SHEC MANAGEMENT SYSTEM

DARTBROOK MINE

CARE & MAINTENANCE

SITE WATER MANAGEMENT PLAN

DBK Doc No: **4746**

Approval: **J Fittler**

Issue	*Issue Date*	*Originator*	*Reviewed*	*Approved*
1	19 January 2007	Hansen Bailey	Fiona Bailey	B Baumhammer
2	30 January 2007	Hansen Bailey	Fiona Bailey	B Baumhammer
3	12 October 2009	Hansen Bailey	Doug Stewart	B Baumhammer
4	13 March 2014	Hansen Bailey	Doug Stewart	J Fittler
5	20 April 2015	Hansen Bailey	Doug Stewart	J Fittler

Amendments

Issue	Date:	Description	Init.
1	19/01/07	Draft for ACDM Review	FB
2	30/01/07	Draft for DNR & MSC Review	FB
3	12/10/09	Final for NSWDoP Approval	DS
4	13/03/14	Inclusion of Quality Assurance Section and use of the Evaporation Ponds	DS
5	20/04/15	Inclusion of DP&E amendments	DS

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1 INTRODUCTION

1.1 Background

Anglo Coal (Dartbrook Management) Pty Ltd (ACDM) has development consent for the Dartbrook Underground Coal Mine (DA 231-07-2000). The development consent allows underground mining at a raw coal production rate of up to 6 Mtpa. Due to operational difficulties associated with underground mining conditions the operations ceased in September 2006 and the mine was placed on care and maintenance.

This Water Management Plan addresses water management for the site during the care and maintenance period. As Dartbrook is currently for sale the duration of the care and maintenance period will be on completion of the sale when Dartbrook could potentially be either decommissioned or wholly or partly re-commissioned. Additional management plans addressing water management will be prepared in advance of any future decommissioning and/or recommissioning.

1.2 Site Water Management Plan

This Site Water Management Plan has been developed in accordance with the conditions of the Dartbrook Mine Development Consent. The plan includes management measures for surface and groundwater resources for all components of the Dartbrook Mine and all potential impacts relevant to the care and maintenance period.

The Dartbrook Mine consists of the following main components:

- West Site surface facilities including workshop and maintenance facilities, administration building and underground mine portals;
- East Site surface facilities including the Coal Handling and Preparation Plant (CHPP), rail loop and train loading facilities and Rejects Emplacement Area (REA);
- Wynn Seam underground mine workings which are decommissioned and currently used for tailings disposal and excess mine water storage;
- Kayuga Seam underground mine workings which were the active workings up until the commencement of the care and maintenance period; and
- Hunter Tunnel which connects the underground mine workings to the East Site CHPP facilities.

Figure 1 shows the location of these features of the Dartbrook Mine.

During the care and maintenance period all mining and coal production has ceased. The mine surface facilities will not be operated but will continue to be maintained in a state ready to enable recommissioning in the future.

The Hunter Tunnel will continue to be dewatered and maintained in a state ready to enable recommissioning. The Kayuga Seam underground mine workings have been decommissioned and sealed. The Wynn Seam underground mine workings have previously been decommissioned and are currently used for mine water storage.

1.3 Management Plan Requirements

The Site Water Management Plan documents water management measures for the care and maintenance period for Dartbrook Mine. The primary objective of the Site Water Management Plan is to manage and minimise the impact of the mine on surface and groundwater resources. These objectives will be met through the implementation of the management strategies specified in **Section 2**.

The specific requirements of the Site Water Management Plan are contained in Development Consent Condition 4.1(a). These requirements are listed in **Table 1** with a reference to where each specific requirement is addressed in the Management Plan.

Table 1

Site Water Management Plan Requirements Checklist

Development Consent Condition	Reference
4.1 Site Water Management Plan (a) Prior to the commencement of Mining Operations, prepare a Site Water Management Plan for the DA area, in consultation with DLWC, MSC and to the satisfaction of the Director-General, which shall include, but not be limited to, the following matters:	This document is the Care and Maintenance Site Water Management Plan which has been prepared in consultation with Department of Natural Resources (DNR) and Muswellbrook Shire Council (MSC) and will be submitted to Department of Planning (DoP) for approval.
management of the quality and quantity of surface and ground water within the areas covered by the water management plans;	Sections 2, 3 & 4.
management of storm water and general surface runoff diversion to ensure separate effective management of clean and dirty water; including details of temporary surface drainage works to minimise the flow of surface water onto the rejects emplacement area and details of drainage works to direct runoff from the active rejects emplacement areas to onsite storage dams;	Section 2.2 & approved Erosion and Sediment Control Plan.
measures to prevent the degradation of downstream surface water quality below the pre-mining ANZECC beneficial water use classification due to mining operations, particularly in the Hunter River;	Section 2.2.
measures to determine whether any groundwater from the Hunter River alluvium aquifers is captured by the mine including a response plan in the event that monitoring shows evidence of a dilution of salinity or change in water chemistry, or increase in inflow rate that may indicate leakage from the alluvium to the Hunter Tunnel;	Sections 2.2.3 & 5.2.
measures to be implemented in the event that the continued operation of the Hunter Tunnel leads to a significant increase in groundwater salinity in the alluvial aquifer system;	Sections 2.2.3 & 5.2.
contingency plans for managing adverse impacts of the development on surface and groundwater quality which shall include: contingency arrangements to manage excess saline water if the storage of the mine water management system is exceeded; and	Section 5.2.
contingency measures to manage any impacts identified by monitoring that the management strategies have failed to predict or control, particularly relating to groundwaters associated with the alluvial aquifer of the Hunter River, in consultation with DLWC.	Section 5.2.
details of a dispute resolution process to resolve issues where deepening and/or increased operational costs of licensed bores where the water table has been lowered by mining activities, is disputed between the Applicant and affected landowner;	Section 5.4.
measures to ensure that waters of poorer quality are effectively segregated and reused on the site.	Section 2.2 and approved Erosion and Sediment Control Plan.

Development Consent Condition	Reference
details of a strategy for the decommissioning of water management structures, including dirty water dams and clean water diversion dams	This plan address the care and maintenance period. Decommissioning of the site, including water management infrastructure, will be conducted in accordance with the Mine Closure Plan prepared in accordance with Development Consent condition 2.1(e).
measures to isolate heavily contaminated waters, including waters containing oil and grease, or other pollutants, operation chemical residues or other criteria, to avoid mixing with reuse or discharge waters;	Section 2.2.
measures for assessing chemical water quality impacts of the mining operation above and below the mine site;	Section 4.
projection of potential groundwater changes during mining (short term) and post-mining (long term) with particular attention given to the affect of changes to groundwater quality and mobilisation of salts including down gradient of the rejects emplacement area;	Section 2.2.
details of consultation with landholders who use water from the proposed longwall mining area and adjacent area and those parts of Dart Brook and Sandy Creek alluvia immediately adjacent to the mining areas, in relation to their requirements for and the availability of, water and shall consider those water uses in the formulation of the management plan;	Section 5.4.
details of a surface water and groundwater monitoring program (refer to clause 4.2(a)(ii)); and	Section 4.
a program for reporting on the effectiveness of the water management systems and performance against objectives contained in the approved site water management plans, and EIS.	Section 6.

2 WATER MANAGEMENT

2.1 Introduction

Water management during the care and maintenance period will focus on the potential surface and groundwater impacts relevant to the care and maintenance activities. These include:

- Management of surface runoff at the West Site surface facilities;
- Management of surface runoff at the East Site surface facilities;
- Management of ongoing dewatering of the Hunter Tunnel;
- Management of the mine water storage in the Wynn Seam goaf and the Kayuga Seam goaf; and
- Management of the Evaporation Ponds

The water management strategies for these aspects are described in the following sections.

Erosion and sediment control for all surface areas disturbed by the mining operations will continue to be managed in accordance with ACDM's approved Erosion and Sediment Control Plan. This plan specifically addresses erosion and sediment control for the following areas:

- West Site surface facilities, including the Staged Discharge Dam (SDD) and Western Holding Dam (WHD) *;
- East Site surface facilities, including the Eastern Holding Dam (EHD) *;
- Rejects Emplacement Area;
- Surface areas affected by mine subsidence; and
- Ventilation shafts and other minor infrastructure areas.

The Dartbrook Evaporation Ponds (**Figure 1**) were re-commissioned in 2011 and are currently used for excess mine water storage and passive disposal by evaporation. The storage capacity is approximately 103 ML with the bottom bays being used for a rehabilitation trial. Subject to the prevailing weather conditions the estimated evaporation is approximately 100 to 150 ML per annum.

*The SDD, WHD and EHD represent the priority areas of risk at Dartbrook with the potential for water to flow offsite. Under care and maintenance, without coal production, there is a low risk of water being contaminated or flowing uncontrolled offsite.

2.2 Water Management Strategies

2.2.1 West Site Surface Runoff

The West Site drainage management plan is shown in **Figure 2**. Runoff from areas disturbed by mining activities will potentially contain elevated levels of suspended sediment. Catchment areas disturbed by mining operations are therefore isolated by diversion drains and runoff from these areas is directed to sediment control dams or mine water storage dams. Runoff from the Industrial Area is collected and directed to the Western Holding Dam (15 ML). A small surface infrastructure catchment area in the vicinity of the Kayuga Mine box cut drains to a sediment trap and then around the Staged Discharge Dam (450 ML). The total contained catchment area at the West Site is approximately 22 ha.

The Staged Discharge Dam and the Western Holding Dam have more than sufficient capacity to contain runoff from these small catchments and are not likely to overflow during the care and maintenance period. The water levels in these dams are monitored monthly, after significant runoff events and continuously by Citect. If necessary, following prolonged rainfall, water from these dams will be transferred to the Wynn Seam goaf storage area to enable the maintenance of a 50% to 70% freeboard capacity in the dams which provides a storage capacity in excess of a 1:50 Annual Exceedance Probability and ensures they do not overflow.

The Wynn Seam goaf storage has a storage capacity of approximately 2,915 ML.

2.2.2 East Site Surface Runoff

The East Site drainage management plan is shown in **Figure 3**. Runoff from areas disturbed by infrastructure or mining activities will potentially contain elevated levels of suspended sediment. Originally areas disturbed by the surface facilities, including the REA, were isolated by diversion drains with runoff from these areas directed to the EHD (of 85 ML capacity). Following rehabilitation rainfall runoff from the previously disturbed areas flows through a series of smaller sediment control dams and around the Eastern Holding Dam (current catchment of approx. 40 ha). The total contained catchment area at the East Site including the REA is approximately 90 ha.

The Eastern Holding Dam is unlikely to overflow because the dam is inspected weekly and is continuously monitored via Dartbrook's CITECT system. The dam water level is also monitored monthly and after significant runoff events. If necessary, following prolonged rainfall, water from the Eastern Holding Dam will be transferred to the Wynn Seam goaf storage area to maintain a 50% to 70% freeboard capacity which provides a storage capacity in excess of a 1:50 Annual Exceedance Probability which ensures it does not overflow.

A small amount of water will be drawn from the Eastern Holding Dam for CHPP maintenance and dust suppression. If there is insufficient water in the Eastern Holding Dam for CHPP water supply it will be supplemented with water from the Wynn Seam goaf storage area. There is also the ability to transfer water between the Eastern Holding Dam and the Western Holding Dam as the need arises.

2.3 Ground Water Management Strategies

2.3.3 Hunter Tunnel Dewatering

The Hunter Tunnel will continue to be dewatered throughout the care and maintenance period to maintain the tunnel and access/egress for inspections. Water that collects in the tunnel has elevated salinity and will continue to be transferred to the Wynn Seam goaf storage area. The rate of inflow to the tunnel is approximately 220 MLpa.

The Hunter Tunnel inflow rate and water quality will continue to be monitored monthly in accordance with the site water monitoring program specified in **Section 4**. Any monitoring results that may indicate unexpected impact on the Hunter River alluvium, such as increased flow rate or reduced salinity will trigger an investigation. Depending on the findings of any investigation, appropriate mitigation measures would be developed and implemented in consultation with NSW Office of Water.

2.3.4 Wynn Seam and Kayuga Seam Goaf Areas

The Wynn Seam goaf is an approved tailings and mine water storage area. A detailed assessment of the potential groundwater impacts of tailings and mine water storage in the goaf area was included in the Statement of Environmental Effects (Hansen Consulting, 2005) supporting the Development Consent modification for underground tailings disposal. The assessment concluded that there will be no significant adverse groundwater impacts. The groundwater monitoring program discussed in **Section 4.1** is designed to detect any unexpected adverse groundwater impacts.

The accumulation of water in the Wynn Seam Goaf is the main groundwater management issue for the site while Dartbrook is under Care and Maintenance. The management strategy is to dewater the Wynn Seam Goaf so as to have so as to have the rate of outgoing water the same as the incoming water. The Target accumulation of water in the Wynn Seam Goaf is the main groundwater management issue for the site while Dartbrook is under Care and Maintenance. The management strategy is to dewater Action Response Plan (TARP) for the Wynn Seam Goaf is to increase the dewatering capacity when the water level reaches RL 9,934 m, or 269.3 m (depth below surface) at the pleuger pump monitoring site.

