CANYON COAL MINE

WATER MANAGEMENT PLAN

Edition	Rev.	Comments	Author	Authorised By	Date
1	0	Initial document			Jan 2007
	1	2015 Modification Review	T. Dwyer	J. Johnson	Nov 2015

Contents

Figures

Tables

ACRONYMS USED THROUGHOUT THIS DOCUMENT

AR	-	Annual Review (incorporates former Annual Environmental Management Report)
ANZECC	-	Australian and New Zealand Environment and Conservation Council Guidelines for Fresh and Marine Water Quality, 2000.
DA	-	Development Application
DPE	-	Department of Planning and Environment
DPI	-	Department of Primary Industry - Water
DRE	-	Department of Industry, Skills and Regional Development - Division of Resources and Energy
SD	-	Sediment Dam
WHC	-	Whitehaven Coal

1 INTRODUCTION

1.1 Scope

The Whitehaven Coal Mine (now known as Canyon Coal Mine) is located within the Narrabri Shire, approximately 30 km north-west of Gunnedah and 15 km east of Boggabri in the Gunnedah coalfields of NSW. The mine lies within the mining leases (MLs) 1464 and 1471, and is approved under DA 8-1-2005, as modified.

The mine commenced operations in 2000 and ceased mining in 2009 following exhaustion of the resource. The site has undergone extensive rehabilitation and the majority of surface infrastructure, including all coal handling and processing infrastructure, has been removed.

This Water Management Plan has been prepared in accordance with Condition 24, Schedule 3 of DA 8-1-2005, as modified, which states:

"Within 6 months of this consent, the Applicant shall prepare and implement a Water Management Plan for the mine, to the satisfaction of the Secretary. This plan must include:

a) the site water balance;

b) an Erosion and Sediment Control Plan;

c) a Groundwater Monitoring Plan;

d) a Surface and Groundwater Response Plan to address any potential adverse impacts associated with the development; and

e) provision for a review of collected data and monitoring requirements 5 years after the cessation of mining, or as otherwise agreed by the Secretary".

Since completion of major rehabilitation works, water management activities at the Canyon Coal Mine have been limited to monitoring and, as required, dewatering of sediment dams and water management structure maintenance works.

In accordance with Schedule 3, Condition 24 e) a review of collected water monitoring data over the last 5 years ie October 2010 to October 2015, has been undertaken to determine ongoing monitoring requirements. The findings of this review and proposed ongoing monitoring are presented in Section 5.

1.2 Plan Components

The following sub-sections provide:

- A description of the water management system in place at the mine (Section 2);
- A site water balance (Section 3);
- An erosion and sediment control (Section 4);

- A review of post-mining collected data (Section 5)
- A surface and groundwater monitoring program (Section 5.3);
- A surface and groundwater response plan (Section 6); and
- Document Review and reporting (Section 7).

2 THE EXISTING WATER MANAGEMENT SYSTEM

The surface water management system at Canyon (refer Figure 1) includes:

- Water quality monitoring locations,
- Diversion banks to divert clean water flows away from historic disturbance areas to clean water storage dams;
- Storage dams that harvest clean water;
- Catch drains to collect and direct water generated from the rehabilitated landform to sediment basins;
- Contour banks and rock lined waterways on, or to direct water from, the rehabilitated landform to the natural surface; and
- Agricultural contour banks and farm dams.

Water management structures were designed and constructed by Soil Services consistent with the requirements, standard drawings and construction notes within the document “Managing Urban Stormwater: Soils and Construction Manual” (DoH, 2004).

The surface water discharge criteria from any licensed discharge point of the site, as specified in Schedule 3, Condition 19 of DA 8-1-2005, as modified, are presented in Table 1.

