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Dear David

Airly Mine
Surface Water Licencing Requirements

1 Introduction

GHD Pty Ltd (GHD) has determined current and future surface water licence requirements for Airly Mine and has reviewed current availability within the relevant surface water source.

2 Legislation

The *Water Management Act 2000* (WM Act) is progressively being implemented throughout NSW to manage water resources in the state, superseding the *Water Act 1912*. The aim of the WM Act is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions. Surface water sources throughout NSW are managed via Water Sharing Plans (WSPs) under the WM Act. Key rules within WSPs specify when licence holders can access water and how water can be traded.

2.1 Water Sharing Plans

Airly Mine is regulated by the Greater Metropolitan Region Unregulated River Water Sources WSP (GMRU WSP). The GMRU WSP covers an area of approximately 3,250,000 ha. The WSP covers six water sources which are made up of a total of 87 management zones. The water extraction entitlement and active licences within the GMRU WSP (at the time of commencement of the WSP) are identified in Table 2-1.

Table 2-1 GMRU WSP Water Sources Extraction Entitlement and Licences

Water Source	Total Entitlement (ML/year)	Number of licences
Shoalhaven River	362,270	185
Illawarra Rivers	3,045	105

Water Source	Total Entitlement (ML/year)	Number of licences
Upper Nepean and Upstream Warragamba	669,520	411
Hawkesbury and Lower Nepean Rivers	**120,532**	**1,395**
Southern Sydney Rivers	35,341	63
Northern Sydney Rivers	1,865	49

Airly Mine lies within the Capertee River Management Zone of the Hawkesbury and Lower Nepean Rivers Water Source. As at January 2015, there was 92,235 ML (distributed over 1,310 water access licences) of tradeable water access entitlement in the 'unregulated rivers (other)' licence class of the Hawkesbury and Lower Nepean River Water Source (DoE, 2015).

2.2 Surface Water Licencing Requirements

2.2.1 Basic Landholder Rights

There are three types of basic landholder rights in NSW under the WM Act:

- Domestic and stock rights.
- Native title rights.
- Harvestable rights.

Domestic and Stock Rights

Landholders are entitled to take water from a river, estuary or lake which fronts their land or from an aquifer which is underlying their land for domestic consumption and stock watering, without the need for a WAL. However, a water supply work approval to construct a dam or a groundwater bore is still required.

Native Title Rights

Anyone who holds native title with respect to water, as determined by the *Native Title Act 1993*, can take and use water for a range of purposes, including personal, domestic and non-commercial communal purposes.

Harvestable Rights

Landholders are entitled to collect a proportion of runoff from their property and store it in one or more dams up to a certain size, known as a 'harvestable right', which is determined from the total contiguous area of land ownership. In the Central and Eastern Divisions of NSW (where the assessed operations are located), landholders may capture and use up to 10% of the average regional rainfall runoff for their property without requiring a licence under the WM Act.

The maximum harvestable right is the total volume of runoff that a landholder is entitled to use without requiring a licence. If the maximum harvestable right for a site is exceeded, licensing for the volume of water extracted from the surface water source exceeding the harvestable right is required under the WM Act.

The guidelines for determining the maximum harvestable right dam capacity (MHRDC) indicate that the following dams are exempt from the calculation of the MHRDC and do not require a licence (NOW, 2010):

- Dams for the control or prevention of soil erosion.
- Dams for the capture, containment and recirculation of drainage.
- Dams without a catchment.

2.2.2 Exemption from Requirement for Access Licence and Works Approval

As specified by Section 31 of the *Water Management (General) Regulation 2011*, dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice to prevent the contamination of a water source, are considered to be 'excluded works' and are exempt from the requirement for water supply works approval. The use of water from such dams is also exempt from the requirement for a Water Access Licence (WAL) under Section 18 of the Regulation.