Groundwater will accumulate slowly in the decommissioned Kayuga Seam goaf area. The re-establishment of the groundwater table in the Kayuga Seam goaf following the completion of mining was assessed in detail in the Dartbrook Extended EIS (HLA-Envirosciences P/L, 2000). The EIS concluded that groundwater recovery would take significantly in excess of 100 years and there were no adverse impacts on groundwater predicted in the post-mining phase. Significant groundwater impacts due to groundwater recovery are therefore not expected during the care and maintenance period. The groundwater monitoring program discussed in **Section 4.1** is designed to detect any unexpected adverse groundwater impacts.

2.4 Water Licenses

ACDM water licences for mining purposes are listed in **Table 2**. The mine currently has licences for groundwater supply from the Blairmore bores and for dewatering of the Hunter Tunnel and Wynn Seam goaf.

Table 2
Water Licences

Mine Water Licence No.	Valid Until	Allocation	Bore Number	Property Name	Property
20BL166121	29/04/2007	25 ML	GW078058	Blairmore Bores	Lot 1 DP835733
20BL166122	29/04/2007	25 ML	GW078059	Blairmore Bores	
20BL169015	28/05/2003	30 ML	NA	Dewatering from Hunter Tunnel	
20BL169016	28/05/2003	150 ML	NA	Dewatering from Wynn Seam Goaf	Not Applicable

ACDM has two surface water licences (20SL060787 and 20SL051598) issued under Part 2 of the Water Act 1912 for watercourse diversions located on Brown's Mountain.

ACDM also has several Water Allocation Licences under the Water Management Act 2000 for extraction of surface water from the Hunter River for non-mining purposes.

3 MINE WATER BALANCE

Estimated sources of water, water demands and the total site water balance for the care and maintenance period are listed in **Table 1** . Estimated sources of water, water demands and the total site water balance for the care and maintenance period are listed in **Table 3**.

Runoff volumes have been calculated using a daily water balance model based on 125 years of daily rainfall data. The rainfall data have been applied to the contained catchment areas assuming a range of soil storage capacities based on detailed catchment subdivisions using a GIS. Storage evaporation estimates are based on daily calculations of storage surface areas and 125 years of daily evaporation rates. Daily rainfall and evaporation data were synthesised by the Bureau of Meteorology.

The water balance shows that the site will generate an excess of 123 ML during an average rainfall year. Excess water generated during the care and maintenance period will be stored in the Wynn Seam Goaf, the Staged Discharge Dam and the Evaporation Ponds. This is equivalent to about 4 years of storage capacity assuming average rainfall. Additional water storage may be made available in the Kayuga Seam Goaf.

In the unlikely event that water volumes in excess of the site storage capacity are generated during the care and maintenance period water could be discharged to the Hunter River in accordance with the Hunter River Salinity Discharge Scheme and the Environment Protection Licence discharge conditions.

A small quantity of raw water, used for potable and fire water, is sourced from the licensed Blairmore Bores. In addition, a small quantity of potable water from the Aberdeen town supply is used at the CHPP.

Table 3
Care and Maintenance Site Water Balance

Mine Water Sources and Demands	Annual Volume (ML)		
	Dry Year (90% AEP)	Average Year (50% AEP)	Wet Year (10% AEP)
Water Sources			
Hunter Tunnel Dewatering	212	212	212
Nett Seepage from Wynn Seam	102	102	102
East Site Surface Runoff (CHPP & REA)	70	145	242
West Site Surface Runoff	41	152	240
Sub-Total	**425**	**611**	**796**
Water Demands			
Storage Evaporation	194	130	104
East Site Water Usage	10	10	10
West Site Water Usage (by Evaporation)	**519**	**348**	**278**
Sub-Total	**728**	**488**	**392**
Water Balance	**-298**	**123**	**404**

Source: Dartbrook's OPSIM Water Management Model.

4 MONITORING PROGRAM

4.1 Surface Water Monitoring

The surface water monitoring sites for the care and maintenance period are listed and shown in **Figure 4**.

The monitoring program is designed to the monitor the quality of all relevant surface waters on the site during the care and maintenance period including:

- Runoff from the East Site, including the infrastructure areas, collected in the Eastern Holding Dam and the REA Stage 4 Dam;
- Underdrainage water from the REA;
- Runoff from the West Site surface facilities collects in the Western Holding Dam and is pumped to the Staged Discharge Dam;

- Background water quality in the Hunter River and Dart Brook upstream and downstream of the site; and
- Any licensed discharges from the Staged Discharge Dam in accordance with the conditions of the Dartbrook Environment Protection Licence.

Table 4 shows all the surface water monitoring sites, their analytes and the monitoring frequency under care and maintenance.

Under care and maintenance monitoring will at least be conducted annually including pH and Electrical Conductivity with monitoring for reactive and Methylene Blue Active Substances (MBAS)(foaming agents) at the Eastern Holding Dam, Western Holding Dam and Staged Discharge Dam.

Samples will be tested in accordance with the relevant Australian Standards and Dartbrook Environment Protection Licence requirements.

The Target Action Response Plan (TARP) trigger levels for surface water monitoring have been calculated from the monitoring carried out since coal production ceased in 2006. Since 2006 Dartbrook has been under care and maintenance management. **Table 5** shows the surface water Impact Assessment Criteria used to calculate the TARP which are based on exceeding the 95th percentile of the analyte data-set from the 2007 to 2014, inclusive.

Any exceedance of trigger levels is investigated to determine the cause of the exceedance which may then be reported as an incident. See also **Section 5.1**.

Table 4- Surface Water Monitoring - Analysis Matrix

Site	Bicarbonate mg CaCO3/L	Carbonate mg CaCO3/L	Hydroxide mg CaCO3/L	Biochemical Oxygen Demand mg/O2/L	Calcium - total mg/L	Chloride mg/L	Conductivity µS/cm - field	Faecal Coliforms_ cols/100mL	Hardness (mg/L	Magnesium - total mg/L	MBAS mg/L	Nitrates mg N/L	Oil & Grease mg/L	pH - field	Phosphorus - reactive mg/L	Potassium - total mg/L	Sodium - total mg/L	Sulfates mg/L	TDS - calculation	TSS@105C mg/L	Algae Count *
DART(a)	√	√	√			√	3m	√				√		3m	√	√	√	√	√	√	
DARTUP	√	√	√			√	3m	√				√		3m	√	√	√	√	√	√	
E2	√	√	√		√	√	m			√				m		√	√	√	√	√	
EHD	√	√	√		√	√	√			√	√		√	√	√	√	√	√	√	√	
HUNT	√	√	√			√	3m	√				√		3m	√	√	√	√	√	√	
HUNTUP	√	√	√			√	3m	√				√		3m	√	√	√	√	√	√	
REA	√	√	√		√	√	√			√				√		√	√	√	√	√	
REA Stage 4 Dam	√	√	√		√	√	√			√				√		√	√	√	√	√	
Staged Discharge Dam (SDD)	√	√	√		√	√	√			√	√		√	√	√	√	√	√	√	√	m
Sewage Treatment Plant (STP)				√			m		m				√	m						√	m
WHD	√	√	√		√	√	√			√	√		√	√	√	√	√	√	√	√	m
WSD	√	√	√		√	√	√			√				√		√	√	√	√	√	
ETD *							√							√							

* ETD = Evaporation Tailings Dam, m = monthly, 3m = 3 monthly, √ = annually

Table 5 Surface Water Impact Assessment Criteria

Site	Bicarbonate mg CaCO3/L	Carbonate mg CaCO3/L	Hydroxide mg CaCO3/L	Biochemical Oxygen Demand mg/O2/L	Calcium - total mg/L	Chloride mg/L	Conductivity µS/cm - field	Faecal Coliforms_ cols/100mL	Magnesium - total mg/L	MBAS mg/L	Nitrates mg N/L	pH - field	Phosphate mg/L	Phosphorus - reactive mg/L	Potassium - total mg/L	Sodium - total mg/L	Sulphates mg/L	TDS - calculation	TSS@105C mg/L
DART (a)	508	61	1			638	2554	2360			0.7	8.3	0.6	0.3	3	225.8	49.2	1712	99
DARTUP	831	55	1			853	3310	2500			0.8	8.3	0.6	0.3	3	225.8	49.2	1712	98
E2	4355	6248			5	3091	27760												
EHD	1733	1448			112	5956	1379		4.0	0.3		9.5	0.4	0.11	5	326	30	919	54
HUNT	210	14	211			50	559	1875			0.3	8.4	0.2	0.1	3	33	28	376	70
HUNTUP	211	16	1			47	531	1540			0.2	8.5	0.3	0.1	3	33	29	356	65
REA	3330	1285			28	1340	11388		68			9.4			22	2907	1427	7584	
REA Stage 4 Dam	473	67			423	33	559		15			8.7			13	65	36	372.5	63
Sewerage Treatment Plant (STP)	1278	1485		30	2	619	2255					9.7						55	
Staged Discharge Dam (SDD)	5155	2014		17	8	864	9407		8	0.3		9.9	0.1	0.1	26	2540	37	6301	137
WHD	1329	504			22	331	3959		14	0.3		9.7	0.3	0.2	13	1035	75	2650	366
WSD	1300	319			32	344	4833		36			9.4			26	2124	50	5247	304
ETD	297	76			9	65	1027		8			9.3			12	176	9	691	19

4.2 Groundwater Monitoring

The groundwater monitoring sites for the care and maintenance period are listed and shown in **Figure 5.**

Table 6 Shows all the ground water monitoring sites, their analytes and the monitoring frequency under care and maintenance

ACDM has and continues to conduct a rationalisation of the Dartbrook Mine groundwater monitoring program. A copy of the original rationalisation report, which includes a detailed description of the current groundwater monitoring program, is included in **Appendix A**. The monitoring parameters and frequencies are in accordance with the requirements of the Dartbrook Environment Protection Licence.

The monitoring program is designed to monitor all potential groundwater impacts including:

- Impacts on alluvial aquifers including the Hunter River alluvium, Dartbrook alluvium and Sandy Creek alluvium
- Impacts from the storage of tailings and mine water in the Wynn Seam goaf;
- Leakage from the Staged Discharge Dam;
- Seepage from the REA; and
- Groundwater levels in the coal seams and privately owned stock watering bores.

Monitoring of NOW designated boreholes is conducted 6 monthly and will include a full analysis suite including metals and salts and monitoring for oil and grease, phosphorus

In accordance with Development Consent Condition 4.1(b), ACDM will undertake annual assessments of the accuracy of the groundwater model predictions outlined in the Dartbrook Extended EIS compared with monitored groundwater impacts in consultation with the NSW Office of Water (NOW). The results of the assessments will be reported in the Annual Environmental Management Report (AEMR). Should the assessment identify significant differences between the EIS model predictions and monitored impacts, ACDM will revise the assessment of the potential impacts on groundwater systems in consultation with NOW and implement any further mitigation measures necessary in consultation with NOW.

Depth Monitoring of the water level in the Wynn Seam is carried out monthly. The Target Action Response Plan (TARP) for the Wynn Seam Goaf water level is triggered at 269 m (depth below surface) and discussed in Section 5.2.

The Target Action Response Plan (TARP) trigger levels for ground water monitoring have also been calculated from the monitoring carried out since coal production ceased in 2006, Since 2006 Dartbrook has been under care and maintenance management. **Table 7** shows the ground water Impact Assessment Criteria used to calculate the TARP which are based on exceeding the 95th percentile of the analyte data-set from the 2007 to 2014, inclusive.

Any exceedance of trigger levels is investigated to determine the cause of the exceedance which may then be reported as an incident. See also **Section 5.1**.

4.3 Water Management System Monitoring

Water management system monitoring includes the monitoring of water levels in all relevant water storages. Storage water levels are monitored monthly and following any significant runoff events. Storages to be monitored are as follows:

- Eastern Holding Dam;

- Western Holding Dam;
- Staged Discharge Dam; and
- Wynn Seam goaf storage.

Water transfers between the water storages and dewatering volumes from the Hunter Tunnel is also monitored using flow meters or pumping hours. The storage level and flow monitoring data is used to monitor and confirm the site water balance as required by Development Consent condition 4.2(a)(iii)3). An annual reconciliation of the site water balance is be reported in the AEMR.

4.4 Quality Assurance

Sampling and analysis will be undertaken by a suitably qualified and experienced person with best practice standards of diligence, care and efficiency. All aspects of monitoring including collection, sampling, transport, analysis and reporting will be subject to a Quality Control System.

The Quality system generally should;

- satisfy the International Standard ISO 9001 “Quality Management Systems – Requirements”,
- generally meet the requirements of AS/NZS ISO 14001:2004, and
- use a NATA accredited laboratory for the analysis of samples.

