EcOz Environmental Consultants

Dhupuma Plateau Bauxite Mine Water Account

Pre-mining Estimate

Gulkula Mining Company Pty Ltd

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RELIANCE, USES and LIMITATIONS

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1 Introduction

This Water Account, prepared by EcOz Environmental Consultants (EcOz) for the Gulkula Mining Company Pty Ltd proposed bauxite mine, is prepared in accordance with the Minerals Council of Australia, *Water Accounting Framework for the Minerals Industry* (MCA 2014); as outlined in the *User Guide Version 1.3 – January 2014* documentation and *Input-Output Model, February 2014* (Excel Spreadsheet).

As stated in the User Guide, there are three components of the framework: (1) the Input-Output model, (2) the Operational Model and (3) the Water Quality Description. The specific reports generated using these three components are the:

i. Input-Output Statement: listing of inputs, outputs and diversions with their associated water quality category.

ii. Accuracy Statement: showing the proportions of flows by volume, which are measured, estimated or simulated.

iii. Statement of Operational Efficiencies: showing the proportion of reuse and recycled flows in relation to the total flows into the tasks

iv. Contextual Statement: providing background information about the water resources of the operational facility as well as any conditions that have an impact on the management of those water resources such as climate information.

It is important to note this water account is based on very limited data given the proposed mine site is located in a remote area with little pre-existing information on surface water and groundwater. Additionally, given operations are yet to begin, estimates of water usage in mining tasks are approximate and assumptions have been made where no data exists. The data and information for this water account comes from existing broad-scale information, such as NT Government reports, and a preliminary hydrology and hydrogeology assessment undertaken by EcOz involving a field survey 6 – 8 April 2016 (see EcOz 2016).

The accuracy of this water account will be improved as more data and information is obtained in the coming months and when mining operations commence.

This water account does not include a Statement of Operational Efficiencies as water usage is restricted to simply dust suppression and amenities use and no water will be reused or recycled in mining operations.

1.1 Mining project summary

The proposed bauxite mine is located on the Dhupuma Plateau, approximately 30 km south of Nhulunbuy and 16 km south-west of Yirrkala. Mining operations are planned to start in October / November this year and will comprise surface strip mining of bauxite (maximum depth ~4.5 m), using front-end loaders (or similar), with a disturbance area of 35 Ha planned in the first four years; including mining areas and associated infrastructure. The mine will have a life of eight years, and include a ramp-up from 100,000 tpa to 500,000 tpa over the first four years. From project year five onwards, an estimated 15 Ha per year is planned to be disturbed, predominantly from mining.

There will no processing activities on-site; the ore will be hauled to the Rio Tinto Alcan Gove hard stand ore stockpile, approximately 13km from Dhupuma plateau.

The mining operation will not generate waste rock, residues or tailings, and therefore no storage facility is required. Similarly, the mining operation does not require any process / mine water dams or explosives.

Rehabilitation will be performed progressively, with pit voids mined and then back-filled and seeded within 12 months of initial clearing.

Water supply for the mine will be an existing groundwater bore; Production Bore 2 (Garma Bore). The majority of water use at the mine will be for dust suppression; estimated at 50 kL/day during the dry season and 25 kL/day during the wet season. Other minor water use includes for on-site office amenities approx. 1.25 kL per day for the five employees working onsite at any one time, and for off-site accommodation at the nearby college for 25 workers using approx. 6.25 kL per day.

Wastewater from the on-site office amenities and off-site accommodation goes to a septic system and associated absorption trench.

2 Contextual Statement

2.1 System Boundary and Reporting Period

The system boundary for this water account includes the bauxite mining footprint and associated on-site and near-site infrastructure (i.e. site office, workshops, and workers accommodation). It does not include ore processing, which will be undertaken off site at Rio Tinto's Alcan Gove Bauxite Operations.

The bauxite resource is within Exploration Licence EL 30226 (see Figure 2-1). EL 30266 covers an area of approximately 6 900 Ha, and the identified bauxite resource comprises approximately 150 Ha within this.

In regards to the reporting period, this water account applies only to the first year of mining operations; where a total area of 35 Ha maximum will be cleared for mining and 100,000 tonnes of ore will be excavated from within this area.