2.2.3 Water Used in Mining Activities

An amendment to the WM Act (Section 60I) came into effect on 1 March 2013. This amendment provides that a WAL is required to take, remove or divert water from a water source (whether or not water is returned to that water source) or to relocate water from one part of an aquifer to another part of an aquifer in the course of carrying out a mining activity. Various activities are captured by the provisions of the amendment including mining, mineral exploration and petroleum exploration.

3 Assessment Methodology

An assessment was undertaken to determine the surface water licence requirement for Centennial Airly. This section outlines the methodology adopted to determine surface water licencing requirements.

3.1 Harvestable Rights

A WAL is required for the capture of clean runoff from undisturbed catchments in excess of the maximum harvestable right. Harvestable rights are applicable to each of Centennial operations over the area of contiguous land owned by Centennial. This area of contiguous land ownership has been determined for each of the assessed operations and is shown in Table 3-1. The online *Maximum Harvestable Right Calculator* (NOW, 2014) was used to calculate the maximum harvestable right for each of the assessed operations. As outlined in Section 2.2, the maximum harvestable right is equal to 10% of the average rainfall runoff of the total area.

The dams across the contiguous land contribute to the harvestable rights of each of the assessed operations. The capacity of existing dams was determined using the dam sizing estimate methodology recommended by NOW (2010) using aerial imagery to estimate the surface area of existing dams. The

depth for all dams was assumed to be 3 m, which is considered to be a conservative approach such that the aggregate capacity of existing dams may be slightly overestimated. Since dams used for the reticulation of drainage and coal and sediment-laden runoff is exempt from requiring licensing under the WM Act, dams that receive dirty water were not included in the assessment of harvestable rights. Maximum harvestable rights and the estimated volume of harvestable right dams for each of the operations are outlined in Table 3-1.

Table 3-1 Airly Harvestable Rights

Contiguous landholding (ha)	Maximum harvestable right (ML/year)	Harvestable right dams (ML)
1,764.8	132.4	79.1

3.2 Clean Catchments

As outlined in Section 2.2, containment and recirculation of drainage and/or effluent to prevent the contamination of a water source does not require a WAL. However, the capture of clean catchment runoff in excess of the site's maximum harvestable rights will require licencing under the WM Act.

Catchments for Airly Mine were adopted from *Airly Mine Extension Project: Surface Water Impact Assessment* (GHD, 2014).

3.2.1 Runoff Modelling

The clean water runoff intercepted by the mine water management system of each of the operations was calculated. The average runoff was determined by the Australian Water Balance Model (AWBM).

The AWBM was adopted as the most suitable model as it is widely used throughout Australia in mine water balances, has been verified through comparison with large amounts of recorded streamflow data and literature is available to assist in estimating input parameters based on recorded streamflow data (Boughton and Chiew, 2003). Another advantage of the AWBM is the consideration of soil moisture retention when determining runoff.

The AWBM is a catchment water balance model that calculates runoff from rainfall after allowing for relevant losses and storage. As seen in Figure 3-1, the model consists of three storages representing factors such as infiltration into the soil. Rainfall initially enters these storages and once a storage element is full, any additional rainfall is considered to be excess rainfall. Of this excess rainfall, a proportion is routed to the groundwater/baseflow storage (BS) while the remainder is routed to the surface storage (SS). The discharge from the baseflow storage and surface storage is estimated as a proportion of the volume of the storages at the end of each day. The total daily runoff is equal to the combined volume of water discharged from these two storages. The definition of AWBM parameters is provided in Table 3-2.