Table 6 Dartbrook Groundwater Monitoring Sites (Annual and Six-Monthly

Site	Analyte													
	Frequency	Depth to Standpipe - metres	pH - field	Electrical Conductivity uS/cm - field	Alkalinity – Bicarbonate mg $CaCO_3$ /L	Alkalinity – Carbonate mg $CaCO_3$ /L	Alkalinity – Hydroxide mg$CaCO_3$ /L	Calcium – total mg/L	Chloride mg/L	Magnesium – total mg/L	Potassium – total mg/L	Sodium – total mg/L	Sulphates mg/L	Total Dissolved Solids - calculation	Total Suspended Solids @105 C
Hunter River Alluvium															
FRA1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
JOR1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
KAI1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
WAL2	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Dart Brook Alluvium															
ADN1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
DAN2	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
WM1A	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Sandy Creek Alluvium															
BRO3	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
COR3	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
GWO38412	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
WM3	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Site	Analyte													
	Frequency	Depth to Standpipe - metres	pH - field	Electrical Conductivity uS/cm - field	Alkalinity – Bicarbonate mg $CaCO_3$ /L	Alkalinity – Carbonate mg $CaCO_3$ /L	Alkalinity – Hydroxide mg$CaCO_3$ /L	Calcium – total mg/L	Chloride mg/L	Magnesium – total mg/L	Potassium – total mg/L	Sodium – total mg/L	Sulphates mg/L	Total Dissolved Solids - calculation	Total Suspended Solids @105 C
Sandy Creek South															
GWO32889	Annual	√	√	√											
Staged Discharge Dam															
RDH505	Annual	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Coal Seams															
DDH183	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
DDH193	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
DDH212a	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Kayuga 1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Regolith over Kayuga LW															
CAS2	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CAS4	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
JLON1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
TIon1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Site	Analyte													
	Frequency	Depth to Standpipe - metres	pH - field	Electrical Conductivity uS/cm - field	Alkalinity – Bicarbonate mg $CaCO_3$ /L	Alkalinity – Carbonate mg $CaCO_3$ /L	Alkalinity – Hydroxide mg$CaCO_3$ /L	Calcium – total mg/L	Chloride mg/L	Magnesium – total mg/L	Potassium – total mg/L	Sodium – total mg/L	Sulphates mg/L	Total Dissolved Solids - calculation	Total Suspended Solids @105 C
Rejects Emplacement Area															
RDH508	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH508a	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH509	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH509a	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH510	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH510a	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH511	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH511a	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Property Subsidence Management Plans															
Belgrave	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
GWO38582	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Other Monitoring Bores															
Athlone	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BEL1	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Site	Analyte														
	Frequency	Depth to Standpipe - metres	pH - field	Electrical Conductivity uS/cm - field	Alkalinity – Bicarbonate mg $CaCO_3$ /L	Alkalinity – Carbonate mg $CaCO_3$ /L	Alkalinity – Hydroxide mg$CaCO_3$ /L	Calcium – total mg/L	Chloride mg/L	Magnesium – total mg/L	Potassium – total mg/L	Sodium – total mg/L	Sulphates mg/L	Total Dissolved Solids - calculation	Total Suspended Solids @105 C
CAD2	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
DDH124	6 monthly	√	√	√											
DDH212b	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
DDH212c	6 monthly	√	√	√	√	√	√	√	√	√	√	√	√	√	√
RDH271	6 monthly	√	√	√											

Table 7 Ground Water Impact Assessment Criteria

Site	Depth to Ground - Metres	pH – Field	Electrical Conductivity µS/cm - field	Bicarbonate mg CaCO3/L	Carbonate mg CaCO3/L	Alkalinity – Total as CaCO3 mg CaCO3/l	Calcium – Total mg/L	Chloride mg/L	Magnesium – Total mg/l	Potassium – Total mg/l	Sodium – Total mg/l	Sulfates mg/l	Total Dissolved Solids – calculation mg/L	Total Suspend Solids @105C mg/L
Hunter River Alluvium														
FRA1	13.8	8.1	659	209		204	63	93	34	13	37	40	440	48
JOR1	10	7.4	2818	545	53	543	120	673	164	5	256	106	1980	6
KAI1	11.5	7.6	541	206		206	47	35	22	1	36	20	360	69
WAL 2	10	7.3	1870			550	115	213	113	0.5	100	50		
WAL2	10.5	7.9	1917	548		548	113	252	113.	2	998	94	1289	213
Dart Brook Alluvium														
ADN1	8	7.4	2970	392		391.5	107	670	141	1	318	65	2000	2
DAN2	8	8	2555	303		302.5	100	589	110	2	271	48	1719	6
WM1A	9	7.6	3535	520		519.7	99	575	107	28	389	96	2371	260
Sandy Creek Alluvium														
BRO3	6.2	9.1	1866	244	13	244	11	23	6	12	101	6	1353	8
COR3	5.3	8.3	2360	556		556	13	278	10	7	439	4	1589	10
GWO38412	4.8	7.5	1917	199		199	41	216	40	3	128	44	1285	3
WM3	7.6	7.1	5366	504		504	101	456	82	6	280	22	2683	611

Site	Depth to Ground - Metres	pH – Field	Electrical Conductivity µS/cm - field	Bicarbonate mg CaCO3/L	Carbonate mg CaCO3/L	Alkalinity – Total as CaCO3 mg CaCO3/l	Calcium – Total mg/L	Chloride mg/L	Magnesium – Total mg/l	Potassium – Total mg/l	Sodium – Total mg/l	Sulfates mg/l	Total Dissolved Solids – calculation mg/L	Total Suspend Solids @105C mg/L
Sandy Creek South														
GWO32889	4.60	8.5	2713										1648	
Staged Discharge Dam														
RDH505	8	7.5	13564	919		919	277	4813	726	37	1880	387	9090	58
Coal Seams														
DDH183	29	7.2	7350	1432		1455	151	1781	335	32	1131	300	5240	76
DDH193	44.5	7.1	7173	1524		154	57	1736	139	31	1446	121	4820	252
DDH212(a)	27.5	8.5	3861	1170	29.4	1190	6	649	10	7	942		2596	296
Kayuga 1	14.4	7.1	11100	986		986	171	1987	374	13	1069	371	7443	508
Regolith over Kayuga LW														
CAS2	36.5	7.5	13255	1514		1476	119	4310	459	35	2424	353	8943	267
CAS4	30.2	7.2	14027	396		658	246	4966	599	23	2250	69	9402	226
Tlon1	11.3	8.1	7075	1354		1410	87	1089	258	16	1139	826	4743	393
Rejects Emplacement Area														
RDH508	10.9	7.3	8003	788		792	163	2404	235	15	1370	267	5363	428
RDH508(a)	18	7.1	7071	690			121	1670	137	19	975	123	4140	271
RDH508a	17.9	7.3	7769	793		793	134	2430	193	29	1440	210	5210	597
RDH509	11.5	7.5	5874	878	93.05	853	48	1392	112	10.5	1196	232	3921	186
RDH509(a)	16.5	7.4	3471	730			32	588	49	6	628	102	2290	128

Site	Depth to Ground - Metres	pH – Field	Electrical Conductivity µS/cm - field	Bicarbonate mg CaCO3/L	Carbonate mg CaCO3/L	Alkalinity – Total as CaCO3 mg CaCO3/l	Calcium – Total mg/L	Chloride mg/L	Magnesium – Total mg/l	Potassium – Total mg/l	Sodium – Total mg/l	Sulfates mg/l	Total Dissolved Solids – calculation mg/L	Total Suspend Solids @105C mg/L
RDH510	12.2	7.8	8744	1157		978	230	2731	299	12.5	1387	220	5873	2474
RDH510(a)	12.3	7.4	5779	960			69	1310	127	5.8	1010	156	3930	68
RDH510a	11	7.3	8636	998	15	999	176	2595	300	8.5	1505	238	5788	1745
RDH511	9	7.4	7455	1015		1015	232	1508	253	8.9	1085	409	4995	43
RDH511a	10.8	7.7	7526	1082		1082	233	1660	292	96	1185	449	5044	4108
Property Subsidence Management Plans														
Belgrave	21.5	8	12599	1119		1119	39	3082	356	16	1816	162	8360	39
GWO38582	5	7.9	9940	867		867	68	1113	148	25	997	233	4603	4
Other Monitoring Bores														
Athlone	9	7.8	10560	1238		1238	160	2796	419	27	1668	375	6924	81
BEL1	11.6	7.4	9784	808		808	167	2820	343	20	1580	245	6559	8
CAD2	16.9	7.3	4127	1		1	186	1203	108	15	408		2765	115
DDH124	14.8	7.7	740										495	
DDH212b	27.1	8.6	3816	1176	126	1232	2	628	2	5	999	6	2555	444.
DDH212(c)	27.3	8.3	3820	1150	27	1180		646		4	1010		2560	36
RDH271	82.2	7.6	6033	1980		1980	8	742	8	17	1360	38	3876	706
Wynn seam at Pleuger pump site														
Pleuger *	269													

* See Surface water monitoring E2 for the other analytes

5 CONTINGENCY MEASURES

5.1 Incidents

Incidents are a set of circumstances that have caused, or have the potential to cause, significant risk of material harm to either human-health or the environment, and/or breaches of performance measures/criteria in the consent. Examples of incidents are uncontrolled movements of water such as a discharge offsite, overflowing dams, leaks from pipelines, elevated borehole readings and exceedances of this Water Management Plan.

The triggering of a TARP is not necessarily an incident but commences an investigation which may find that the exceedance is within the above definition of an incident or may require an action to manage the TARP such as lowering the water level of the WHD. The investigation response is subject to which TARP is exceeded. Multiple exceedances may occur before investigations determine that an incident has occurred. All incidents are thoroughly investigated and managed using Dartbrook's Enablon data management system.

Section 6 outlines the process for the reporting and notification of incidents as well as their inclusion in the Annual Environmental Management Report.

5.2 Excess Mine Water

The Dartbrook Mine has significant mine water storage capacity, currently approximately 2,915 ML, with the majority in the Wynn Seam. With appropriate management Dartbrook is unlikely to accumulate mine water volumes in excess of site storage capacity during the care and maintenance period.

The initial TARP for the Wynn Seam Goaf is to provide an alert to increase the dewatering capacity when the water level reaches RL 9,934 m, or 269 m (depth below surface) at the pleuger pump monitoring site. The response action will be to review the target level and see if it is still appropriate and to increase the consumption of mine water by way of evaporation and discharge.

Management strategies include the use of the evaporation sprays and ponds, maximizing the water surface areas and utilizing the Hunter River Salinity Trading Scheme discharge system in accordance with the Dartbrook's Environmental Protection Licence discharge conditions.

5.3 Impacts on Alluvial Aquifers

Sampling and analysis of groundwater inflow quality in the Hunter Tunnel and Wynn Seam workings was conducted by ANSTO in 2003. The work included Tritium concentration analyses to determine whether there was a significant hydraulic connection between the alluvial aquifers and the underground workings.

The assessment concluded that the inflow water sampled had been underground for between 18 to 27 years. This indicates that there is no significant direct hydraulic connection between the underground workings and the overlying alluvial aquifers.

A detailed reconciliation of groundwater monitoring results against groundwater impact predictions for the Dartbrook Mine was conducted (Australasian Groundwater and Environmental Consultants P/L, 2006). The reconciliation report concluded that there has been no adverse impact on the Hunter River and Dart Brook alluvial aquifers due to the Dartbrook mining operations.

The groundwater monitoring program, as described in Section 4, is designed to detect any unexpected adverse impacts on the alluvial aquifers due to the previous mining operations. In the event that unexpected impacts are detected, ACDM would consult with NOW to develop appropriate mitigation measures. The nature of the mitigation measures would be dependent on the cause of the unexpected impact.

5.4 Impacts on Privately Owned Groundwater Bores

Mining ceased at Dartbrook in 2006. Groundwater bores on privately owned land which may have been affected by Dartbrook mining activities are shown on **Figure 6.** Monitoring and management measures for these bores were included in the relevant Property Subsidence Management Plans (PSMPs) for these properties. The PSMPs have been approved by NSW Infrastructure and Investment (previously Department of Primary Industries (DPI) and were prepared in accordance with the development consent and in consultation with the relevant property owners.

The management strategy specified for potential impacts on privately owned bores now includes the following components:

- Six monthly monitoring of groundwater for water level, pH and salinity.
- In the event that monitoring results indicate an impact or a landowner complains, ACDM will conduct an investigation to determine the status of the bore.
- If an investigation concludes that a bore has been adversely impacted by mining, ACDM will provide an equivalent alternative water supply in accordance with Development Consent condition 4.1(c).
- Any disputes in relation to whether or not damage to a bore has occurred due to mining will be referred to the Department of Planning (DoP) for resolution in accordance with the dispute resolution procedure in Schedule C of the Development Consent.

5.5 TARP Management

Within the context of Dartbrook's Care and Maintenance strategy and cessation of coal production Dartbrook has limited influence on groundwater and surface water. Table 8 shows a summary of the main TARPs, their aspects risks and responses.

Table 8 Responses to TARP exceedances.

	Risk	TARP	Response
Surface Water Dams	Overflow of water from the WHD or EHD offsite	>50% capacity	Transfer water
	Raised analyte reading with potential to pollute or become toxic.	>95th percentile	Investigate if caused by onsite activity. If so treat as an incident.
Groundwater – • Boreholes	Water levels vary substantially	>95th percentile	As above
	Raised analyte reading with potential to pollute or become toxic.	>95th percentile	As above
• Wynn Seam Goaf	Water level continues to rise and flood essential infrastructure.	Current TARP of 269 m below ground level.	Transfer water
	Raised analyte reading with potential to pollute or become toxic.	>95th percentile	Investigate if caused by onsite activity. If so treat as an incident.

