of the mines listed in Table 2. Put simply, each individual impact assessment has been undertaken assuming that only that specific project would be operating.

The Burdekin Basin subcatchments are shown in Figure 3 and Table 5. Figure 4 shows the Burdekin Basin relative to the Galilee Basin and the 11 mine sites described in Table 2.
Figure 3: Sub-catchment areas of the Burdekin Basin (DNRME, 2019)
Table 5: Burdekin Basin subcatchment areas

<table>
<thead>
<tr>
<th>Subcatchment</th>
<th>Subcatchment name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lower Burdekin</td>
</tr>
<tr>
<td>B</td>
<td>Haughton</td>
</tr>
<tr>
<td>C</td>
<td>Bowen</td>
</tr>
<tr>
<td>D</td>
<td>Broken</td>
</tr>
<tr>
<td>E</td>
<td>Belyando Suttor</td>
</tr>
<tr>
<td>F</td>
<td>Cape Campaspe</td>
</tr>
<tr>
<td>G</td>
<td>Upper Burdekin</td>
</tr>
</tbody>
</table>

Figure 4: Map showing the Galilee Basin and the mine sites relative to the Burdekin Basin
3.2 Currently available water entitlements

The Water Plan and WMP provide unallocated water reserves which are defined for potential future supply to mining and other projects in the Burdekin Basin. Key points of relevance to potential mining projects in the Galilee Basin include:

- Currently available reserves:
  - 130,000 ML of unallocated General reserve and 9,200 ML of Strategic reserve within the Belyando-Suttor sub-catchment (Water Plan subcatchment E) (noting estimated potential cumulative peak mine water demand of approximately 110,000 ML);
  - 5,000 ML of unallocated General reserve and 5,000 ML of Strategic reserve within the Cape-Campaspe sub-catchment Water Plan subcatchment F).

- Potential future reserves:
  - 300,000 ML of unallocated Strategic reserve associated with specific water supply infrastructure projects – 150,000 ML associated with the future raising of Burdekin Falls Dam and 150,000 ML associated with future water infrastructure within the Bowen-Broken sub-catchment.

<table>
<thead>
<tr>
<th>Reserve</th>
<th>Mean annual volume (ML) by subcatchment area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>General reserve</td>
<td>50,000</td>
</tr>
<tr>
<td>Strategic reserve for state purpose</td>
<td>0</td>
</tr>
<tr>
<td>Nominal volume (ML) by subcatchment area</td>
<td></td>
</tr>
<tr>
<td>SunWater reserve</td>
<td>0</td>
</tr>
<tr>
<td>Strategic reserve for a future raising of Burdekin Falls Dam</td>
<td>150,000</td>
</tr>
<tr>
<td>Strategic reserve for water infrastructure - Bowen and Broken subcatchments</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
- (1) At the commencement of the protocol, 9,200ML is available to be granted from strategic reserve as shown in Table 6. Upon completion of an existing State purpose project, 10,800ML will return to the State and the total available volume held in strategic reserve will be 20,000ML.

On the basis of the above, State water planning for the region has inherently allow for the level of development and water use requirements associated with the mines currently under some level of initial or advanced planning. However, it is important to note that without significant water supply infrastructure development, the above reserves would be available as unsupplemented (i.e. run-of-river) supply only, with associated reliability limitations due to the hydrologic characteristics of the area (i.e. high variability) as discussed in Section 4 below.
4. **Hydrological assessment**

Assessment was undertaken using recorded rainfall and streamflow data for the area, as well as hydrological information from the Departmental model for the Belyando-Sutter sub-catchment of the Burdekin Basin (i.e. developed in the IQQM software) as used in the development of the Water Plan. Current model set-up for the Belyando-Sutter sub-catchment upstream and downstream of the potential mining projects include both the main trunk of the Belyando River as well as the significant tributaries within or proximal to potential mining such as Alpha Creek and Native Companion Creek.

Hydrological characteristics for four (4) key locations within the Belyando-Sutter catchment (shown in Map 2 of Attachments) have been assessed:

1. Alpha Creek at confluence with Native Companion Creek;
2. Native Companion Creek at Violet Grove gauging station;
3. Belyando River downstream of Native Companion Creek confluence; and,
4. Belyando River at Gregory Development Road gauging station.