Mining is planned to start around October / November this year, and will continue to operate throughout the wet season (November – April) and following dry season (May – October). Operations in the first year will be small-scale, extracting around 100 000 tpa; increasing to 500 000 tpa in subsequent years. Given the extreme contrast in conditions during the wet season and dry season separate input-output models are developed for each season.

As mentioned in the Introduction, this water account is a pre-mining estimate based on very limited data and information. The Gulkula Mining Company intend to greatly improve the accuracy of water accounting input data and information over the first year of mining with the collection of task water usage data, and groundwater and surface water monitoring data.

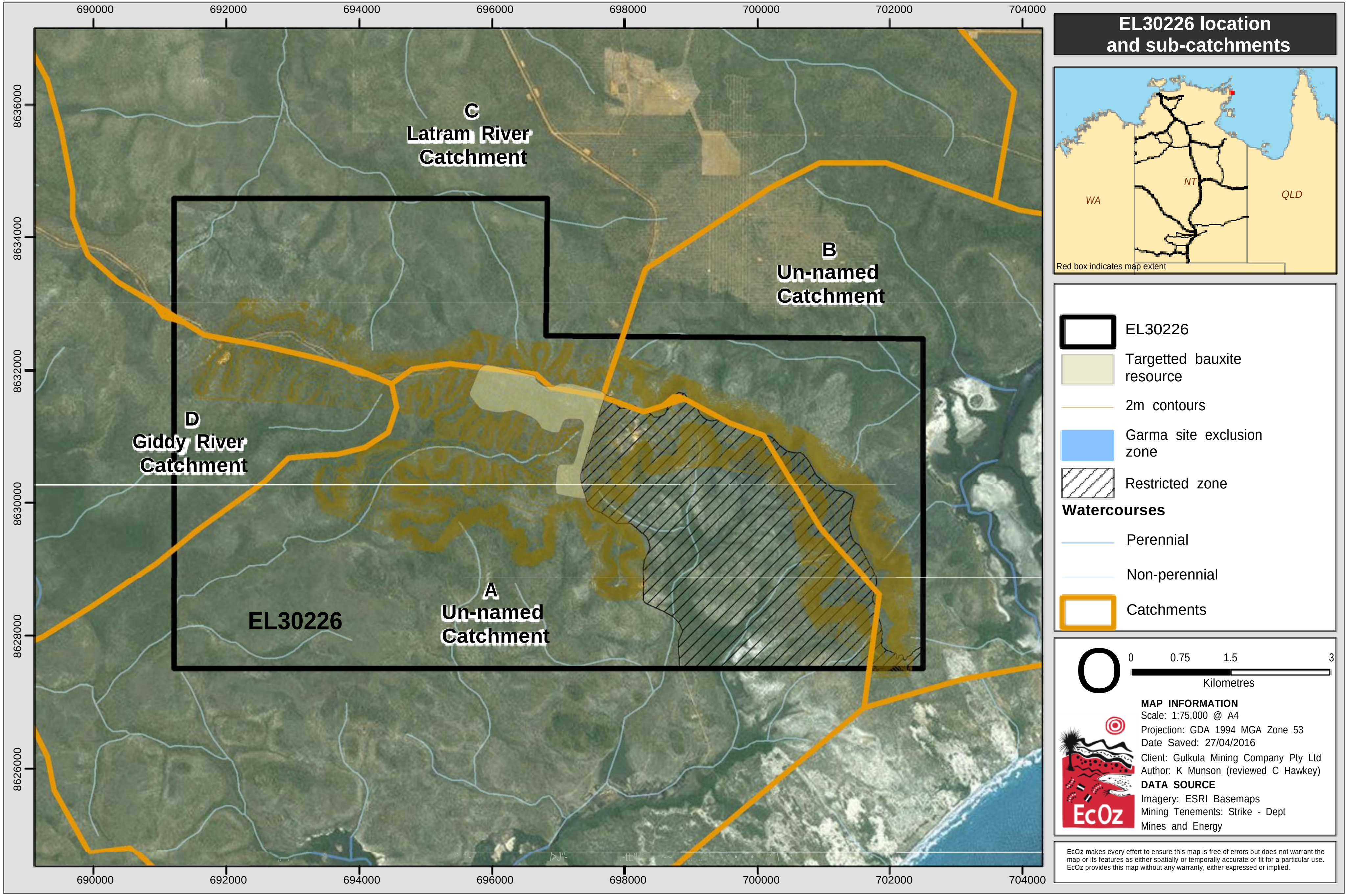
2.2 Geographical terrain, surface hydrology and groundwater