Table 1 - Surface Water Discharge Criteria

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	100 percentile concentration limit
Oil and Grease	mg/L			10
pH				6.5≤pH≤8.5
Total suspended solids	mg/L	20	35	50

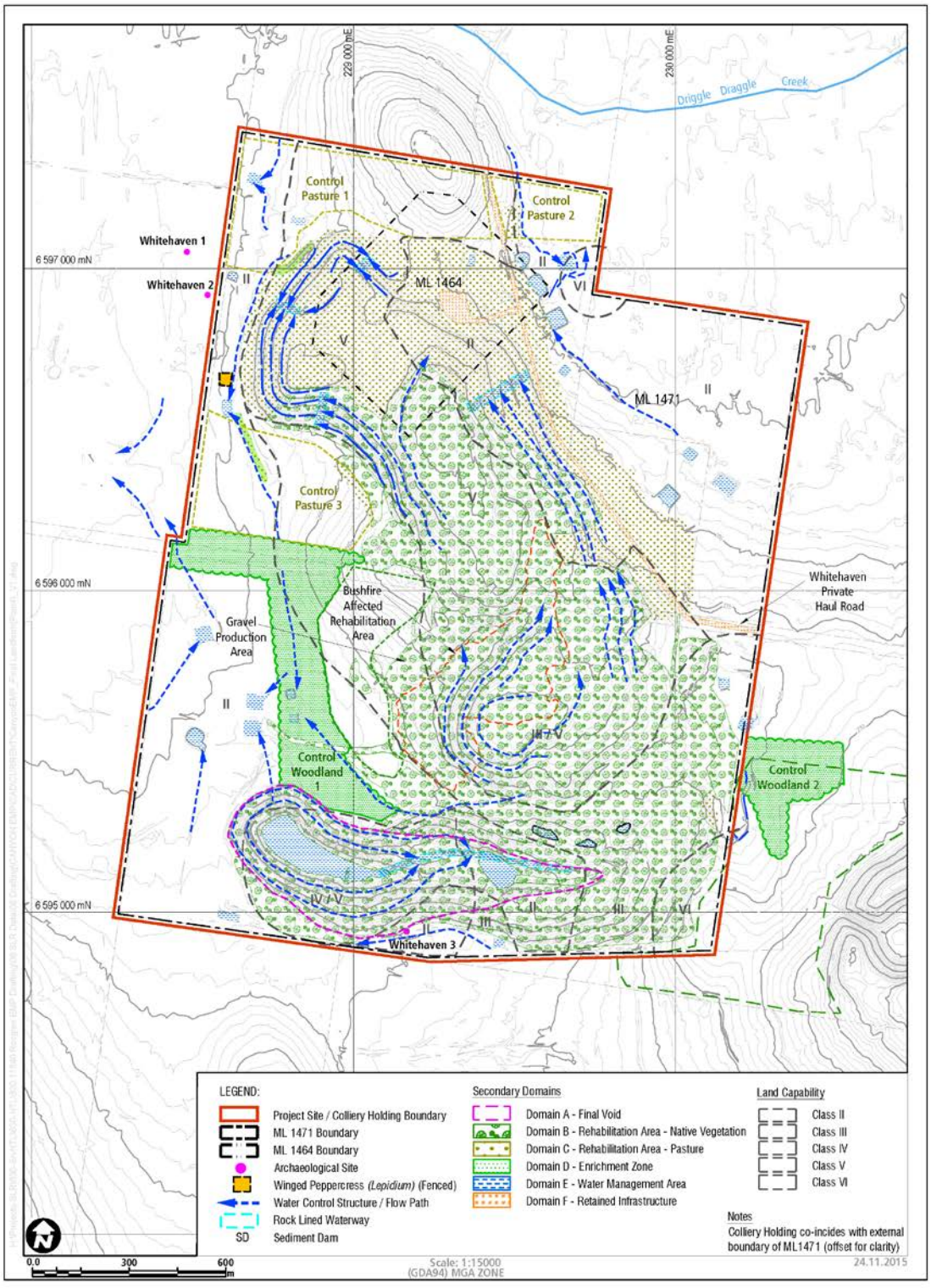

Figure 1 - Water Management System

However, the Canyon Mine EPL 10094 was surrendered on the 11th September 2015 and as such no licence discharge points currently exist making the above criteria no longer applicable.

3 SITE WATER BALANCE

Consideration of the site water balance is limited to that of the final void water level (refer Section 5.1 and 5.2) as the site has no other water make or operational (including potable) water use requirements.