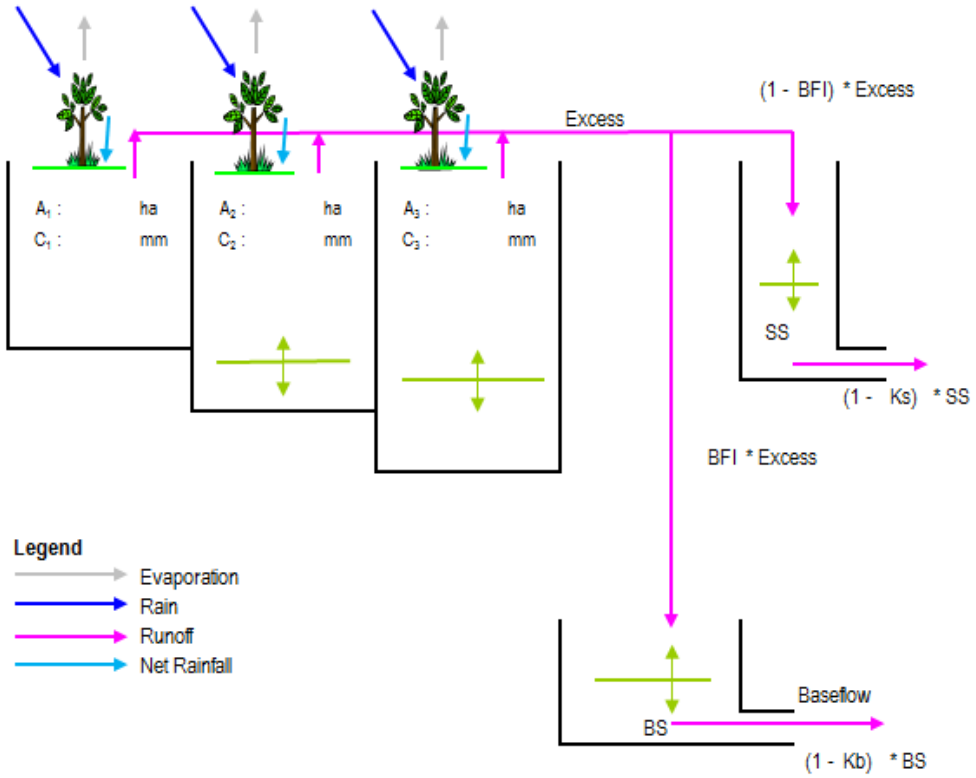

Figure 3-1 AWBM Representation

Table 3-2 Description of AWBM Parameters

Parameter	Description
A_1, A_2, A_3	The partial areas of the overall catchment contributing to storages 1, 2 and 3 respectively.
C_1, C_2, C_3	The capacity of storages 1, 2 and 3 respectively.
BFI	The proportion of excess rainfall flowing to the baseflow.
Excess	Excess from storages C_1, C_2 and C_3.
SS	Surface storage recharge.
BS	Baseflow storage recharge.
K_b	The proportion of the volume of the baseflow storage remaining in the storage at the end of each day. Not applicable for this water and salt balance model as there

Parameter	Description
	is no baseflow component.
K_s	The proportion of the surface storage remaining in the storage at the end of each day.

The relevant site catchments were divided into two areas representing bushland/vegetation and impervious areas. The two areas were modelled with a different set of AWBM parameters. The AWBM parameters adopted for the assessment are presented in Table 3-3.

The parameters for bushland/vegetation areas were determined based on available literature where historical streamflow data had been used to provide recommendations on parameter selection. The AWBM has been calibrated against runoff data from 221 gauged catchments across Australia. The nearest location for which AWBM parameters have been determined by Boughton and Chiew (2003) was Capertee River, located approximately 25 km east of Airly Mine. The recommended parameters relating to baseflow were adjusted to reflect the ephemeral nature of drainage lines adjacent to the sites.

The impervious areas were modelled with no infiltration into the soil and no surface storage or baseflow storage. Only one storage was assigned a non-zero capacity. This storage represents depression storage of 7 mm for impervious areas. The baseflow parameters were adjusted to reflect no baseflow as the relevant site catchments are not typically large enough to generate baseflow.

The runoff for each relevant catchment was calculated by scaling the runoff depth to reflect the catchment bushland/vegetation area, impervious area and disturbed/compacted area. The runoff parameters were considered reasonable given the lack of site-specific flow gauging data and significant variability in catchment runoff characteristics that can occur.