EL 30226 encompasses the Dhupuma Plateau, a 9.8 km^2 narrow bauxite-capped plateau that rises approximately 100 m above the adjacent valley floors and alluvial floodplains (Figure 2-1). The plateau falls away towards the Latram River catchment in the north, the Giddy River catchment to the west, and other catchments draining into the Gulf of Carpentaria in the east. The proposed mining activities within EL 30226 will be restricted to bauxite deposits on the Dhupuma Plateau area and will not extend into the adjacent valley floor and floodplain areas.

2.3 Catchment details

The Dhupuma Plateau within EL 30226 forms the watershed of four catchments; catchment boundaries shown in Figure 2-1. The north western portion of EL 30266 includes the headwaters of streams draining into the Latram and Giddy Rivers, which flow into Melville Bay. EL 30266 also contains two un-named catchments flowing south and to the east, entering the Gulf of Carpentaria.

The entire area proposed for mining in the first year lies within the un-named catchment A (Figure 2-1). The area proposed for mining is located at the very headwaters of this catchment and hence all surface water flows at the site are from direct rainfall; with no water flowing onto the site from upstream sources (i.e. there is no area of catchment upstream of the site).



Path: Z:\01 EcOz_Documents\04 EcO z Vantage G IS\EZ16005 - Dhupuma Surface and Groundwater Studies\01 Project Files\Figure 2 1. EL30226 location and sub-catchments v1b.mxd

Figure 2-1. EL30226 location and sub-catchments

2.4 Climate

Figure 2-2 depicts climate data from Gove Airport (BoM station 14508); the nearest weather station to EL 30226, located approximately 10 km north-west.

The site lies within the wet-dry tropics and experiences a dry season (approximately May to October) and a wet season (November to April). EL 30226 is located in an area that can be subject to cyclonic conditions during the wet season, and the area was most recently impacted by Cyclone Marcia (February 2015).

Annual average rainfall is 1450 mm, the bulk of which occurs during the wet season, with negligible rain between June and October. The wettest months are January, February and March with averages of 274 mm, 281 mm and 280 mm of rain, respectively. The average pan evaporation rate is approximately 2 000 mm per annum (BOM 2016). Temperatures range from a highest mean maximum of 33.1 ^{0}C in November to a lowest mean minimum of 19.0 ^{0}C in August.

Mean monthly wind speed recorded at station Gove Airport (station 14508) ranges from 11.4 km/h (March) to 22.1 km/h (June). Wind speeds are generally higher in the dry season months, when prevailing winds are south-easterly. During the wet season, monsoonal weather from the northwest is more typical. On average, throughout the course of a year, wind direction is predominantly east-south-east in the morning and north-west in the afternoon.