6 REPORTING

6.1 Annual Reporting

Environmental reporting during the care and maintenance period is via the AEMR. The AEMR is required to be submitted to NSW Planning and Environment (DP&E), NSW Department of Industry – Resources and Energy Division (DRE), NSW Office of Water (NOW), Environment Protection Authority (EPA), Muswellbrook Shire Council (MSC), Upper Hunter Shire Council (UHSC) and the Dartbrook Community Consultative Committee (DCCC). The AEMR is also to be made available for public information at the MSC and UHSC offices.

In accordance with Development Consent Condition 4.2(a)(iii), the AEMRs will present water monitoring results, including:

1 "a basic statistical analysis (mean, range, variance, standard deviation) or the results for the parameters measures in individual bores / wells and as a subset of the aquifer;

2 an interpretation of the water quality results and changes in time for water quality and water levels (supported with graphs and contour plots showing changes in aquifer pressure levels);

3 an interpretation of the water balance identifying the volume of water and comparing this to predictions made in the EIS or the previous AEMR; and

4 provide an electronic copy of the data forwarded to DLWC.(NOW)"

AEMRs are also required to include (Development Consent condition 9.2):

- a review of the site water balance for the year, the quantity of water used from water storages and details of discharge of any water from the site;
- annual assessment of groundwater monitoring results and comparison with EIS groundwater impact predictions (Development Consent condition 4.1(b));
- an assessment of the effectiveness of the water management system against the objectives and TARPs specified in this Plan; and
- any incidents and corrective actions.

6.2 Incident reporting

As described in **Section 5** all water related incidents will be reported to the relevant Statutory Departments especially the DP&E, EPA, DRE and NOW.

Pollution – defined specifically in the POEO Act. "At its broadest this prohibits placing anything in waters that changes their chemical, biological or physical nature." (from the EPA Licensing Fact Sheet).

The site Pollution Incident Response Management Plan requires the reporting of "pollution incidents *immediately* to the EPA", DP&E, other appropriate Authorities and neighbours if there is actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial."

As per **Section 6.1** all incidents are also reported in the AEMR

7 RESPONSIBILITIES

The key personnel with responsibility for environmental management on the mine site is the Environmental Coordinator. The Environmental Coordinator will be responsible for ensuring that the requirements of this management plan are implemented.

Specific responsibilities of the Environmental Coordinator will include:

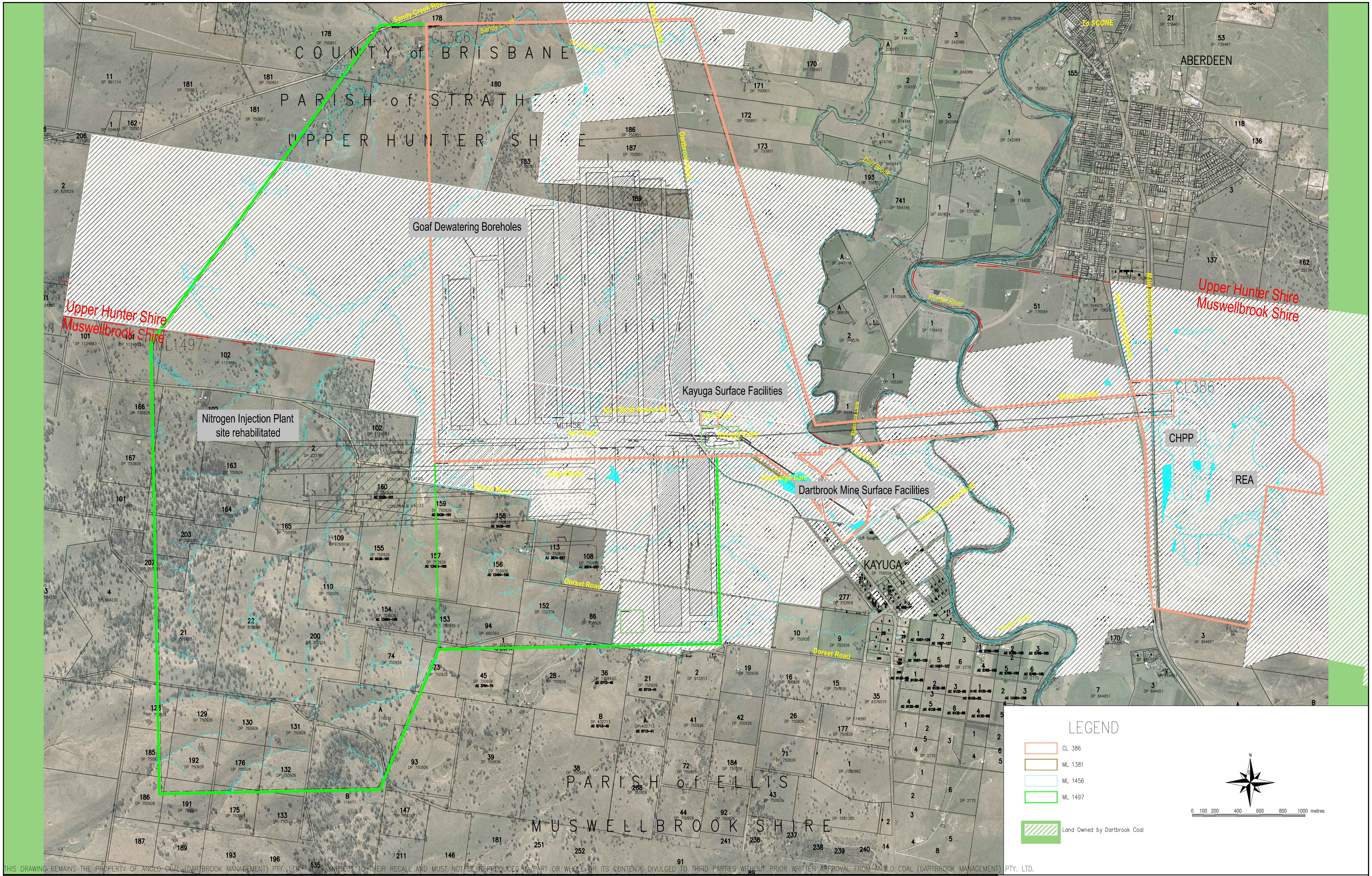
- ensuring that all personnel and contractors are given adequate training in environmental awareness, legal responsibilities, and water management measures;
- operation of the water management system in accordance with **Section 2**;
- surface water and groundwater monitoring in accordance with **Section 4**;
- conducting any investigations or implementing contingency measures in accordance with **Section 5**; and
- reporting in accordance with **Section 6**.

8 REVIEW REQUIREMENTS

In accordance with Development Consent condition 3.2(f), this Plan will be reviewed every five years, when significant changes are made to the Water Management system and prior to the conclusion of the care and maintenance period.

* * *

FIGURES



AngloAmerican

DRAWN	REVISIONS	REV.	DATE	BY	DESCRIPTION	CHK.
PC		A	26/08/11	PC	Initial Issue	DS
26/08/11		B	05/07/13	PC	Labels Added	DS

Dartbrook Mine
Site Layout at Care & Maintenance
& Current Mining Lease Areas - Figure 1

Datum :	AHD	SCALE	A3	DRG.	REV.
GRID :	MGA(56)	1:30000		32551	B

No 1 Shaft

Catch Drain

Sedimentation Dam No 2

Overburden Emplacement

Topsoil Stockpile

Topsoil Stockpile

Kayuga Entry

Hardstand

Macintyre Homestead

Catch Drain

Sedimentation Dam No 1

Dartbrook Road

Dart Brook

Blairmore Road

Staged
Discharge Dam

Topsoil Stockpile

Blairmore Road
Underpass

STP
Irrigation
Paddocks

Effluent Ponds

Perimeter Drain

Staged Discharge Dam
Embankment Toe Drain

Blairmore Road
Underpass

Admin Building
Workshop

Oil Separator

Western
Holding Dam

LEGEND

N

0 25 50 100 150 200 250 metres

DRAINAGE LINE

MINING LEASE

AngloAmerican

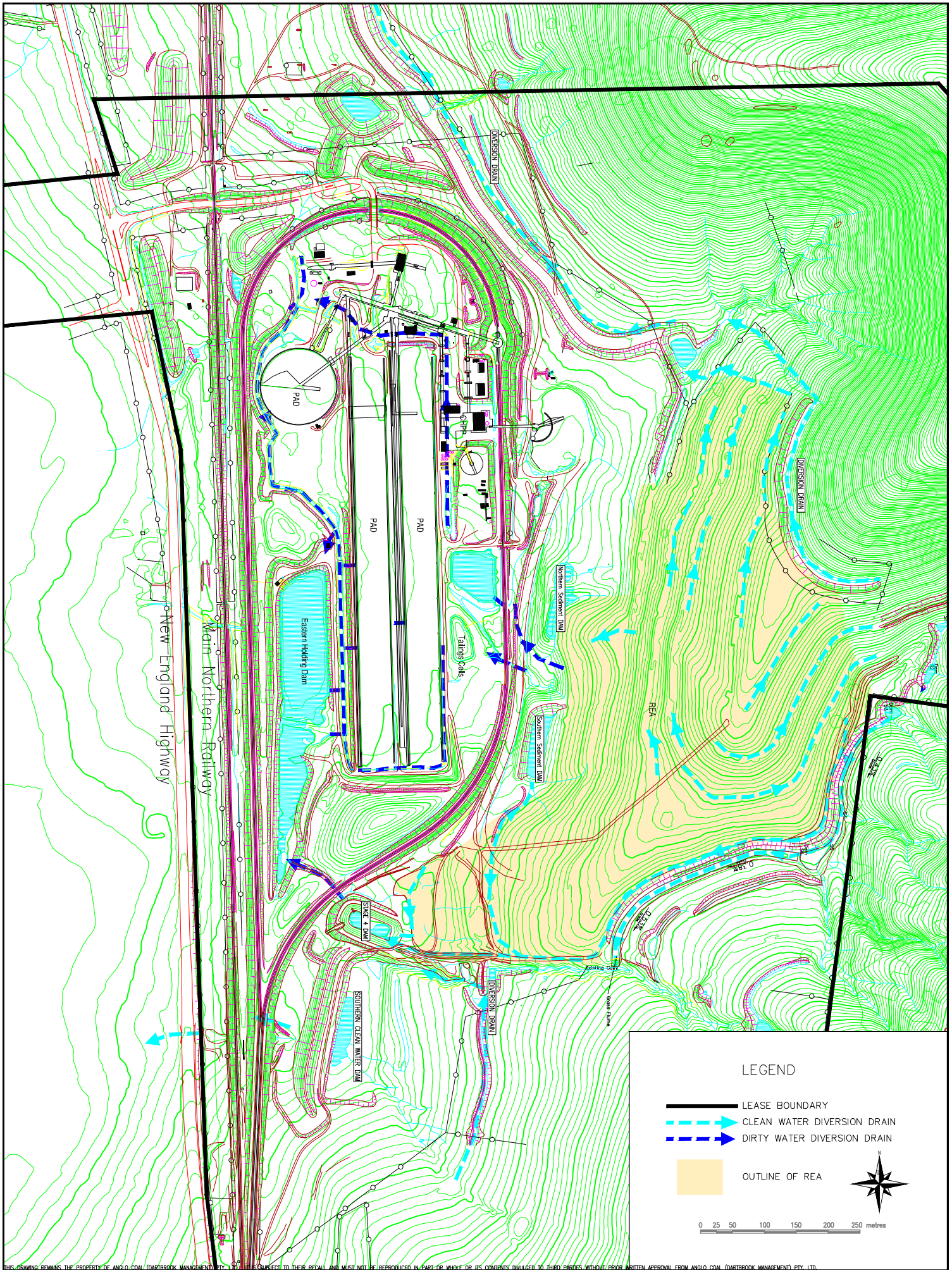
DRAWN
PC
9/05/03

REVISIONS

REV.	DATE	BY	DESCRIPTION	CHK.
K	27/03/14	PC	Figure No Modified to Match Water Management Plan	DS
G	30/03/07	PC	A4 Layout Added	FY
H	16/02/10	PC	General Update	DS
I	18/02/11	PC	Logo Modified to AngloAmerican	DS
J	14/03/14	PC	Modified to Match SDD Dam Safety Manual	DS