4 EROSION AND SEDIMENT CONTROL PLAN

Current sources of erosion and sediment at Canyon are limited to:

- Runoff from minor remaining disturbed areas eg access tracks, at erosive velocities, and
- Surface water runoff from rehabilitated areas prior to full stabilisation.

Proposed ongoing monitoring for erosion and sediment control is presented in Section 5.3.

5 POST MINING DATA AND MONITORING REVIEW

As per Schedule 3, Condition 24 e) of DA 8-1-2005, and the previously approved Water Management Plan (WHC, 2006), the results of the post-mining water monitoring, particularly the water quality and level within the final void and the water levels and characteristics in surrounding bores, have been reviewed to ascertain the need for a continuance of the current water monitoring program, its expansion, reduction or termination.

5.1 Surface Water Review

Surface water monitoring has been undertaken at monitoring locations to assess water quality against discharge criteria and determine background water quality upstream of the site and receiving water quality downstream of the site.

Historic surface water records over a five year period were reviewed with respect to frequency of site discharge, minimum/average/maximum results of parameters of interest at each monitoring site, and comparison of individual discharge location results to upstream and downstream location results to determine any material influence on receiving water quality.

The review included comparison of results to:-

- Discharge criteria,

- Upstream and downstream receiving water qualities, and
- Australian and New Zealand Environment and Conservation Council Guidelines for Fresh and Marine Water Quality, 2000.

Surface water quality monitoring locations are shown in Figure 2.

A summary of surface water monitoring results for the period October 2010 to October 2015 is presented in Table 2.

Table 2 - Surface Water Monitoring Summary (October 2010 to October 2015)

Site (refer Figure 2)	Site Description	Frequency	Parameters	Purpose	pH (min/max/av.)	TSS – mg/L (min/max/av.)	Conductivity – µS/cm (min/max/av.)	Grease and Oil – mg/L (min/max/av.)
WW-7	Discharge from SD-1	Each overflow event when discharging	pH, TSS, Grease and Oil, Conductivity	To verify compliance with parameters identified in **Table 1.**	No discharge	'-	'-	'-
WW-8	Discharge from SD-2	Each overflow event when discharging	pH, TSS, Grease and Oil, Conductivity	To verify compliance with parameters identified in **Table 1.**	No discharge	'-	'-	'-
WW-9	Discharge from SD-3	Each overflow event when discharging	pH, TSS, Grease and Oil, Conductivity	To verify compliance with parameters identified in **Table 1.**	6.6/7.2/7	15/68/38	112/301/179	<5/<5/<5
WW-11	Driggle Draggle Creek, upstream of any mine-related discharges *	If discharge is occurring at WW-7, WW-8, WW-9, WW-13 or WW-14	pH, TSS, Grease and Oil, Conductivity	To determine quality of water in Driggle Draggle Creek upstream of all mining-related activities.	6.6/7.4/7	24/183/87.1	73/134/94	<5/<5/<5
WW-12	Driggle Draggle Creek, downstream of any mine-related discharges *	If discharge is occurring at WW-7, WW-8, WW-9, WW-13 or WW-14	pH, TSS, Grease and Oil, Conductivity	To determine quality of water in Driggle Draggle Creek downstream of all mining-related activities. To compare with WW-11.	6.4/7.5/6.9	38/283/103	19/282/112	<5/<5/<5

Site (refer Figure 2)	Site Description	Frequency	Parameters	Purpose	pH (min/max/av.)	TSS – mg/L (min/max/av.)	Conductivity – µS/cm (min/max/av.)	Grease and Oil – mg/L (min/max/av.)
WW-13	Discharge from SD-4	Each overflow event when discharging	pH, TSS, Grease and Oil, Conductivity	To verify compliance with parameters identified in **Table 1**.	No discharge	'-	'-	'-
WW-14	Discharge from SD-5	Each overflow event when discharging	pH, TSS, Grease and Oil, Conductivity	To verify compliance with parameters identified in **Table 1**.	No discharge	'-	'-	'-
	Upper Void	Quarterly	pH, TSS, Grease and Oil, Conductivity	To compare with Lower Void.	8.3/9.7/8.9	**5/182/33	242/626/426	**5/9/5.3
	Lower Void	Quarterly	pH, TSS, Grease and Oil, Conductivity	To compare with EA predictions.	8.0/9.1/8.6	8/97/29	346/1950/841	**5/8/5.6