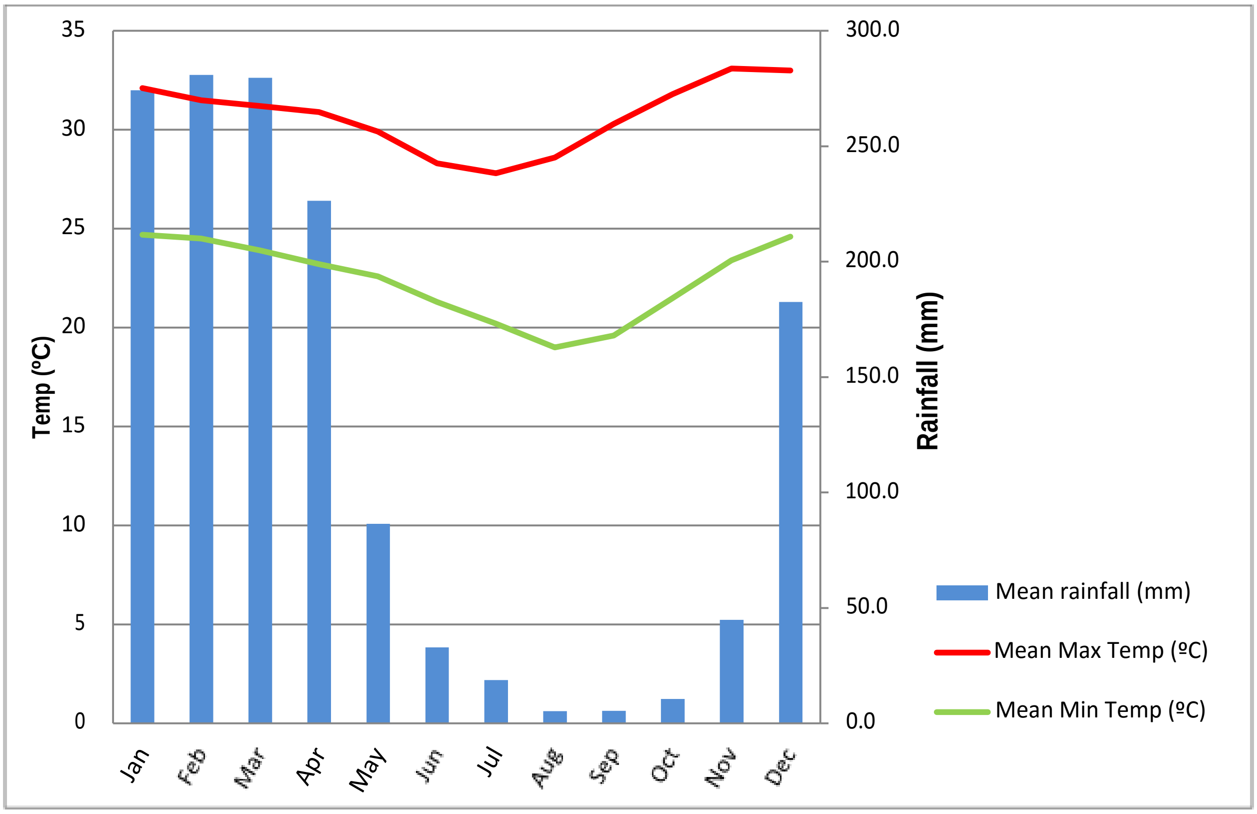


Figure 2-2. Climate data - Gove Airport (Station 014508)

2.5 Surface hydrology

As mentioned in Section 2.3 above, the proposed mine site is located at the top of the catchment and therefore no streams or surface water runs onto the site. All runoff at the mine site is generated from direct rainfall. Runoff flowing from the proposed mine site flows south into the streams of un-named catchment A (Figure 2-1). During the wet season, runoff from the site will include that flowing from areas of exposed soil cleared of vegetation, and soils disturbed by excavation activities; as well as rainfall captured in pits and pumped out. The Gulkara Mining Company will implement an erosion and sediment control plan including sediment basins and spreader banks to minimise the discharge of sediment-laden water from the site.

No surface water will be used in any mining tasks or kept in any storages on site; as such, under the MCA 2016 framework definitions, rainfall, runoff and discharge of surface water from the site is considered a “diversion”.

The unnamed streams flowing south from the mine site have been identified as permanent water courses flowing up to 10 L/s at the end of the dry season (Prowse et al 1999). Sustained flows at the end of the dry season potentially indicate groundwater inflows. The map Water Resources of North Eastern Arnhem Land indicates numerous springs located along the coastal fringe in the south-east of the EL 30226, past Bamundurr (see Prowse et al 1999). Patches of rainforest, vine thicket and Melaleuca forest present throughout EL 30266 are potentially sustained by groundwater discharge and may represent groundwater dependent ecosystems. These vegetation patches appeared to differ to surrounding vegetation on available satellite imagery of EL 30266.

2.6 Groundwater

The information below, taken from Ecoz 2016, summarises the existing broad-scale knowledge of groundwater in the region. Of most importance for this water account, is that this information indicates the groundwater aquifer is located more than 25 m below the surface bauxite deposit due to the elevated position of the Dhupuma plateau. As such, it is not expected that groundwater will be intercepted by mining operations, given excavations will be a maximum of 4.5 m. Dewatering of the pits therefore will not be required other than the pumping of pooled rainwater during the wet season.