Dartbrook Mine
Water Management West Site
FIGURE 2

Datum :	AHD	SCALE	A3	DRG.	REV.
GRID :	MGA(56)	1:5000		29418	K



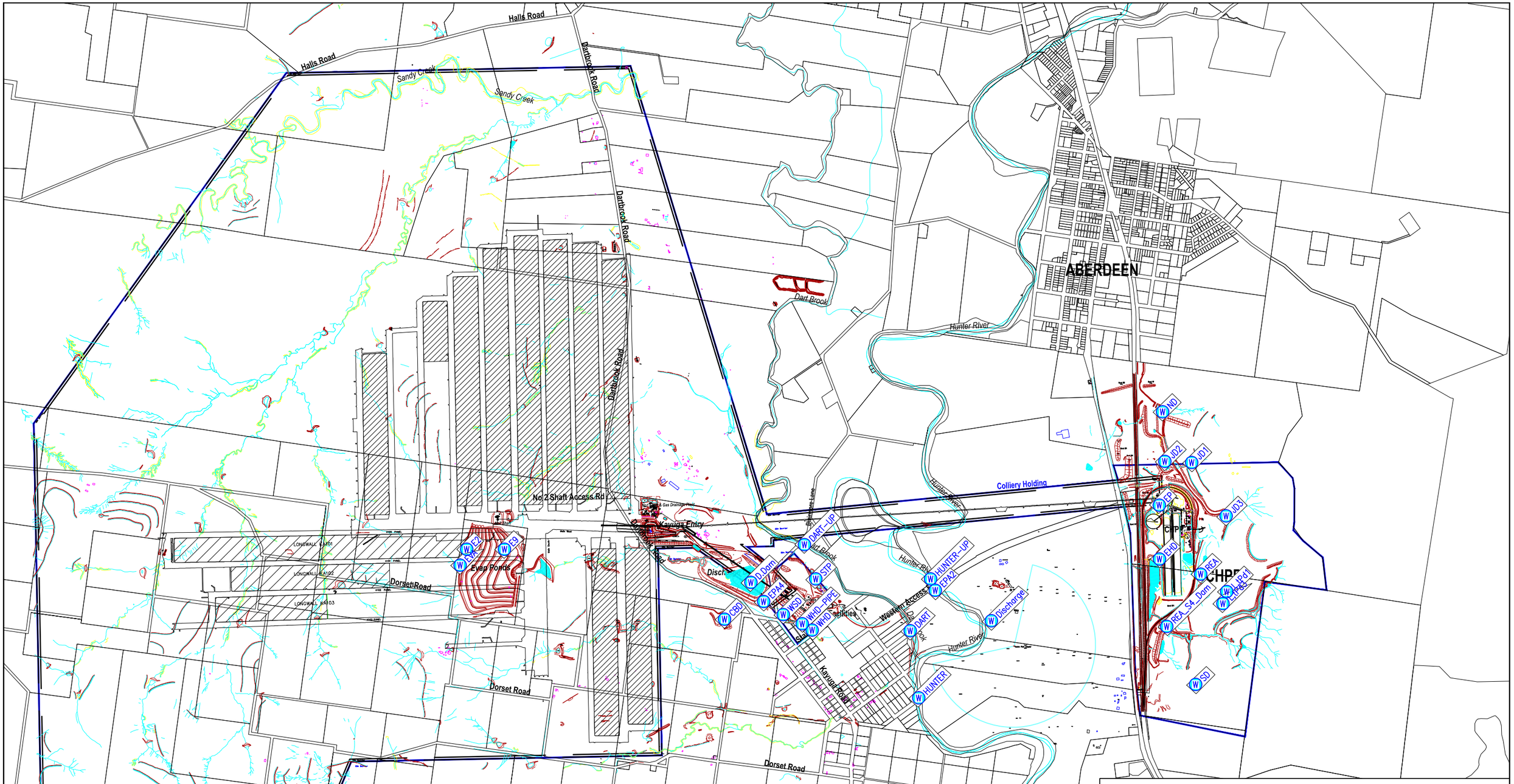
AngloAmerican

REVISION				
REV.	DATE	BY	DESCRIPTION	CHK.
L	18/02/11	PC	Logo Modified to AngloAmerican	
M	27/03/14	PC	Figure No Modified for Water Ma't Plan	
K	17/02/10	PC	REA Drainage Updated	

DRAWN	DATE	CHECKED	APPROVED
PC	06/03/01		

Dartbrook Mine
Water Management East Site
FIGURE 3

SCALE		DRG.	REV.
1:7500	A4	23346	M



AngloAmerican

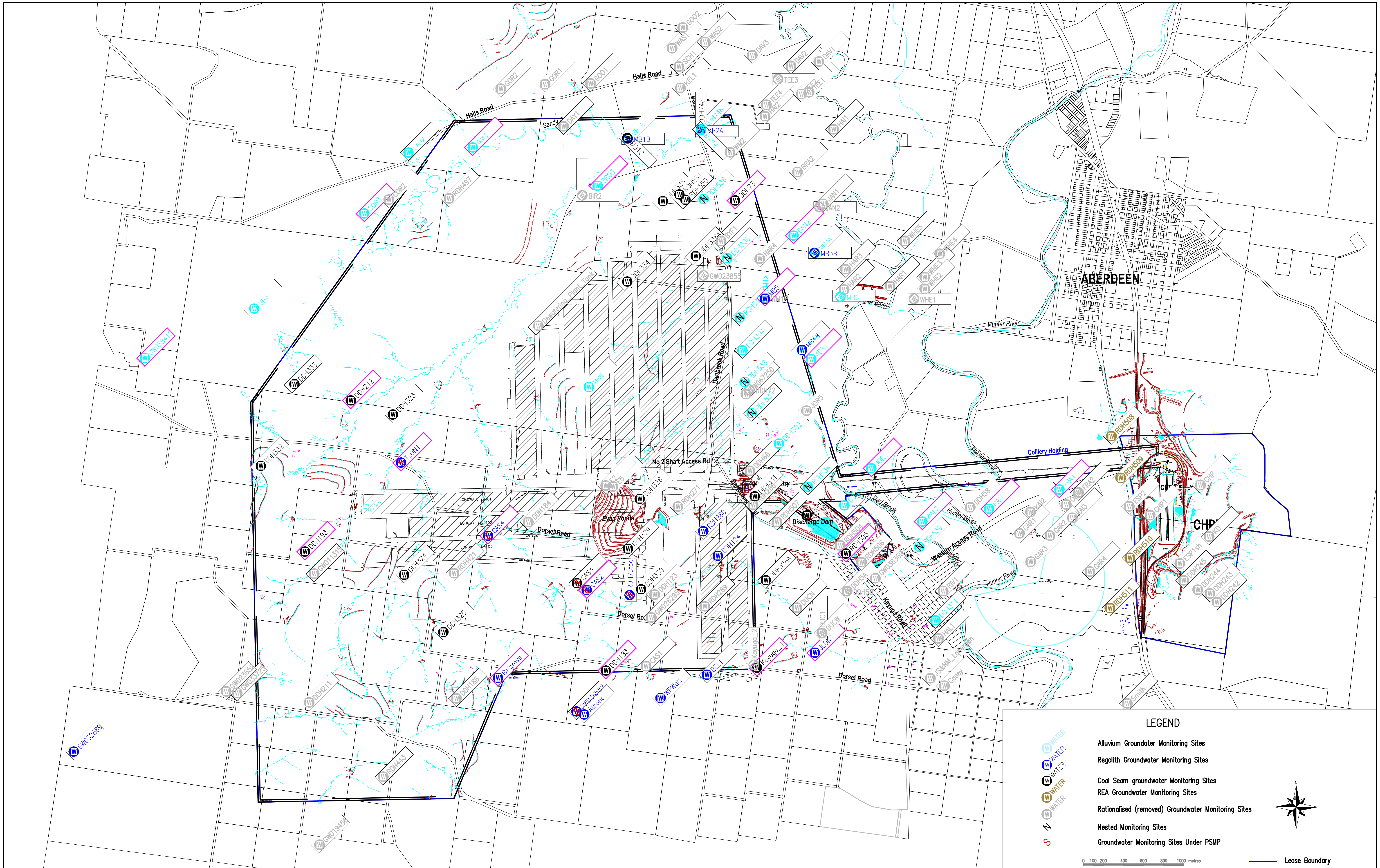
DRAWN
PC
09/05/03

REVISIONS

REV.	DATE	BY	DESCRIPTION	CHK.
K	18/02/11	PC	logo modified to AngloAmerican, Scale to 1:30000	DS
G	30/03/07	PC	E7 Renamed to E2	FY
H	02/05/08	PC	General Update	FY
I	23/06/09	PC	Updated to 2008	RC
J	01/03/10	PC	Roads Removed for Clarity	DS

Plan Showing Location of Surface Water Monitoring Sites FIGURE 4

Datum : AHD GRID : MGA(56)	SCALE 1:30000	A3	DRG. 29419	REV. K



AngloAmerican

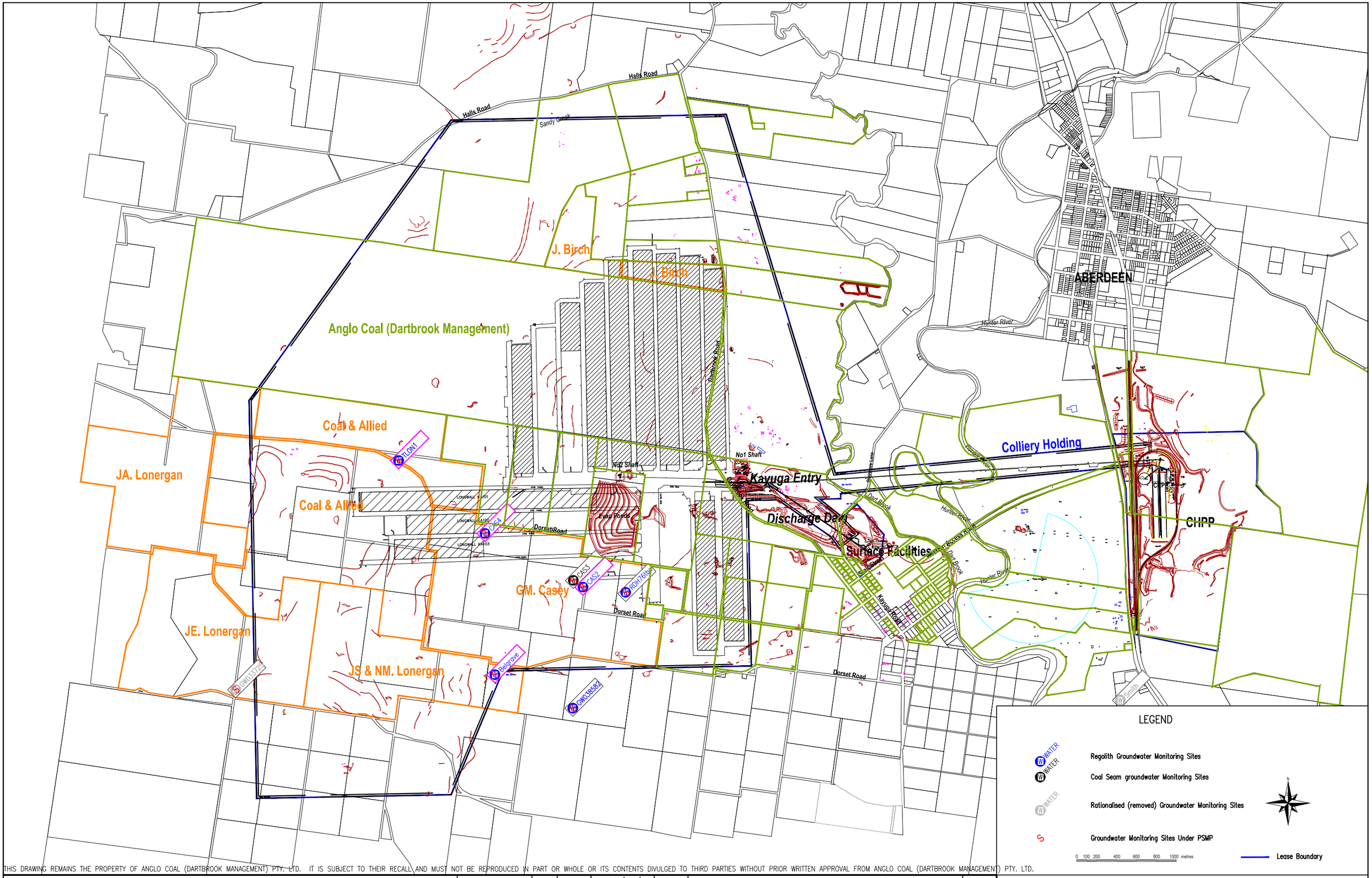
DRAWN			
PC			
20/03/00			

REVISIONS

REV.	DATE	BY	DESCRIPTION	CHK.
U	29/05/12	PC	2012 Drilling Added	DS
V	05/07/12	PC	RDH550 & RDH551 Added	JF
W	29/11/13	PC	Scale moved to 1:34000 to extend range	DS
S	27/01/12	PC	Points Highlighted	DS
T	27/02/12	PC	Bores Included in Program, Moved West to Show GW032889	DS

Plan Showing Location
of Ground Water Monitoring Sites
FIGURE 5

Datum :	AHD	SCALE	A3	DRG.	REV.
GRID :	MGA(56)	1:34000		27431	W



AngloAmerican

DRAWN	REVISIONS	REV.	DATE	BY	DESCRIPTION	CHK.
PC		A.	27/03/14	PC	Initial Issue – Modified & Updated Hansen Plan	DS
27/03/14						

Plan Showing Property Subsidence Management Plan Ground Water Monitoring Sites FIGURE 6

Datum :	AHD	SCALE	A3	DRG.	REV.
GRID :	MGA(56)	1:34000		32613	A

APPENDIX A
Report on Rationalisation of Groundwater Monitoring Program

Australasian Groundwater & Environmental

REPORT on

RATIONALIZATION OF GROUNDWATER MONITORING NETWORK

DARTBROOK MINE

prepared for
HANSEN CONSULTING

Project Number G1284
March 2006

ABN:64 080 238 642

TABLE OF CONTENTS

Attachments:

Figure 1 – Groundwater Monitoring Plan

Figure 2 – Landowners Groundwater Bores

EHB/ae (Dartbrook Mine)
Project No. G1284
March 2006

REPORT ON

RATIONALIZATION OF GROUNDWATER MONITORING NETWORK DARTBROOK MINE

1.0 INTRODUCTION

Anglo Coal (Dartbrook Management) Pty Ltd (ACDM) operate the Dartbrook Coal Mine located next to the Hunter River, north of Muswellbrook, in the Hunter Valley of New South Wales. Mining is achieved through the longwall mining method with coal currently being extracted from the Kayuga Seam, which is situated about 175m above the Wynn Seam. The Wynn Seam was mined in the past as per the mine plan. Mining in the Wynn Seam was completed in mid 2003.