* Where stream flows occurring and discharges reach Driggle Draggle Creek

** Results <5 mg/L taken as 5 mg/L.

SD – Sediment Dam

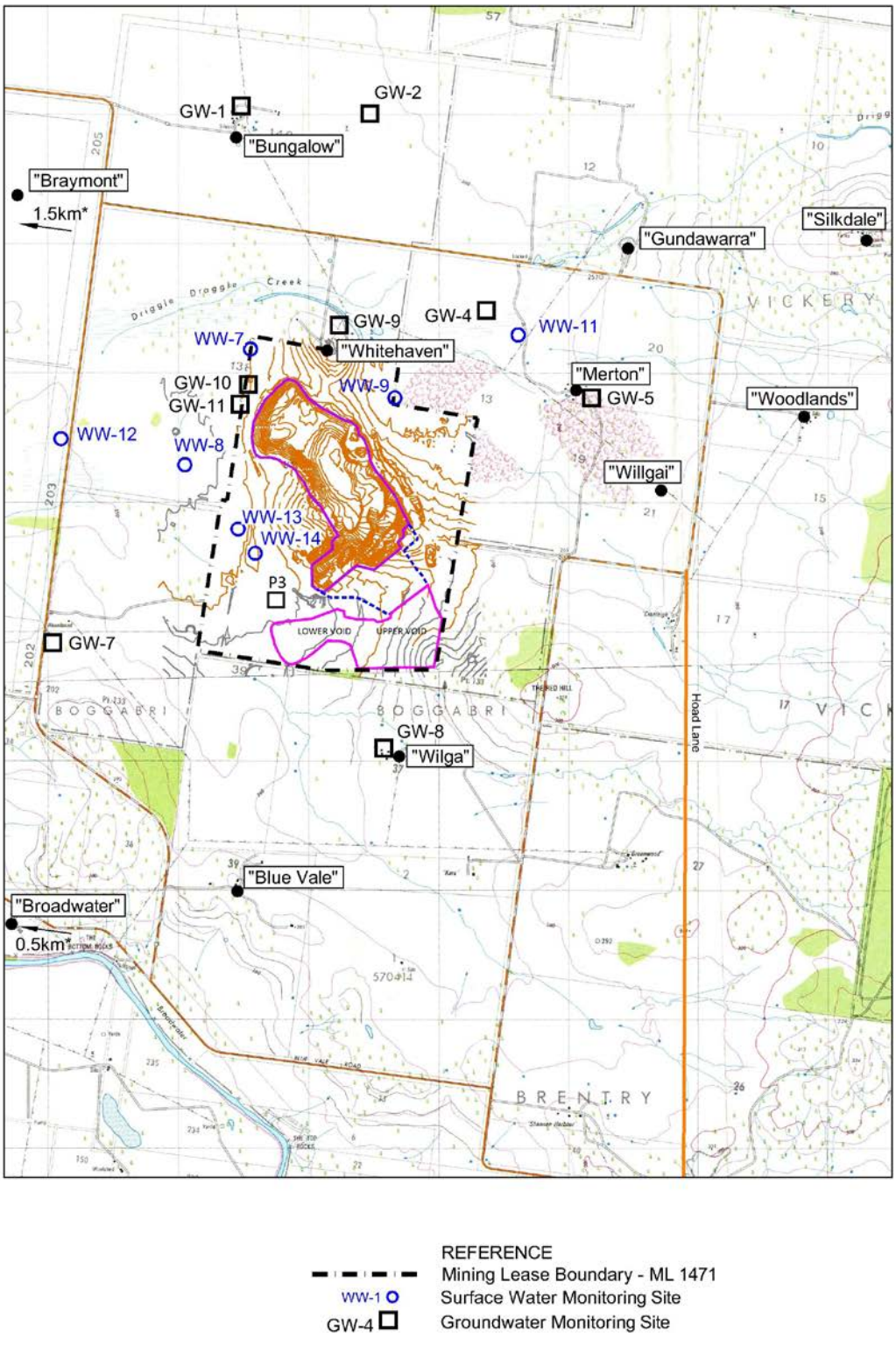

Figure 2 - Surface and Groundwater Monitoring Locations

The surface water monitoring summary presented in Table 2 indicates:-

SD1 (WW-7), SD2 (WW-8), SD4 (WW-13), SD5 (WW-14)

- No discharge occurrences over the five year review period and therefore no data collection from monitoring locations WW-7, WW-8, WW-13 and WW-14 respectively.

SD3 (WW-9)

- Minimum, average and maximum pH levels within discharge criteria and ANZECC values, and similar to upstream and downstream receiving waters,
- Average TSS within discharge criteria and ANZECC value, with a maximum slightly above discharge criteria and ANZECC value at 68mg/L. This maximum result was recorded 12/11/2010 since which maximum levels have been at criteria level or below. Both average and maximum TSS results were well below upstream and downstream receiving waters.
- Average and maximum conductivity levels below ANZECC value. Average and maximum conductivity were higher than both upstream and downstream receiving waters, however average upstream (94 µS/cm) and downstream (112 µS/cm) conductivities were not materially different.

WW-11 and WW-12

- Below levels of detection of Grease and Oil,
- Minimum, average and maximum pH levels within ANZECC values,
- Average and maximum TSS levels above ANZECC values both upstream, 87.1mg/L and 183mg/L respectively, and downstream, 103mg/L and 283 mg/L respectively. As noted above for WW9 TSS levels of waters discharged from site have been at or below 50mg/L since November 2010.
- Below levels of detection of Grease and Oil at both upstream and downstream of mine site.

In general, TSS and Conductivity fluctuations recorded for both discharge and receiving waters are thought to be a function of the climatic conditions experienced in advance of a rainfall event and the intensity/scale of the rainfall event itself eg an intense rainfall event following a period of dry weather would be expected to result in elevated TSS concentrations.