Regional groundwater mapping (scale 1:500 000) was undertaken in 1999 by Zaar et al. as part of a study of the water resources of East Arnhem Land. The mapping identifies the following groundwater resources within EL 30266:

1. **‘Small homeland supply’** - majority of the proposed lease area and all of Dhupuma Plateau

   Narrow zones of high yielding sand aquifers occurring as valley infill; thin, laterised sandstone occurring across dissected plateaus, hard sedimentary rocks and poorly consolidated sandstone aquifers. Yields up to 0.5 L/s with moderate to low success rate expected. Occasional higher yields with careful bore site selection.

2. **‘Little chance of water’** – some areas in the SW and NE sections of the proposed lease area

   Small, isolated aquifers in weathered granite, cemented sandstone, volcanic rocks and sand layers within clay in the north-east and south. Bore yields up to 1 L/s. Small supplies with low success rate expected.

3. **‘Lots of water/large supply’** – small portion of the NW corner of the proposed lease area

   Widespread aquifer of poorly consolidated sandstone with typical bore yields of 10-50 L/s. High success rate expected. This aquifer provides a key source of base flow for major streams.

Note this broad-scale mapping was interpreted from limited drilling data and geological mapping and has not been ‘ground-truthed’ in areas where no drilling has occurred, such as the western half and far-eastern sections of the proposed lease area.

Eighteen groundwater bores have been drilled within EL 30226 and are concentrated around the ELDO and Dhupuma College sites. The majority of bores intersected groundwater in sandy clays and interbedded marine sands of the Cretaceous Yirrkala Formation at depths of 43 – 100 mbgl. Groundwater generally occurs in the coarser sand beds (where circulation is often lost during drilling), which range in thickness from a few metres to tens of metres thick. The Cretaceous aquifer is located more than 25 m below the surface bauxite deposit due to the elevated position of the plateau. The only groundwater intersection recorded above 43 m was in bore RN9263 which encountered groundwater between 17 and 19 m in fractured claystone (over 12 m below the bauxite resource). This bore was drilled toward the end of the wet season and is immediately adjacent to a deeper historic production bore (RN9267) that did not intersect groundwater until 93 mbgl. It is probable that RN9263 intersected a local, ephemeral and perched groundwater rather than the regional watertable which occurs at more significant depths.

The crystalline granitic basement of the Bradshaw Complex occurs at depths ranging from 0 - >150 m in the lease area. The basement is likely to exhibit low permeability (except where local geological structures such as faults and fractures form minor aquifers) and probably represents the lower aquifer boundary for the Cretaceous aquifer. Due to limited drilling information the thickness of the Cretaceous aquifer is poorly defined across the project site but it is known to thin to the northeast and south of the Dhupuma Plateau where outcrops of the Bradshaw Complex have been identified.

The groundwater recharge regime is unknown, due to a lack of time-series water level data or long-term bore performance data. There is probably some degree of direct recharge through the lateritic and pisolitic/nodular bauxite cap of the plateau, but this may be limited by the mottled clay zone (averaging 10 m thick) underlying the laterite.

Groundwater flow direction often, (although not always), reflects surface topography, flowing from higher elevations to lower elevations. Although uncertain without surveyed groundwater levels, it is likely that groundwater flow in the lease area radiates away from the plateau in all directions, where it discharges towards the coast or into the Giddy or Latram River catchments. The linear plateau may act as a groundwater divide in this area. Currently, the only groundwater extraction within the project area and the greater lease area occurs from the old Dhupuma College production bore no. 2 (Registered No. unknown). This bore is equipped with a solar pump and provides water to a large storage tank on the Garma site. Water from this storage is used as a supply for the training centre, knowledge centre, associated accommodation and as the principal water supply for the Garma festival. This water bore is also that proposed to be used to supply water for mining operations.

2.7 Water Quality Description

The *Water Accounting Framework for the Minerals Industry* (MCA 2014) categorises water into the following:

Category 1: Water is of a high quality and may require minimal and inexpensive treatment (for example disinfection and pond settlement of solids) to raise the quality to appropriate drinking water standards.

Category 2: Water is of a medium quality with individual constituents encompassing a wide range of values. It would require moderate level of treatment such as disinfection, neutralisation, removal of solids and chemicals to meet appropriate drinking water standards.

Category 3: Water is of a low quality with individual constituents encompassing high values of total dissolved solids, elevated levels of dissolved metals or extreme levels of pH. It would require significant treatment to remove dissolved solids and metals, neutralise and disinfect to meet appropriate drinking water standards.