Table 3-3 Australian Water Balance Model Parameters

Parameter	Bushland/vegetation areas	Impervious areas
A_1, A_2, A_3	0.134, 0.433, 0.433	1.0, 0.0, 0.0
C_1, C_2, C_3	18.0, 182.88, 365.76 ($C_{average}$ = 240)	7.0, 0.0, 0.0
BFI	0.0	0.0
Excess	Calculated	Calculated
SS	(1-BFI) x Excess	(1-BFI) x Excess
BS	BFI x Excess	BFI x Excess
K_b	N/A	N/A
K_s	0.5	0.0

3.2.2 GoldSim

The model used to represent the AWBM was GoldSim Version 10.50 (GoldSim Technology, 2011). This software is a graphical object orientated system for simulating either static or dynamic systems. It is like a 'visual spreadsheet' that allows one to visually create and manipulate data and equations.

The model was produced by representing the AWBM as a series of elements, each containing pre-set rules and data, that were linked together to simulate the interaction of these elements within the water cycle. The water cycle was simulated over time in GoldSim and selected outputs from the modelled system were statistically summarised.

The GoldSim model simulated conditions for the project site over a year using daily time steps. Daily time steps were used for the modelling as daily rainfall data was the shortest period of data available.

To assess the impact of rainfall on the site, the water balance modelling was carried out by applying 113 different rainfall patterns over the simulation timeline. To complete this, the simulation timeline was modelled for 113 'realisations', where each realisation represented a single model run. The only variation between realisations was that each realisation modelled a different continuous historical rainfall pattern.

The 113 realisations were applied as the historical rainfall data extended from January 1901 to December 2013 which represents 113 years of complete rainfall data available. The 113 years of rainfall data provides 113 rainfall patterns as the seasonality in rainfall is maintained for each model run, e.g. 1 January in the model was simulated with historical rainfall data for 1 January. For each realisation, a continuous pattern of historical rainfall was applied over the simulation timeline. Where the end of the continuous historical rainfall record was reached in a realisation, the rainfall looped back to the start of the rainfall record. A graphical explanation of the rainfall simulation process is provided in Figure 3-2.

The above repetition process provided 113 values for each simulated element in the model. Each transfer was then statistically assessed to provide estimates of the average catchment runoff.