Upper and Lower Voids

- Minimum and average pH values for both Upper and Lower Voids within discharge criteria and ANZECC values. Maximum pH values for both Upper (9.7) and Lower (9.1) Voids above discharge and ANZECC criteria.
- Average and maximum conductivity values above discharge criteria and ANZECC values for both Upper and Lower Voids.

- Average and maximum levels of Grease and Oil below discharge criteria. The source of Grease and Oil is not clear however continued monitoring of the Lower Void is proposed to determine any trending.

Further, review of additional available data for the Lower Void, not required to be collected for other monitoring sites, indicates:

- Steady trending pH levels between 8.4 and 8.8 since November 2013,
- Increasing Conductivity levels from 348 µS/cm to 1,950 µS/cm, since August 2013 and onset of drier climatic cycle,
- Plateauing of Total Alkalinity around 346 mg/L since May 2014,
- Increase in Chloride levels from 31 mg/L to 425 mg/L, since August 2011,
- Increase in Sodium levels from 85 mg/L to 425 mg/L, since August 2011,
- Stable trending in all other parameters monitored.

Monitoring of water level within the Lower Void is not currently undertaken but forms part of the proposed monitoring program, refer Section 5.3.

5.2 Groundwater Review

A summary of groundwater monitoring results for the period October 2010 to October 2015 is presented in Table 3. For the purposes of review monitoring bores located remote from the mine site ie GW-2, GW-4, GW-5, GW-7, GW-8, and GW-9, have been assessed in terms of recorded Standing Water Level (SWL) against initial SWL, refer Table 3, whereas monitoring bores in proximity to the mine site ie GW-10, GW-11 and P3, have been assessed in terms of both recorded SWL against initial SWL, and temporal trends in water quality parameters previously determined for monitoring, refer Table 4, Table 5 and Table 6, respectively.