Sampling undertaken 6 – 8 April 2016 by EcOz 2016 provides data for informing the categorisation of surface water and groundwater relevant to the water account.

Water samples collected from representative streams located downstream of the proposed mining area i.e. sample sites DPSW1 and DPSW2 in EcOz 2016, indicated this water is Category 1. Total Dissolved Solids

(TDS) concentrations were low, and ranged between 42.4 and 59.8 g/L, pH was close to neutral (6.24 – 6.72), and all dissolved metals concentrations met the *Australian Drinking Water Guidelines* (ADWG) “Health” limits (NHMRC, NRMMC 2011).

Groundwater sampled from Production Bore 2 (Garma Bore) indicated this water is Category 1. TDS was 39.6 mg/L, pH was 4.88, and all dissolved metals concentrations met the ADWG “Health” limits.

In regards to other water relevant to the water account:

- Direct rainfall onto the site is Category 1
- Evaporation from dust suppression activities is Category 1
- Water entrained in the ore is considered either Category 2 or 3; as stipulated in MCA 2014
- Runoff from the mine site is considered Category 2 or 3, given it will likely be turbid depending on erosion and sediment control measures implemented on site
- Wastewater from the on-site amenities and workers camp is either Category 2 or 3 depending on water treatment

2.8 Water policy

The northern half of EL 30266 falls within the Gove Water Control District (WCD). Water resources in this area are subject to management under the NT *Water Act* and associated regulations. Water Control Districts provide a basis for administering the management of surface water and groundwater resources and regulate activities including the investigation, use, control, protection and allocation of water resources. Water Control Districts are generally proclaimed in areas where there is a need for close management of water resources to avoid stressing groundwater reserves, river flows or wetlands.

The NT *Water Act* does not currently apply to mining activities where the key legislation relating to the management of water resources on mining leases is the NT *Mining Management Act*. The Northern Territory government has recently expressed an intention to remove the mining exemptions from the *Water Act. S*hould this eventuate, Gulkula Mining Company will be required to obtain:

- a bore construction permit to drill any bore located within the Gove WCD; and
- an extraction licence to take groundwater from any bore located within the Gove WCD

In the southern half of EL 30266, which falls outside the Gove WCD an extraction license will only be required if the proposed water bore has a pumping rate greater than 15 L/s.

3 Input-Output Model

3.1 Water Flow Chart

Figure 2-3 is a preliminary flow chart of inputs and outputs of water involved in mine site operations. This will be improved and amended as more data and information is gained over the coming year. It is important to note that inputs and outputs represented in the flow diagram will differ greatly between the wet season and dry season; with no rainfall and runoff during the dry season and significantly less dust suppression required during the wet season. Also of note that under the definitions outlined in the MCA 2016 framework, the rainfall/runoff → discharge to streams component of the water flow diagram is considered a "diversion" since this water is not used for any mining task or kept within any storage on site.