With hydrological results for each provided in three forms:

1. Illustrative flow data: Show the day-by-day and year-by-year behaviour of flow at each location.
2. Daily flow exceedance curves: Provide a good indication of the range of daily flow events likely to be experienced in the watercourse over time, and the likelihood of those flows occurring. Indicates implications for mine water supply (if relying on surface water) in terms of the rate of extraction scale of on-site storage capacity required to provide supply reliability/security appropriate for mining projects.
3. Annual flow exceedance curves: Illustrates the range and likelihood of total annual flow volumes likely to be experienced over time. Provides further indication of potential mine water supply/management system requirements by illustrating the probability of years with sufficient total flow volume to meet total cumulative peak mine demands.

Assessment was focussed on providing insights into the hydrological characteristics, and associated implications for mining projects and downstream users, at a range of temporal scales comprising:

- Short-term streamflow behaviour:
  - Streamflow information for specific flow events to illustrate the potential time available for capture/use of natural streamflow, and the relativity between ‘quick’ or surface flow response and the any persistence of baseflow.
  - Daily flow exceedance characteristics: Provides an understanding of the potential daily streamflow conditions over the longer-term, allowing
preliminary statistical definition of the probability of particular flows occurring.

- Long-term hydrologic characteristics:
  - Average and median annual streamflows: Provide a high-level understanding of the estimated average and median annual flow volumes experienced within the catchment over the past 100+ years.
  - Annual flow exceedance characteristics: Provides preliminary understanding of the probability of particular volumes of flow occurring over a year and the potential balance/imbalance between mine water demands and available streamflow volumes.

4.1 Short-term hydrologic characteristics

The short-term hydrological characteristics of the Belyando River and its tributaries of most relevance to the potential for use as a reliable and sustainable mine water supply are described in the following sections.

- Highly variable, short duration (‘flashy’) streamflow events
- Unpredictability: The variability of the climate and hydrology of the area is such that it is not possible to predict streamflow over any short-term (days to months) time scale.

Periods of streamflow within the creeks and rivers of the Belyando-Suttor sub-catchment are generally in direct response to rainfall, show a sharp/fast rising, peaking and falling of flow with little or no ongoing flow or baseflow, as shown in Figure 6 to Figure 8 below, with zero flow conditions within less than 1-2 weeks of significant (< 1% probability of exceedance) flow events.

Daily exceedance curves for each location (Figure 9 to Figure 12 below) provide a good indication of the likely days of available flow which would need to be accessed to meet demand. The daily flow exceedance information again paints a picture of high variability (i.e. short, sharp flow events, with little or no flow persistence) which would have implications for mine water supply (if relying on surface water) in terms of requiring high rates of extraction and large on-site storage capacity.

The implications of the results we see are that if there was to be any reasonable level of environmental passing flow condition applied to extractions, the reliability of supply would be further constrained with increasing need for major on-site storage and high rates of extraction, which would occur in fairly sporadic and infrequent events.
Figure 5 – March 2019 simulated flow – Alpha Creek (1,920 ML/day peak flow equalled or exceeded in less than 1% of days)

Figure 6 – March 2019 recorded flow – Native Companion Creek (3,245ML/day peak flow exceeded in less than 1% of days)
Figure 7 – March 2019 simulated flow – Belyando River (14,370 ML/day peak flow exceeded in less than 1% of days)

Figure 8 – March 2019 recorded flow – Belyando River (56,590 ML/day peak flow exceeded in less than 1% of days)
**Figure 9:** Alpha Creek daily flow duration curve and cumulative peak mine demand (South Galilee)

**Figure 10:** Native Companion Creek daily flow duration curve and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner)
Figure 11: Belyando River daily flow duration curve and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner + Alpha North + Degulla)

Figure 12: Belyando River daily flow duration curve and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner + Alpha North + Degulla + Carmichael + China Stone + Hyde Park)
4.2 Longer-term average hydrologic characteristics

The longer-term hydrological characteristics of the Belyando River and its tributaries of most relevance to the potential for use as a reliable and sustainable mine water supply are described in the following sections.

- Highly variable: Long-term (yearly, multiple year) time scales;
- Unpredictability: The variability of the climate and hydrology of the area is such that it is not possible to predict streamflow from year-to-year or longer periods (for example over the proposed period of mine operations).

The following figures are provided in pairs for each of the four assessment locations and comprise:

- A figure showing year-by-year flow behaviour at each site over the period of available model and recorded streamflow data, illustrating the long-term hydrologic characteristics of the catchment as well as types of conditions that could be experienced over periods of 10-30 years, of relevance to mining projects.
- A second figure showing the annual exceedance characteristics for the same location, providing insights into the likelihood of annual flow in any given year with comparison against cumulative peak mine demand with potential to impact on flows within the watercourse.