A conveyor tunnel passes beneath the alluvial plain of the Hunter River and transports coal from the mine on the western side of the river to the Coal Handling and Preparation Plant (CH&PP) on the eastern side, adjacent to the New England Highway and Northern Railway. The rejects disposal area is next to the Preparation Plant and both are on the side of a hill, referred to as "Browns Mountain".

The current groundwater monitoring program was approved in accordance with the Environmental Protection Authority (EPA) Licence. A variation to the EPA Licence was received in April 2005, which removed the requirement to monitor specific groundwater monitoring sites as listed in the license. The licence now requires groundwater to be monitored *"at locations representative of where any predicted groundwater impacts caused by the mining operation may occur".*

The groundwater monitoring program has been reviewed and rationalized as outlined in this report, and a proposed revised program prepared. The work was undertaken by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) at the request of Hansen Consulting on behalf of their client ACDM.

2.0 CURRENT MONITORING AND NEED FOR RATIONALIZATION

A groundwater monitoring program has been established to comply with licensing conditions and monitoring has been undertaken since 1998. The current groundwater monitoring program which is implemented by Ecowise Environmental under contract to ACDM, consists of a network of 88 bores of which 17 have been destroyed, are blocked or are inaccessible. The current network therefore consists of 61 bores/wells that are currently being monitored every 3 months. In addition, 9 bores are monitored monthly. The monitoring frequency and parameters monitored are:

- monthly monitoring of water level, pH, EC and /TSS (9 locations);
- quarterly monitoring of water level, pH, EC (61 locations); and
- bi-annual monitoring of water level, pH, EC plus detailed laboratory analysis of a range of parameters (21 locations).

The current groundwater monitoring program was developed with the objective of satisfying two separate approvals, viz:

- 2001 Development Consent where the Conditions require surface and groundwater quality and quantity monitoring as outlined in the Site Water Management Plan; and
- monitoring of selected landowner bores in accordance with the approved Property Subsidence Management Plan (PSMP).

The objectives of the monitoring program as defined in the 2001 Development Consent Condition 4.2 (a) are *that the monitoring program shall have the capacity to collect sufficient data to adequately assess:*

- *the impact on groundwater levels on neighbouring properties and in the locality, and to identify any water quality impacts,*
- *the impact of the development on groundwaters associated with the alluvial aquifer of the Hunter River including the ongoing monitoring of the volume and quality of inflows into the Hunter Tunnel,*
- *regional groundwater levels and water quality including the extension of the regional groundwater network to include bores RDH508-511, and*
- *any concerns or complaints from surrounding landholders on groundwater matters, and any ensuing actions, which shall be recorded and be available to DLWC.*

The monitoring bore network is to assess:

- the impact of the current Kayuga Seam longwall mining operations, future longwall mining operations in the Piercefield and Mt Arthur seams and of past longwall mining of the deeper Wynn Seam with respect to deep and shallow depressurization of the coal measures strata created by dewatering, and any adverse impact it may have on shallow alluvial and regolith aquifers and existing bores and wells;
- the impact of the conveyor tunnel on the overlying Hunter River alluvial aquifer; and
- the impact of rejects disposal on the groundwater regime, particularly the Hunter River alluvium.

Figure 1 shows the existing groundwater monitoring network.

The depth to groundwater of many bores in the revised program is more than 50 metres. Ecowise Environmental have indicated that due to the narrow diameter of the casing purging of these bores prior to sampling is, at present, not practical due to the time involved for the bores to recharge.

Monitoring of the large number of bores in the current monitoring program is an onerous, time consuming and expensive task. It is considered that the number of bores is excessive compared to other similar mining operations and could be rationalized without compromising the objectives of the groundwater monitoring program.

3.0 CRITERIA USED IN RATIONALIZING MONITORING BORE PROGRAM

The review of the status of the active 61 monitoring bores in the network found that bore construction data from many of the bores was not recorded and could not be located, leading to uncertainty as to which aquifer was being monitored.

There are two main aquifer systems at the Dartbrook Mine, viz:

- alluvial aquifer system associated with the Hunter River, Dart Brook and Sandy Creek, and
- the coal seam aquifers.

The alluvial aquifers are the most important with respect to groundwater dependent ecosystems and human use. The Hunter River alluvial aquifer is used for irrigation, stock and domestic purposes, whereas it is understood that alluvium associated with Dart Brook and Sandy Creeks is primarily used for stock and/or domestic supplies. The Hunter River is a major aquifer providing good yields of high quality water.

The coal seam aquifers are generally deep, low yielding and contain poor quality (brackish to saline) groundwater. They are far less significant aquifers and therefore the impact of the mine on these aquifers has less significance.

The prime focus of the groundwater monitoring program should therefore be the alluvial aquifers, and whether the mine is impacting these aquifers with respect to providing seepage pathways to the mine, and hence impacting on water levels and water quality. This is of particular concern with respect to the conveyor tunnel which passes beneath the Hunter River alluvial plain and the potential for seepage from the alluvium to the tunnel. Also of concern is any impact of the CH&PP and Rejects Disposal Area on the eastern side of the river and the underground tailings disposal in the Wynn Seam goaf.

The criteria used in rationalizing the monitoring bore program was therefore:

- a greater number of bores in the important alluvial aquifers than in the less significant coal seam aquifers;
- where possible, removal of bores where there is uncertainty of the aquifer being monitored by the bore;
- a less dense network, particularly in areas where many monitoring bores are in close proximity;
- selection of bores at strategic locations; close to the mine, over the tunnel etc, that would likely be impacted first, if adverse impact were to occur;
- removal of deep coal seam monitoring bores located over the longwall panels, that would likely be destroyed by mining.
- retain those bores that are specifically required by the 2001 Consent Conditions and the PSMP.

4.0 REVISED MONITORING NETWORK

4.1 Site Water Management Plan

The proposed revised groundwater monitoring network is given in Table 1 and the bore locations are shown on Figure 1. The proposed program is discussed briefly below. The bores that have been removed from the program and those that have collapsed, are inaccessible etc are summarized on Tables 2 and 3 respectively.

Hunter River Alluvium over Conveyor Tunnel

Four monitoring bores (JOR1, WAL2, KAI1 and FRA1) are proposed in a west to east direction across the alluvial plain along the alignment of tunnel. The bores selected are those that are closest to the tunnel and therefore will first respond to any leakage to the tunnel. Monitoring bore RDH508 and RDH509 on the eastern side of the alluvium will also detect seepage to the tunnel although their primary purpose is to detect impact from the CH&PP and Rejects Disposal Area.

Dart Brook Alluvium

Four monitoring bores/wells ((DDH73(b), DAN2, WM1A and ADN1) have been selected in the Dart Brook alluvium which occurs between the mine and Hunter River alluvium, and therefore should first respond to any impact of the mine. The bores/wells were selected at approximately 1200m intervals.

Sandy Creek Alluvium

Four bores/wells (GW038412, BR03, COR3 and WM3) were selected in the Sandy Creek alluvium to provide an even spread along the creek. .

Sandy Creek South

Only one monitoring bore (GW032889) is located in this area to the south-west of the mine. It is reported to be in regolith, but may include alluvium. There is no access to this bore and it is reported to have been filled in, in 2005. As such it is proposed that no monitoring be undertaken in the Sandy Creek Alluvium.

Dam Leakage

Bore RDH505 which is 2.6m deep has been retained in the program to monitor for leakage from the Staged Discharge Dam.

Coal Seams

A total of four bores are proposed for monitoring the Kayuga, Piercefield and Mt Arthur Seam: (DDH73(a), DDH183, DDH193, and Kayuga 1. The Kayuga Seam is the seam currently being mined and is therefore the focus of this revised monitoring program. The Kayuga Seam monitoring bores are located around the perimeter of the existing and proposed longwall panels and therefore should not be destroyed by mine subsidence.

Only one bore is recorded as being in the Wynn Seam, DDH186(a) and this has collapsed. Bore DDH212(a), which is suspected to be completed in the Wynn Seam is proposed for Wynn Seam monitoring, but the seam in which the bore is completed needs to be confirmed first.

Regolith

Three bores (CAS2, CAS4, and TLON1), located above the longwall panels and centre of the mining area, are proposed for monitoring the regolith. In addition the Belgrave bore on the boundary of the mining lease will be monitored.

JLON1, was part of the previous monitoring program and, because it is reported to have gone dry, is the subject of some concern that it may have been impacted by mining. It. has therefore been retained although a separate report on JLON1 concludes that the bore has gone dry because of an extended dry period and not because of the impact of mining.

Rejects Emplacement Area (REA)

There are four REA monitoring bores (RDH508-511) located west of the REA and CH&PP. Monitoring of these bores is a requirement of the current conditions of consent and will be continued. There is however no construction data on any bores and the aquifer intervals being monitored are therefore unknown, but it is suspected that the alluvium is being monitored. As discussed earlier, monitoring bores RDH508 and RDH509 serve a dual purpose of monitoring the impact of both the conveyor tunnel and CH&PP/Rejects Area on the alluvium.

Bore RDH511 has been destroyed and should be replaced.

4.2 Property Subsidence Management Plans (PSMPs)

Additional to the Groundwater Monitoring Program, the Environmental Protection Authority (EPA) Licence required, groundwater monitoring under the PSMPs of the following bores: RDH76, CAS2, GW038582 and Belgrave (refer Figure 2). CAS2 and Belgrave are included as part of the regolith monitoring program.

While GW023652 and GW033725 are also to be monitored under the PSMP, JE Lonergan no longer provides access. In addition, JA & WE Lonergan have stated on 22 June 2005 that monitoring of Sandy Creek Well and the Unnamed bore adjacent to Athlone_is not required.

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Table 1: SUMMARY OF PROPOSED BI-ANNUAL MONITORING BORES - DARTBROOK COAL MINE											
Bore	Co-ordinates mE	mN	Collar RL (mAHD)	ToC	Depth (m)	Casing from - to (m)	Screen	Aquifer Monitored	Casing type	Bore Licence	Status	Required by EPA License
Hunter River Alluvium over Conveyor Tunnel Alignment												
FRA1	289065	1436975	171.7?	161.0				Hunter River alluvium		GW07917	well	Yes
JOR1	287189	1437223	160.3					Hunter River alluvium		GW078927	well	Yes
KAI1	288359	1436796	161.2					Hunter River alluvium		GW078932	well	Yes
WAL2	287690	1436680	160.3					Hunter River alluvium**			well	Yes
Dart Brook Alluvium												
ADN1	286610	1438326	161.6					Dart Brook alluvium		GW078973	well	No
DDH73(b)	285878	1439926					11.7 - 17.5	Dartbrook alluvium	40mm, uPVC	GW079005	bore	Yes
DAN2	286456	1439564	163.5					Dart Brook alluvium		GW078995	well	Yes
WM1A	286159	1438945	163	162.7			10.0 - 16.0	Dart Brook alluvium	50mm, uPVC	GW078965	bore	Yes
Sandy Creek Alluvium												
BRO3	284506	1440098	180					alluvium		GW078980	bore	Yes
COR3	282169	1439865	199.6					Sandy Creek alluvium		GW078993	bore	Yes
WM3	283265	1440504	191.7	190.4			4.0 - 8.8	Sandy Creek alluvium	50mm, uPVC	GW078967	bore	Yes
GWO38412	279949	1438461			6.7			Sandy Creek alluvium		well	Yes	
Dam Leakage												
RDH505	286920	1436376	172.54	26				Regolith – shallow overburden	50mm uPVC	No Licence		Yes

Table 1: SUMMARY OF PROPOSED BI-ANNUAL MONITORING BORES - DARTBROOK COAL MINE												
Bore	Co-ordinates		Collar RL (mAHD)	ToC?	Depth (m)	Casing	Screen	Aquifer Monitored	Casing Type	Bore Licence	Status	Required by EPA License
	mE	mN				from - to (m)						
Coal Seams												
DDH73(a)	285878	1439926	166.31	166.8	246.6		99 - 110.5	Piercefield / Kayuga	50mm, uPVC	GW079005	bore	Yes
DDH183	284499	1435250	226.02	226.1	110.9			Kayuga	50mm, uPVC	No licence	bore	Yes
DDH193	281513	1436496	273.31	273.6	323.8			Kayuga	50mm, uPVC	No licence	bore	Yes
DDH212(a)	282000	1437999	230.40		360.2			Wynn **	25mm uPVC	No licence	bore	Yes
Kayuga 1								Kayuga**		No licence		No
Regolith												
CAS2	284322	1436060	238.6					Regolith – shallow overburden		bore	PSMP	
CAS4	283347	1436619	249.8					Regolith – shallow overburden		GW078988	windmill	PSMP
JLON1	286591	1435391	166.6					Regolith – shallow overburden		GW078926	windmill	Yes
TLON1	282491	1437367	221.5					Regolith – shallow overburden		GW078952	windmill	PSMP
Belgrave								**		No licence	PSMP	PSMP
Rejects Emplacement Area (REA)												
RDH508	289595	1437500	167.3		30			Hunter River alluvium	50mm PVC	No licence		Development Consent Condition Section 4.2(a) (ii) 3
RDH509	289679	1437080	160.3		30			Hunter River alluvium		No licence	bore	
RDH510	289757	1436279	159.8		30			Hunter River alluvium		No licence	bore	
RDH511	289548	1435780	157.7		30			Hunter River alluvium	Destroyed – to be replaced	No licence	bore	