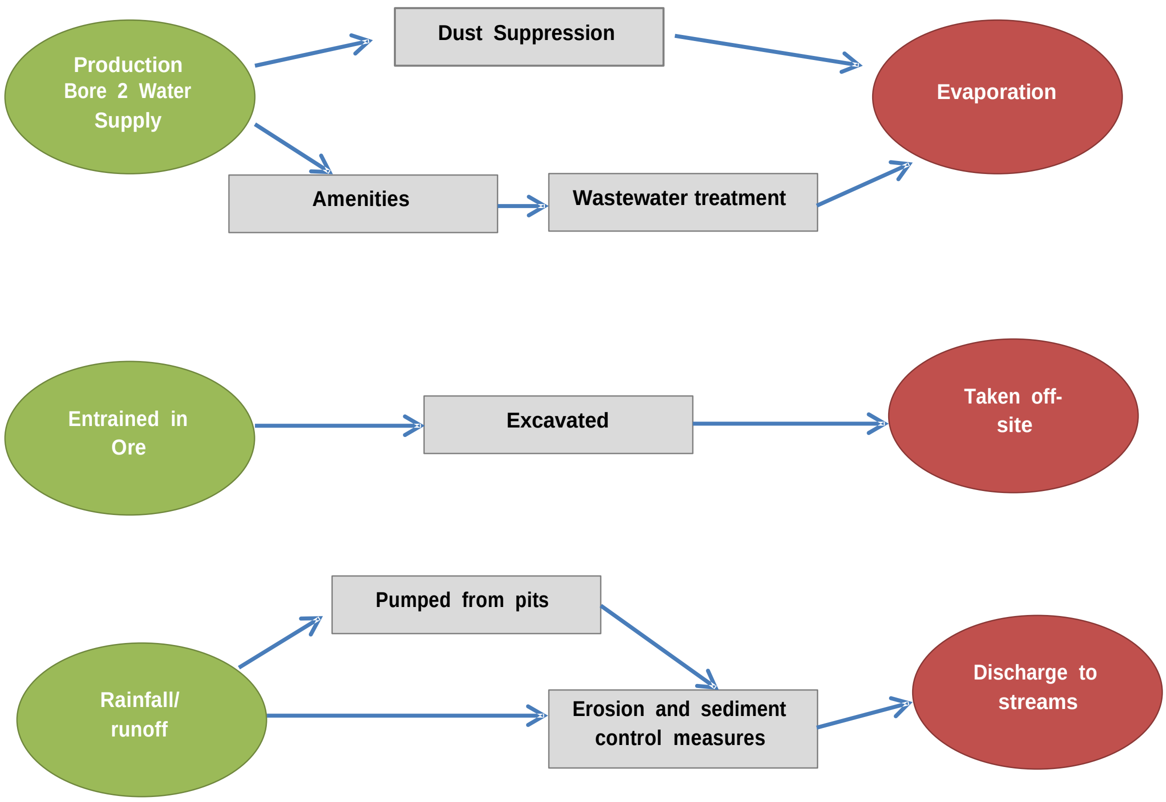


Figure 3-1. Water flow chart for mining operations

3.2 Inputs

3.2.1 Groundwater supply

Groundwater extracted from Production Bore 2 (Garma Bore) is estimated at 50 kL/day during the dry season and 25 kL/day during the wet season. Other minor water use supplied by this bore includes for on-site office amenities approx. 1.25 kL per day for the five employees working onsite at any one time, and for off-site accommodation at the nearby college for 25 workers using approx. 6.25 kL per day.

As such, total water usage for the wet season is 32.5 kL/day = 5.8825 ML

And total water usage for the dry season is 57.5 kL/day = 10.58 ML

3.2.2 Ore entrainment

The volume of water (ML) entrained in the ore (V_{ent}) is calculated using a total annual estimated tonnage of ore excavated of 1 Mt and an estimated ore moisture content of 4% in the dry season and 8% in the wet season. To calculate this value, it is assumed 0.5 Mt of ore is excavated in the dry season and 0.5 Mt in the wet season:

Dry Season: V_{ent} = 1000 x 0.5 x 0.04 = 20 ML

Wet Season: V_{ent} = 1000 x 0.5 x 0.08 = 40 ML

3.3 Outputs

3.3.1 Evaporation

It is assumed that all water used for dust suppression is evaporated.

It is assumed that all wastewater from the amenities is either evaporated directly from the absorption trench or taken up by plants and lost through evapotranspiration.

3.3.2 Transport off-site

It is assumed that all water entrained in the ore is transported off site.

3.4 Diversions

3.4.1 Rainfall

To calculate the volume of rainfall incident on the disturbed area of the mine during the first year of mining, it is assumed that the disturbed area is 35 Ha (35 000 m^2) and the average annual rainfall of 1450 mm for the nearest weather station Gove Airport (BoM station 14508) all falls during the wet season (October – April). Note as mentioned in Sections 2.3 and 2.5 above, the mine site is at the top of the catchment and there is no runoff flowing onto the site from upstream sources; all runoff is from incident rainfall.

As such, the volume of rainfall input to the site during the wet season in ML is:

$V_{Rainfall}$ = (1.45 m rainfall) x (350 000 m^2 area) = 507 500 m^3 = 507.5 ML

3.4.2 Surface water discharge

The volume of surface water discharge from the site is calculated using the total rainfall for the site during the wet season (507.5 ML), a retained rainfall factor of 0.1 to allow for seepage into the ground, and a monthly pan evaporation of 150 mm (or 900 mm for the 6 wet season months).