Table 3 - Groundwater Monitoring Summary (October 2010 to October 2015)

Site (refer Figure 2)	Purpose	Frequency and Summary	
		SWL	SWL Summary
GW-2	To determine existing status and any impacts	Quarterly	SWL stable at approximately 19m Initial SWL 19.5m in 2005
GW-4	To determine existing status and any impacts	Quarterly	SWL stable at 20-21m Initial SWL 21.6m in 2005
GW-5	To determine existing status and any impacts	Quarterly	SWL stable at approximately 23.7m Initial SWL 24.4m in 2005
GW-7	To determine existing status and any impacts	Quarterly	SWL stable between 27-28m. Initial SWL 25.8m in 2005.

Site (refer Figure 2)	Purpose	Frequency and Summary	
		SWL	SWL Summary
GW-8	To determine existing status and any impacts	Quarterly	SWL stable at approximately 22.4m to May 2013 then variable down to 35m and more recently up to 23m. Windmill in use on bore. Initial SWL 19.29m in 2005.
GW-9	To determine existing status and any impacts	Quarterly	SWL stable at approximately 19m to August 2013 then variable from 23.6m to 18.2m. Windmill in use on bore. Initial SWL 20.75m in 2005.
GW-10	To determine existing status and any impacts	Quarterly	SWL stable at approximately 19.3m Initial SWL 21.64m in 2005
GW-11	To determine existing status and any impacts	Quarterly	SWL stable at approximately 17.5m Initial SWL 18.33m in 2008.
P3	To determine existing status and any impacts	Quarterly	SWL stable at approximately 21.4m. Initial SWL 19.2m in 2006.

The groundwater monitoring summary presented in Table 3 shows that recorded SWL levels are generally stable and comparable to initial SWLs. GW-8 and GW-9 monitoring locations showed variability in SWL due to presence of operating windmills.

Table 4 - Groundwater Monitoring Summary - GW 10 Quality (October 2010 to December 2011)

Site ID	Date	Field Parameters		Total Metals				Major Cations				Major Anions			Nitrite as N - mg/L	NOX as N - mg/L
		pH - Field	EC - Field - µs/cm	Aluminium (Al) - mg/L	Arsenic (As) - mg/L	Iron (Fe) - mg/L	Manganese (Mn) - mg/L	Calcium (Ca) - mg/L	Magnesium (Mg) - mg/L	Sodium (Na) - mg/L	Potassium (K) - mg/L	Chloride (Cl) - mg/L	Sulfate (SO4) - mg/L	Alkalinity - mg/L		
GW10	**16-Feb-11**	6.69	5600	<0.01	<0.001	0.11	0.016	100	107	1330	14	1530	389	989	<0.01	0.6
	13-May-11	6.77	6950													
	31-Aug-11	6.8	5980	0.05	0.002	3.98	0.004	115	111	1410	13	1440	419	1040	<0.01	0.69
	5-Dec-11	7.95	5930													
	Minimum	6.69	5600	0.05	0.002	0.11	0.004	100	107	1330	13	1440	389	989		0.60
	Maximum	7.95	6950	0.05	0.002	3.98	0.016	115	111	1410	14	1530	419	1040		0.69
	Average	7.05	6115	0.05	0.002	2.05	0.010	108	109	1370	14	1485	404	1015		0.65

Note – monitoring of parameters ceased in December 2011 due to placement of a pump over the bore.

Table 5 – Groundwater Monitoring Summary – GW 11 Quality (October 2010-October 2015)