Notes:

i) full suite of analysis required bi-annually

ii) ToC Top of Casing

iii) PSMP = monitoring required under the Property Subsidence Management Plan

iv) ** = Bore depth to be surveyed to confirm which aquifer is monitored

Table 2: SUMMARY OF MONITORING BORES REMOVED FROM PROGRAM - DARTBROOK COAL MINE

Bore	Co-ordinates		Collar	ToC?	Depth (m)	Casing	Screen	Aquifer Monitored	Casing Type	Status	Required by EPA License
	mE	mN	RL (mAHD)			from - to (m)					
BEL1	285506	1435186	179.4					alluvium - regolith		well	Yes
BIR2	284351	1440006	181.5					alluvium		windmill	Yes
BRA2	286506	1440199	165.3					Dart Brook alluvium		well	Yes
BYF1	285729	1439523	166.3					Dart Brook alluvium		well	Yes
CAD2	282623	1440466	199.1					Sandy Creek alluvium			Yes
CAS1	284900	1435287	201.9					Regolith – shallow overburden		bore	Yes
CAS3	284226	1436130	244					Regolith – shallow overburden		GW078987	windmill PSMP
COR2	282417	1439998	197.3					Sandy Creek alluvium		windmill	Yes
DAN2	286456	1439564	163.5					Dart Brook alluvium		well	Yes
DAY1	284178	1440701	182					Sandy Creek alluvium		bore-trough sample	Yes
DDH124	285639	1436375	200.42	201.1	31.8	0.58 - 23.0	23.0 - 29.0	Kayuga Seam	Class 9, 39mm PVC	bore	Yes
DDH186(b)	283001	1435000	264.31					Kayuga Seam	25mm, uPVC	bore	No
DDH186(c)	283001	1435000	264.31					Shallow overburden	25mm, uPVC	bore	No
DDH74(a)	285551	1440647	173.07	172.7	282.7		139 - 145	Piercefield / Kayuga	50mm, uPVC	bore	Yes
DDH74(b)	288551	1440647					4.4 - 10.2	Dartbrook alluvium	40mm, uPVC	bore	
DUCI	286664	1435585	166					alluvium		bore	No
DUCN	286420	1435842	175.4					alluvium		bore	No
DUCW	286625	1435875	184.4					alluvium		bore	No
ESP2	289760	1436795			15.5	0.46 - 11.6	11.6 - 14.5	Hunter River alluvium	Class 18, 50mm PVC	bore	Yes
GAR4	289355	1436148	166.8	158.3				Hunter River alluvium		well	Yes
GAR3	288765	1436258	162.3	159.8				Hunter River alluvium		well	Yes
GOO1	284455	1441122	182.4	182.1				Sandy Creek alluvium		windmill-trough sample	Yes
GWO32889	279166	1434539			18.3	0.6 - 11.6	open hole	Regolith - shallow coal	152mm, steel	GWO32889	Yes

Table 2: SUMMARY OF MONITORING BORES REMOVED FROM PROGRAM - DARTBROOK COAL MINE

Bore	Co-ordinates		Collar	ToC?	Depth (m)	Casing	Screen	Aquifer Monitored	Casing Type	Status	Required by EPA License
	mE	mN	RL (mAHD)			from - to (m)					
								measures Alluvium**			
GWO38582	284197	1434846			29.2	0.6 - 11.5	11.5 - 29.2	Fract. rock-Sandstone	152mm, uPVC		Yes
HAL1	287829	1435509	160.7	158.4				Hunter River alluvium		well	Yes
KAI2	288772	1436756	168.8	160.6				Hunter River alluvium		well	Yes
RDH76	284750	1436000	223.4	223.2				fractured rock?			PSMP
RDH266	286000	1436880	193.14	194.1	33.9	0.15 - 27.4	27.4 - 33.9	sandstone above Kayuga Seam	Class 9, 39mm uPVC	bore	No
RDH271	285248	1436875	213.17	213.5	91.4	0.42 - 83.4	83.4 - 89.4	Kayuga Seam	Class 9, 39mm uPVC	bore	Yes
RDH280	285499	1436625	210.8	211.2	82.5	0.43 - 74.5	74.5 - 80.5	sandstone below Kayuga Seam	Class 9, 39mm uPVC	bore	Yes
RDH289	285499	1435875	215.51	216.4	45	0.9 - 37.0	37.0 - 43.0	Kayuga Seam	Class 9, 39mm uPVC	bore	Yes
RDH421	282999	1436252	277.54	278.2	256.0			Piercefield / Kayuga	50mm, uPVC	bore	Yes
RDH506	287074	1436287	167.94		29			Regolith – shallow overburden	50mm uPVC		Yes
RDH507	286236	1436704	191.91		30			regolith	50mm, uPVC		Yes
RDH508(a)	289595	1437500	167.3					Hunter River alluvium	50mm, uPVC	25mm uPVC in overburden	No
RDH509(a)	289679	143080	160.3					Hunter River alluvium	50mm, uPVC	25mm uPVC in overburden	No
RDH510(a)	289757	1436279	159.8					Hunter River alluvium	50mm, uPVC	25mm uPVC in overburden	No
RIV1	287884	1435983	163.1					Hunter River alluvium?		well	Yes
TEE4	286208	1440876	171.1	168.4				Dart Brook alluvium?		well	Yes
WM1P	286159	1438945	163	162.7				Dart Brook alluvium		bore	Yes

Note: Bores that have gone dry due to mining of the Kayuga Seam

Table 3: SUMMARY OF DESTROYED, NO ACCESS, ETC MONITORING BORES - DARTBROOK COAL MINE											
Bore	Co-ordinates		Collar	ToC?	Depth (m)	Casing	Screen	Aquifer Monitored	Casing type	Status	Required by EPA license?
	mE	mN	RL (mAHD)			from - to (m)					
DDH123	285000	1436000	214.24	215.3	91.5	0.6 - 83.6	83.6 - 89.5	Kayuga Seam	Class 9, 39mm uPVC	destroyed by mining	Yes
DDH184	283750	1436750	276.21	276.0	396.3			Piercefield / Kayuga	50mm, uPVC	Grouted for LW KA101	Yes
DDH186(a)	283001	1435000		264.6	353.0			Wynn Seam	25mm, uPVC	Collapsed - No Sample	Yes
DDH211	281527	1434987	300.96							No Access - Jim Lonergan's land	Yes
DDH212(b)	282000	1437999	230.40					Mt Arthur / Kayuga	25mm uPVC	bore	
ESP1sh	290255	1436213			10.8	0.5 - 7.8	7.8 - 10.8	Sandstone/siltstone	Class 18, 50mm uPVC	Site destroyed	No
GWO11315	281601	1436272								No sign of bore/windmill	No
GWO19455	281285	1432487								No Access - Mt Pleasant owned land	No
GWO19456	281604	1433561								No Access - Mt Pleasant owned land	No
GWO23652	280701	1435112								No Access - John Lonergan's land	No
GWO23855	285548	1439183								Bore sealed around windmill - no access	No
GWO26295	284963	1435773								No sign of any bore/windmill - all buildings in this area cleared	No
GWO33725	280810	1435095								No Access - John Lonergan's land	No
GWO38369	287209	1436124								Bore Sealed	No
GWO67250	284351	1440006								Site does not exist -	No

Table 3: SUMMARY OF DESTROYED, NO ACCESS, ETC MONITORING BORES - DARTBROOK COAL MINE

Bore	Co-ordinates		Collar	ToC?	Depth (m)	Casing	Screen	Aquifer Monitored	Casing type	Status	Required by EPA license?
	mE	mN	RL (mAHD)			from - to (m)					
										destroyed?	
JOR5	286553	1437810	159.5					Dart Brook alluvium		well collapsed	No
RDH443	282254	1434230	326.74	325.1				Piercefield / Kayuga	50mm, uPVC	No Access - Mt Pleasant owned land	No
RDH497	283019	1439998	199.17							Bore filled in	No
RDH504	286865	1436458	172.97							Collapsed	No
RDH511(a)	289548	1435780	157.7					Hunter River alluvium		(a) is smaller piezo	No
WM2	285836	1440409	170.6	170.0			10.3 - 16.0	Dart Brook alluvium	50mm, uPVC	Destroyed by farming	Yes

5.0 TAILINGS DISPOSAL MONITORING

ACDM received a modification to the 2001 Development Consent in November 2005 to for the disposal of tailings in the Wynn Seam goaf. As discussed in the Statement of Environmental Effects (SEE) prepared for the modification, it would appear that there is only one bore (DDH212[a]) that currently monitors the Wynn Seam. Therefore although the program outlined in Section 4.0 is suitable for the current mining operation, it is not suitable for monitoring the impact of the proposed tailings disposal in the Wynn Seam goaf. Additional bores will have to be constructed in the Wynn Seam and it is recommended in the groundwater section of the SEE that three monitoring bores be established in the Wynn Seam goaf:

- near the tailings discharge pipe in panel 1 at the up-gradient end of the Wynn Seam panel layout, (WSG1),
- in the central area of the panel layout, (WSG2); and
- at the Wynn Seam dewatering bores (WSG3), that is the down-gradient end.

The proposed bore locations are shown on Figure 1.

There are a large number of gas drainage bores located in the Wynn Seam goaf and it is recommended that if feasible two are converted to groundwater monitoring bores. A dewatering bore could be used for monitoring at the down-gradient end.

It is further recommended that the bores be included in the existing monitoring program and monitored for the following parameters:

- water level, pH EC – quarterly;
- water level, pH, EC, TDS, alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate, nitrate and molybdenum – biannually.

6.0 DATALOGGERS

Dataflow 392 capacitive transducer type loggers were installed in bores DDH183, DDH184 DDH193 and possibly DDH211, on a temporary basis as part of the June (2000) EIS[1]. Bores DDH183 and DDH193 monitor the Kayuga Seam whereas DDH184 and DDH211 are reported to have monitored the Wynn Seam. DDH182 was destroyed during mining of Kayuga Seam Panel KA102 and access cannot be obtained to DDH211 which is on Jim Lonergans land.

The 1991 DC specifies that four loggers to be installed, 2 in the alluvium and 2 in the Permian coal measures. Bores DDH183 and DDH193 in the Kayuga Seam will form part of the proposed monitoring network however, it is considered that there is no need to re-install the dataloggers in them as it is known that the Kayuga Seam will be impacted and it is considered that manual monitoring will be sufficient to record this impact. It is however proposed that a data logger be installed in alluvial monitoring bores at two sites; JOR1 and WM1A, that is Hunter River and Dartbrook alluvium respectively. It is considered that these bores will provide early warning of potential adverse impact on the alluvium.

[1] HLA Envirosciences Pty Limited, (June 2000), *"Dartbrook Extended – Environmental Impact Statement"*, Vol 3, App. L.

7.0 PARAMETERS TO BE MONITORED

The prime impact of the mine will be on water levels rather than on water quality except in areas such as the REA, where there is potential for seepage and contamination to occur. Therefore it is proposed that the parameters monitored should be water level, pH and EC in all bores on a quarterly basis. In addition a full suite of analysis for:

- water level, pH, EC, TDS, alkalinity, calcium, chloride, magnesium, potassium, sodium and sulfate,

should be undertaken biannually on the four bores near the REA, that is, RDH508 - 511.

It is very difficult and often impossible to purge 50mm diameter bores with a purge pump where the water level is quite deep. In the past it is understood that the bores were not purged and therefore the chemical analyses may not be truly representative of the aquifer water quality. It is recommended that in order to obtain pH and EC data representative of the aquifer water from monitoring bores with deep water levels, the bores be purged by airlifting using polypipe inserted to well below the water level, and connected to a small compressor. At least 3 casing volumes should be removed from the bore before measuring pH and EC and/or airlifting should continue until the EC and pH have stabilized.

The bores in the REA area where full chemical analysis is required have a shallow water table and should be purged by pumping or bailing at least 3 casing volumes prior to the sample being taken.

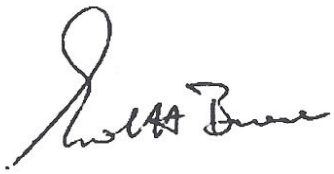
8.0 RECOMMENDATIONS

It is recommended that:

- the depth of all bores in the proposed revised program be measured to ascertain which aquifer they monitor, and that they be airlift developed to ensure hydraulic connection with the aquifer;
- where the elevation of the bore to the top of casing and ground level has not been surveyed, this should be done;
- bore RDH511 be replaced (it has recently been destroyed);
- if an adverse impact is detected in any of the alluvial monitoring bores, nearby alluvial bores be added to the monitoring program;
- the groundwater sampling/monitoring program and collection, transport and storage of groundwater samples should be undertaken in accordance with the guidelines, "Murray Darling Basin Groundwater Quality Sampling Guidelines", August 1997, Technical Report No. 3, Groundwater Working Group; and
- on approval of the Site Water Management Plan and monitoring program, three monitoring bores be established in the Wynn Seam goaf to monitor the impact of the proposed tailings disposal (eg at the up-gradient end of Wynn Panel layout, centre of the panel layout and near the Wynn seam dewatering bores).