$V_{Discharge}$ = 507.5 – (507.5 x 0.1 retained rainfall) – (0.90 m evap x 350 000 m^2 area x 0.001)

$V_{Discharge}$ = 507.5 – 50.75 ML – 315 ML = 141.75 ML

3.5 Input-Output Statement

The Input-Output Statements provided below were generated using the MCA 2014 excel spreadsheets. A separate statement is generated for the wet season (November 2016 to April 2017) and dry season (May 2017 – October 2017).

As mentioned in Section 1, the accuracy of this water account is predominantly low; as indicated in the accuracy statement columns on the right.

Table 3-1. Wet season input-output statement

Input-Output	Source/Destination	Inputs/Outputs	Water Quality			Sub-Element Total (ML)	Accuracy (high, medium, low)		
			Category 1 (ML)	Category 2 (ML)	Category 3 (ML)		Measured	Estimated	Simulated
Input	Surface Water	*Precipitation and Runoff*				0			
		Rivers and Streams				0			
		External Surface Water Storages				0			
	Groundwater	*Aquifer Interception*				0			
		Bore Fields	5.8825			5.8825		Medium	
		Entrainment		40		40		Medium	
	Sea Water	*Estuary*				0			
		Sea/Ocean				0			
	Third Party Water	*Contract/Municipal*				0			
		Waste Water				0			
	TOTAL INPUTS		**6**	**40**	**0**	**46**			
Output	Surface Water	*Discharge*				0			
		Environmental Flows				0			
	Groundwater	*Seepage*				0			
		Reinjection				0			
	Sea Water	*Discharge to Estuary*				0			
		Discharge to Sea/Ocean				0			
	Supply to Third Party					0			
	Other	*Evaporation*	5.8825			5.8825		Low	
		Entrainment		40		40		Low	
		Other (define)				0			
	TOTAL OUTPUTS		**6**	**40**	**0**	**46**			
DIVERSIONS*									
Input	Surface Water	*Precipitation and Runoff*	507.5			507.5		Low	
		Rivers & Streams				0			
	Groundwater	*Aquifer Interception*				0			
	TOTAL DIVERSION INPUTS		**507.5**	**0**	**0**	**507.5**			
Output	Surface Water	*Discharge*		141.75		141.75		Low	
	Groundwater	*Reinjection*	50.75			50.75		Low	
	Supply to Third Party					0			
	Other	*Evaporation*	315			315		Low	
	TOTAL DIVERSION OUTPUTS		**365.75**	**141.75**	**0**	**507.5**			

Table 3-2. Dry season input-output statement

Input-Output	Source/Destination	Inputs/Outputs	Water Quality: Category 1 (ML)	Category 2 (ML)	Category 3 (ML)	Sub-Element Total (ML)	Accuracy (high, medium, low): Measured	Estimated	Simulated
Input	Surface Water	*Precipitation and Runoff*				0			
		Rivers and Streams				0			
		External Surface Water Storages				0			
	Groundwater	*Aquifer Interception*				0			
		Bore Fields	10.58			10.58		Medium	
		Entrainment		20		20		Medium	
	Sea Water	*Estuary*				0			
		Sea/Ocean				0			
	Third Party Water	*Contract/Municipal*				0			
		Waste Water				0			
	TOTAL INPUTS		**11**	**20**	**0**	**31**			
Output	Surface Water	*Discharge*				0			
		Environmental Flows				0			
	Groundwater	*Seepage*				0			
		Reinjection				0			
	Sea Water	*Discharge to Estuary*				0			
		Discharge to Sea/Ocean				0			
	Supply to Third Party					0			
	Other	*Evaporation*	10.58			10.58		Low	
		Entrainment		20		20		Low	
		Other (define)				0			
	TOTAL OUTPUTS		**11**	**20**	**0**	**31**			
DIVERSIONS*									
Input	Surface Water	*Precipitation and Runoff*				0			
		Rivers & Streams				0			
	Groundwater	*Aquifer Interception*				0			
	TOTAL DIVERSION INPUTS		**0**	**0**	**0**	**0**			
Output	Surface Water	*Discharge*				0			
	Groundwater	*Reinjection*				0			
	Supply to Third Party					0			
	Other	*Evaporation*				0			
	TOTAL DIVERSION OUTPUTS		**0**	**0**	**0**	**0**			

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