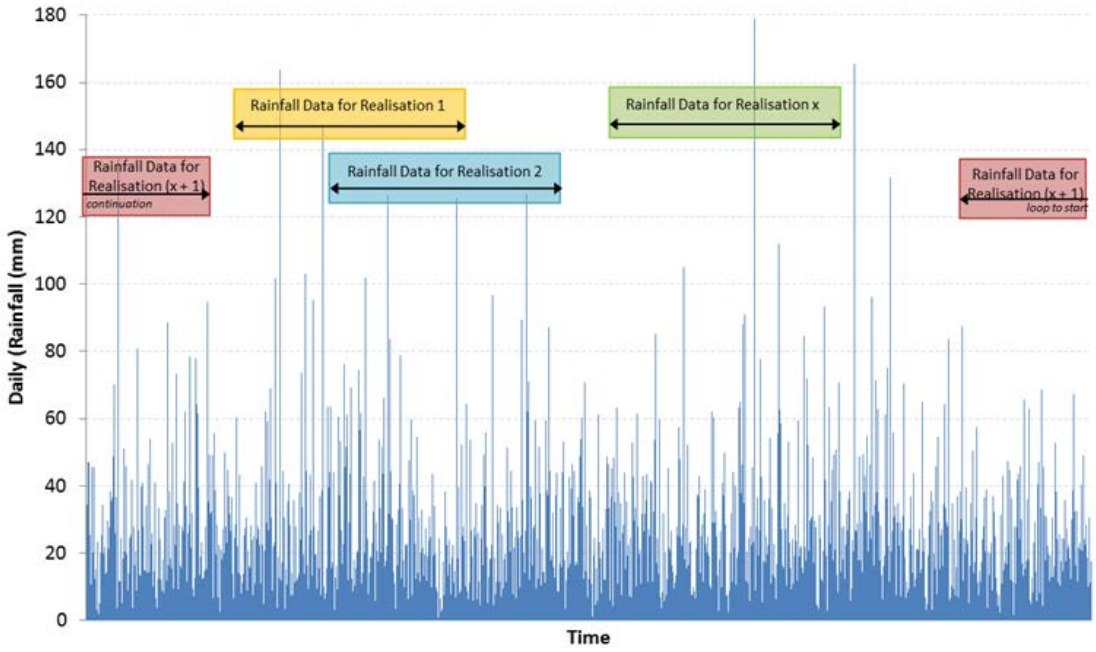

Figure 3-2 Rainfall Simulation Conceptualisation

3.3 Mine Water Usage

Section 60I of the WM Act states that a WAL is required for water used in mining activities where surface water (either dirty or clean) is removed or diverted from a water source. Current mine water usage has been determined from current usage data provided by Centennial Airly. Future surface water usage requirements for mining activities have been predicted using the site water balance model, reported in GHD (2014).

4 Surface Water Licence Requirements

4.1 Harvestable Rights

As outlined in Section 3.2, a WAL is required for the capture of clean runoff from undisturbed catchments in the mine water management system in excess of the maximum harvestable rights. The clean water runoff intercepted by the mine water management system at Airly Mine was determined by the Australian Water Balance Model (AWBM) as outlined in Section 3.2.

A comparison of maximum harvestable rights, clean water capture and held volumetric licences for water storages is shown in Table 4-1.

Table 4-1 Clean Water Capture at Airly Mine

Site	Water Source	Harvestable Rights (ML/year)	Harvestable Rights Dams (ML)	Clean Water Capture (ML/year)	Deficit (ML/year)
Airly Mine	Hawkesbury and Lower Nepean Rivers	132.4	79.1	28	Nil

Airly Mine has sufficient harvestable rights to cover existing harvestable right dams and capture of clean run off in the mine water management system. This will remain the case throughout the Airly Mine Extension Project.

4.2 Current Mine Water Usage

Under existing conditions, water is required at Airly Mine for:

- Supply to underground mining activities.
- Dust suppression.

This water is currently supplied by the 35 ML Dam. Water is transferred from the 35ML Dam to the Process Water Tank. Current mine water usage has been calculated based on data provided by Centennial Airly for transfers from the 35ML Dam to the Process Water Tank for 2014 as shown in Table 4-2.

Table 4-2 Monthly transfers from 35ML Dam to Process Water Tank

Month	Transfer (kL)
January 2014	13
February 2014	146
March 2014	1384
April 2014	3760
May 2014	2752
June 2014	3728
July 2014	3521
August 2014	4231
September 2014	5995

Month	Transfer (kL)
October 2014	3897
November 2014	3404
December 2014	2473
2014 Total	**35304**

Mine water usage in 2014 was approximately 35.3 ML/year. Since April 2014, average usage has been approximately 3.75 ML/month (45 ML/year).

Since there is currently no groundwater usage at Airly Mine, all water used in 2014 was surface water from the Hawkesbury and Lower Nepean Rivers Water Source. Based on recent usage rates, Airly Mine currently requires a surface water access entitlement with a volume of 45 ML/year.

4.3 Future Mine Water Usage

The total predicted mine water usage for the Airly Mine Extension Project, based on the site water balance reported in GHD (2014), was found to be 211 ML/year without a Coal Preparation Plant (CPP) and 253 ML/year with the CPP. The predicted mine water usage of 253 ML/year takes into account water recycling around the surface facilities area. Current mine water usage is much lower than predicted mine water usage due to the site water balance model assumption that mining at Airly is occurring at the proposed maximum rate of 1.8 million tonnes per annum (Mtpa).

Water sources for the Airly Mine Extension Project will be from both groundwater and surface water. Predicted surface water usage by year with a CPP and without a CPP is shown in Figure 4-1 and Figure 4-2 respectively. Maximum future surface water usage for mining at Airly Mine is predicted to be approximately 128 ML/year (with a CPP) and 86 ML/year (without a CPP). Maximum surface water usage requirements occur in year 3 of the Airly Mine Extension Project. Over time, surface water demands reduce due to increased supply of groundwater seepage into the mine.