- data loggers be installed in alluvial monitoring bores JOR1 and WM1A.

AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD



ERROL H. BRIESE
Managing Director/Principal Hydrogeologist

LIMITATIONS OF REPORT

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) has prepared this report for the use of Hansen Consulting in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The methodology adopted and sources of information used by AGE are outlined in this report. AGE has made no independent verification of this information beyond the agreed scope of works and AGE assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to AGE was false.

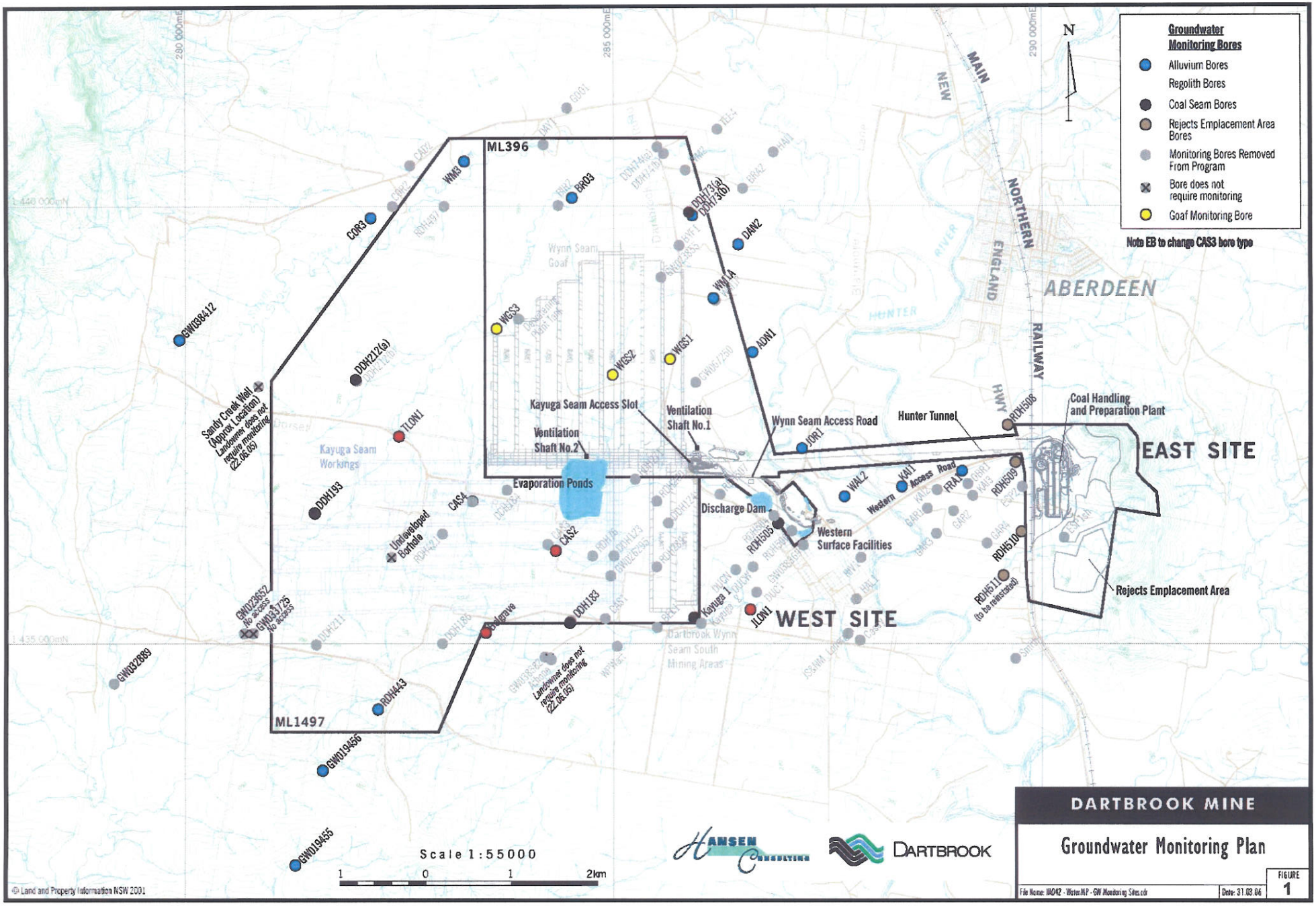
This study was undertaken between 19 January 2005 and March 2006 and is based on the conditions encountered and the information available at the time of preparation of the report. AGE disclaims responsibility for any changes that may occurred after this time.

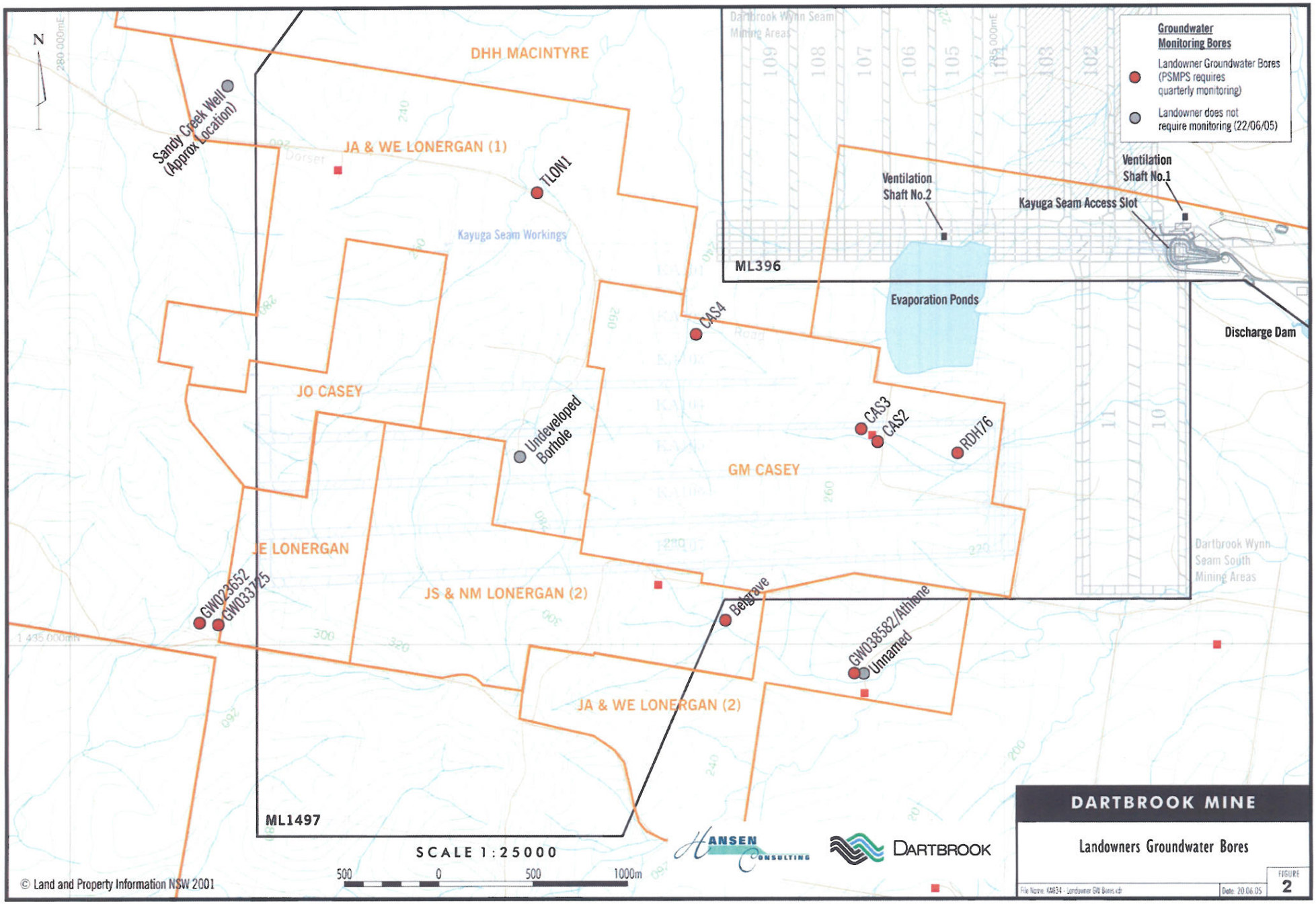
This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. It may not contain sufficient information for the purposes of other parties or other users. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing and other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. Where borehole logs are provided they indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of the site, as constrained by the project budget limitations. The behaviour of groundwater is complex. Our conclusions are based upon the analytical data presented in this report and our experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, AGE must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.


Groundwater Monitoring Bores
Alluvium Bores
Regolith Bores
Coal Seam Bores
Rejects Emplacement Area Bores
Monitoring Bores Removed From Program
Bore does not require monitoring
Goaf Monitoring Bore
Note EB to change CAS3 bore type
N
ML396
ML1497
Wynn Seam Goaf
Kayuga Seam Workings
Kayuga Seam Access Slot
Ventilation Shaft No.1
Ventilation Shaft No.2
Wynn Seam Access Road
Hunter Tunnel
Coal Handling and Preparation Plant
EAST SITE
WEST SITE
Evaporation Ponds
Discharge Dam
Western Surface Facilities
Rejects Emplacement Area
Sandy Creek Well (Approx Location) Landowner does not require monitoring (22.06.05)
Undeveloped Borhole
Landowner does not require monitoring (22.06.05)
GW032852 No access
GW033725 No access
GW032889
GW019456
GW019455
GW038412
COR3
WM3
BR03
DDH173(a) DDH736)
DAN2
WM1A
ADN1
WGS3
WGS2
WGS1
DDH212(a)
TLON1
DDH193
CAS4
CAS2
DDH183
RDH443
Gulgrave
Kayuga 1
JLON1
WAL2
KA11 Access Road
FRA1
RDH508
RDH509
RDH505
RDH510
RDH511 (to be reinstated)
JOR1
Dartbrook Wynn Seam South Mining Areas
NEW MAIN NORTHERN ENGLAND HWY RAILWAY
ABERDEEN
HUNTER RIVER
Scale 1:55000
1 0 1 2km
© Land and Property Information NSW 2001
HANSEN CONSULTING
DARTBROOK
DARTBROOK MINE
Groundwater Monitoring Plan
FIGURE 1
File Name: IA042 - Water MP - GW Monitoring Sites.cdr
Date: 31.03.06


N
DHH MACINTYRE
JA & WE LONERGAN (1)
JO CASEY
GM CASEY
JE LONERGAN
JS & NM LONERGAN (2)
JA & WE LONERGAN (2)
Sandy Creek Well (Approx Location)
TLON1
Kayuga Seam Workings
CAS4
Undeveloped Borhole
CAS3
CAS2
RDH76
GW023652
GW033725
Belgrave
GW038582/Athlone
Unnamed
ML1497
ML396
Ventilation Shaft No.2
Ventilation Shaft No.1
Kayuga Seam Access Slot
Evaporation Ponds
Discharge Dam
Dartbrook Wynn Seam Mining Areas
Dartbrook Wynn Seam South Mining Areas
Groundwater Monitoring Bores
Landowner Groundwater Bores (PSMPS requires quarterly monitoring)
Landowner does not require monitoring (22/06/05)
SCALE 1:25000
500 0 500 1000m
© Land and Property Information NSW 2001
HANSEN CONSULTING
DARTBROOK
DARTBROOK MINE
Landowners Groundwater Bores
FIGURE 2
Date: 20.06.05

APPENDIX B

DP&E Letter of Approval for this Water Management Plan dated 15th September 2015.

NSW GOVERNMENT | Planning & Environment

Doug Stewart
Environmental Coordinator
Dartbrook Mine
PO Box 517
MUSWELLBROOK NSW 2333

Contact: Scott Brooks
Phone: (02) 6570 3401
Fax:(02) 6575 3415
Email:scott brooks@planning.nsw gov au
DA 231-07-2000

Dear Doug,

Dartbrook Mine – C & M Site Water Management Plan Approval

Thank you for forwarding the Dartbrook Mine Care & Maintenance Site Water Management Plan (Rev 5) for review. It is required by Condition 4.1 of the Dartbrook DA 231-07-2000.

The Department has reviewed the plan and found it generally satisfies the requirements of the Approval. I would like to advise you that the Secretary has approved the Plan.

This Plan comes into force on the 21st September 2015 replacing all earlier versions, and remains in force until replaced by any future updated approved Plans.

Could you please forward a finalised copy of the above plan (preferably in PDF format with a copy of this approval letter appended) for the Department's records by the end of September 2015, and place a copy of this approved Plan on the Dartbrook Mine website.

If you require further information or clarification in this matter please contact Scott Brooks on 6575 3401 or by email to scott.brooks@planning.nsw.gov.au.

Yours sincerely

Scott Brooks
Investigations (Lead) Compliance
15-9-2015
As Nominee for the Secretary, Department of Planning & Environment