Year-to-year streamflow within the creeks and rivers of the Belyando-Suttor sub-catchment show long periods of (5 to 10 years) low flow interspersed with short periods (1 to 3 years) of medium to high flow volumes. This high variability is a natural characteristics of Australian hydrology in general and is increasingly prevalent in more inlands catchments such as the Balyando-Suttor.

Annual exceedance curves for each location provide a good indication of the likely days of available flow which would need to be accessed to meet demand. The annual flow exceedance information again paints a picture of high variability (i.e. long periods of low flow interspersed by one or two years with high rainfall/flow conditions).

A good ‘snapshot’ of the potential issues associated with the level of potential demand versus hydrological availability is the comparison between total demand versus ‘median annual flow’ (i.e. flow volume expected to be equalled or exceeded in 50% of years) at the four locations.

For example, under conditions in which all potential projects were operating, the combined peak demand on Native Companion Creek is some 49,000 ML/a while the median annual volume of total flow at Violet Grove gauging station is less than 15,000 ML – indicating that surface water would likely not be a viable source to meet ongoing mine demands over the life of the project.

It is important to note that while these figures effectively assume that peak demands occur coincidently for each mine, given the relative uncertainty associated with estimated vs actual mine water demands the assumption of coincident demands has been adopted
as reasonable for the purposes of understanding potential cumulative impacts if some or all of these projects go ahead.

Figure 13: Alpha Creek annual flow and cumulative peak mine demand (South Galilee)

Figure 14: Alpha Creek annual flow exceedance curve and cumulative peak mine demand (South Galilee)
Figure 15: Native Companion Creek annual flow and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner)

Figure 16: Native Companion Creek annual flow exceedance curve and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner)
Figure 17: Belyando River annual flow and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner + Alpha North + Degulla)

Figure 18: Belyando River annual flow exceedance curve for and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner + Alpha North + Degulla)
Figure 19: Belyando River annual flow and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner + Alpha North + Degulla + Carmichael + China Stone + Hyde Park)

Figure 20: Belyando River annual flow exceedance curve and cumulative peak mine demand (South Galilee + Galilee Coal + Alpha + Alpha West + Kevin’s Corner + Alpha North + Degulla + Carmichael + China Stone + Hyde Park)
4.3 Implications of hydrology for mine water supply

The implications for the mine water supply system of the type of short-term and long-term hydrology exhibited in the Belyando-Suttor catchment is that in order to create a reliable/secure supply source (i.e. one which is able to provide a constant, consistent supply every day) are:

- High rate of take via pumped or gravity-fed water harvesting;
- Significant storage capacity available at the mine;
- High operating and maintenance cost requirements due to ensure reliable operation of infrastructure under intermittent operation at high rates over short periods.

With the general outcome of this type of system being an increased potential for, and need to ensure against:

- Significant impacts during individual flow events as well as over the longer term on downstream environmental/ecological characteristics and other water users – as high rates (comparative to natural flow rates) and relatively large volumes (comparative to natural low to median flow volumes) of water harvesting are required to take advantage of the limited access opportunities.
- Inefficient use of water resources – the need to storage large volumes of water over relatively long periods of time, coupled with the high rates of evaporation in the area, would lead to a significant proportion of harvested flows being lost to evaporation.

In short, development of mine water supply systems in areas of climatic/hydrological characteristics such as the Belyando-Suttor catchment tends towards comparatively high-cost, large-scale harvesting and on-mine storage requirements, with an inherent potential for high impact on downstream water uses (including environmental), as well as low water use efficiency and ongoing operating and maintenance costs and challenges.
5. Summary outcomes and recommendations

On the basis of review and assessment described above, the following represent the key outcomes of the assessment and recommendations for potential elements of work that may add to the understanding of the potential, long-term surface water implications of the range of mining projects proposed, under planning or approved within the Galilee Basin.

At this stage, review and assessment has been undertaken with an initial focus on mining projects within the Belyando-Sutton sub-catchment due to the more advanced state of the majority of these projects.

Key outcomes:

- There are nineteen (19) mining projects in various stages of development located within the Galilee Basin. Of these:
  - Sixteen (16) are located within the Burdekin River Basin, two (2) in the Cooper River Basin and one (1) in the Flinders River catchment of the Gulf Rivers.
  - Eleven (11) are located in a north-south line, some 250 km in length, proximal to the Belyando River in the Burdekin Basin and several of its tributaries, including the six (6) most advanced projects (MLA under application or completed, EIS submitted or completed and EA in application or approved).
  - Five (5) are located in the Cape-Campaspe sub-catchment of the Burdekin Basin, all of which are in the relatively early stages of planning/development and as yet to be granted an MLA.