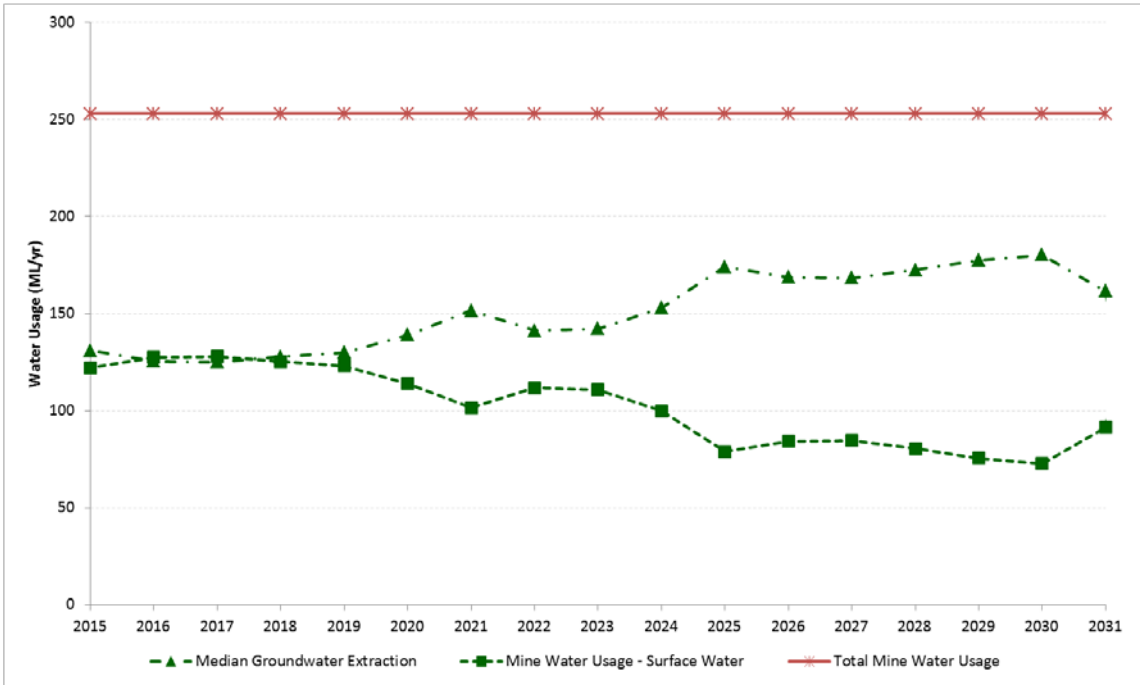

Figure 4-1 Modelled Surface Water Usage – with CPP

Figure 4-2 Modelled Surface Water Usage – without CPP

5 Surface Water Availability

Surface water licence requirements for Airly Mine are summarised in Table 5-1.

Table 5-1 Surface Water Licence Requirements at Airly Mine

Purpose	Volume Required (ML/year)
Clean water capture / dam sizes	Nil
Water use in mining - current	45
Water use in mining – extension project (no CPP)	86 (maximum)
Water use in mining – extension project (with CPP)	128 (maximum)

As detailed in Section 2.1, there was 92,235 ML (distributed over 1,310 water access licences) of tradeable water access entitlement in the 'unregulated rivers (other)' licence class of the Hawkesbury and Lower Nepean River Water Source as at January 2015 (DoE, 2015). This indicates that there is sufficient tradeable water available within the water source to meet the requirements of Airly Mine. Based on data from DoE (2015), 1,827 ML (distributed over 40 licences) was traded within this water source over the period July 2014 to January 2015 indicating that there is active trading within the water source at volumes above the requirements of Airly Mine.

6 References

Boughton and Chiew (2003), Calibration of the AWBM for use on Ungauged Catchments, Technical Report 03/15 Cooperative Research Centre for Catchment Hydrology.

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Sincerely
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