- The hydrology of the Belyando River and its tributaries area is characterised by:
  - High variability: both on a daily/event-based scale (short duration, ‘flashy’, streamflow events), as well as long-term (yearly, multiple year) time scales
  - Unpredictability: The variability of the climate and hydrology of the area is such that it is not possible to predict likely streamflows over any short-term (days to months) to medium-term (one year to multiple years) time scale.

- As a general outcome, the natural hydrology of the catchment does not readily support reliable, ongoing supply for mining projects without significant effort and capital expenditure.

- Based on available information, there is a potential total/sum peak demand of some 110,000 ML/a associated with the eleven (11) projects located within the Belyando-Sutton sub-catchment

- The range of projects currently engaged in the approvals process have not assessed the potential impacts of downstream hydrological and environmental/ecological conditions under conditions of cumulative water
demands. Put simply, each individual impact assessment has been undertaken assuming that only that specific project would be operating.

- Mining projects require a highly reliable, secure water supply to ensure water shortfall-related interruption to operation and production, which is at odds with the hydrological characteristics of the area. As such, it is highly likely that some form of external supply source would be required to mitigate the risk of operational interruption/shutdown due to water supply shortfall.

- As a consequence, it is likely that most (if not all) projects will require or prefer some form of supply other than local surface water resources as the primary supply source. This could take the form of a single, appropriately secure source or more likely a range of sources. Potential sources include local groundwater resources, however most likely any appropriately secure supply would require a component of piped water from a major supply source such as the Burdekin Falls Dam or other supply system.

- The Water Plan (Burdekin Basin) Amendment 2019 (the Burdekin Water Plan) and Burdekin Water Management Protocol (Burdekin WMP) provide for a significant volume of unallocated water reserves which could be accessed for supply to mining projects in the Burdekin Basin. Key points of relevance to potential mining projects in the Galilee Basin include:

  Currently available reserves:

  - 130,000 ML of unallocated General reserve and 9,200 ML of Strategic reserve within the Belyando-Sutter sub-catchment (Water Plan subcatchment E);
  - 5,000 ML of unallocated General reserve and 5,000 ML of Strategic reserve within the Cape-Campaspe sub-catchment Water Plan subcatchment F).

- The cumulative estimated mining take from the Belyando-Sutter sub-catchment is approximately 110,000 ML/a. The total general and strategic reserves for this sub-catchment, as stated above, are 139,200 ML.

- State water planning for the region has inherently allowed for the level of development and water use requirements associated with the mines currently under some level of initial or advanced planning.

- It is important to note however that without significant water supply infrastructure development, the above reserves would be available as unsupplemented (i.e. run-of-river) supply only, with associated reliability limitations due to the hydrologic characteristics of the area (i.e. high variability) as discussed in Section below.

- From the perspective of potential sources of secure supply, there are several proposals for water supply infrastructure within the region currently in various stages of planning. Of most direct relevance is the potential raising of Burdekin Falls Dam, which would allow for activation of some or all of the 150,000 ML
strategic reserve defined under the Water Plan. Further, planning is being undertaken for a major dam on the Bowen River (within the Burdekin Basin) which would allow for activation of some or all of a further 150,000 ML Strategic reserve defined under the Water Plan. It is also worth noting that SunWater have previously undertaken initial stages of planning towards the development of two new water supply schemes located within the adjacent Fitzroy River Basin (Connors River Dam in the Isaac River sub-catchment and Nathan Dam on the Dawson River) however at present no immediate plans for development exist.

- A point of note in regards of the above dot point is that significant competition is likely to exist for any strategic reserve made available through raising of Burdekin Falls Dam and/or development of Bowen River Dam, and it can not be automatically assumed this would be available to meet all mining project demands.

- The findings of this modelling assessment are comparable to those of the 2013 Bioregional Assessment (BA) conducted for the Galilee subregion by the Australian Government. The BA investigates the impact of seven proposed coal mines in the Galilee subregion (South Galilee, Galilee Coal Project, Kevin’s Corner, Alpha, Carmichael, China Stone and Hyde Park). It ultimately finds that the seven proposed mines will decrease surface water outflow, increase water balance losses, substantially increase the number of zero-flow days in the main channel of the Belyando River and the Suttor River (95% confidence) and decrease annual flow volumes (BA 2013). Similar to this assessment, the BA aims to outline the cumulative impacts on surface water which result from the aggregated impacts from individual mines and notes that impacts on surface water in the Belyando-Suttor sub-catchment can extend beyond individual mine leases.
References


Attachments
Map 1 – Mining projects (Belyando-Suttor catchment)
Map 2 – Hydrological assessment locations (Belyando-Sutton catchment)