Site ID	Date	Field Parameters		Total Metals				Major Cations				Major Anions			Nitrite as N - mg/L	NOX as N - mg/L
		pH - Field	EC - Field - µs/cm	Aluminium (Al) - mg/L	Arsenic (As) - mg/L	Iron (Fe) - mg/L	Manganese (Mn) - mg/L	Calcium (Ca) - mg/L	Magnesium (Mg) - mg/L	Sodium (Na) - mg/L	Potassium (K) - mg/L	Chloride (Cl) - mg/L	Sulfate (SO4) - mg/L	Alkalinity - mg/L		
GW11	**3-Nov-10**															
	16-Feb-11	7.8	3300	<0.01	<0.001	0.23	0.336	66	30	675	10	1200	<1	51	<0.01	0.02
	13-May-11	7.05	3920													
	31-Aug-11	7.58	3450	0.25	<0.001	9.91	0.466	92	32	724	10	1240	2	42	<0.01	0.01
	5-Dec-11	7.73	3540													
	12-Mar-12	7.37	3350	<0.01	<0.001	<0.05	0.656	108	34	683	10	1240	<1	32	<0.01	0.36
	29-May-12	7.68	3530													
	23-Aug-12	7.35	3850	0.19	<0.001	21.9	0.862	142	37	685	10	1320	<1	30	<0.01	<0.01
	22-Nov-12	7.29	3910													
	11-Mar-13	7.21	4180	0.04	<0.001	27.6	0.854	141	38	712	11	1310	2	51	<0.01	0.09
	30-May-13	7.12	4280													
	22-Aug-13	7.34	4280	0.25	<0.001	24.8	0.887	168	40	720	12	1350	2	50		
	26-May-14	7.2	4620													
	8-Sep-14	7	4760	0.08	<0.001	32.7	0.834	205	44	620	12	1440	<1	11	<0.01	0.12
	12-Nov-14	6.9	4780													
	24-Feb-15	7	4650	0.03	<0.001	17.8	0.913	220	50	676	10	1410	<1	7	<0.01	<0.01
	21-May-15	7.1	4650													
	26-Aug-15	7.4	4820	0.04	<0.001	13.5	0.756	220	44	668	10	1160	<1	26	<0.01	<0.01
	Minimum	6.9	3300	0.03		0.2	0.336	66	30	620	10	1160	2	7		0.01
	Maximum	7.8	4820	0.25		32.7	0.913	220	50	724	12	1440	2	51		0.36
	Average	7.3	4110	0.13		18.6	0.729	151	39	685	11	1297	2	33		0.12

Table 6 - Groundwater Monitoring Summary – P3 Quality (October 2010 to October 2015)

Site ID	Date	Field Parameters		Total Metals				Major Cations				Major Anions			Nitrite as N - mg/L	NOX as N - mg/L
		pH - Field	EC - Field - µs/cm	Aluminium (Al) - mg/L	Arsenic (As) - mg/L	Iron (Fe) - mg/L	Manganese (Mn) - mg/L	Calcium (Ca) - mg/L	Magnesium (Mg) - mg/L	Sodium (Na) - mg/L	Potassium (K) - mg/L	Chloride (Cl) - mg/L	Sulfate (SO4) - mg/L	Alkalinity - mg/L		
P3	**16-Feb-11**	6.88	7310	0.48	<0.001	0.28	0.037	171	268	1540	13	2970	165	698	0.02	0.48
	13-May-11	6.91	9875													
	1-Sep-11	7.15	8775	19.1	0.004	20.6	0.764	183	275	1580	13	3410	174	562	<0.01	0.39
	5-Dec-11	7.02	8630													
	12-Mar-12	7.02	7780	<0.01	<0.001	<0.05	0.01	180	272	1610	14	2990	275	709	<0.01	0.49
	29-May-12	7.12	7550													
	23-Aug-12	7.15	7210	12	0.002	13.5	0.309	157	241	1370	11	2090	399	659	<0.01	0.9
	22-Nov-12	7.04	7710													
	11-Mar-13	7.17	7310	8.94	<0.001	9.28	0.338	136	206	1310	12	2190	189	796	<0.01	1.18
	30-May-13	7.08	7560													
	22-Aug-13	7.09	6790	1.27	0.001	2.77	0.099	152	186	1220	12	2010	211	808		
	26-May-14	7.1	7350													
	8-Sep-14	7.1	8010	13.4	0.002	14.8	0.531	151	209	1280	12	1920	154	797	<0.01	1.29
	12-Nov-14	7	8150													
	24-Feb-15	7.1	8380	0.19	<0.001	0.28	0.033	158	237	1510	10	2460	156	900	<0.01	0.72
	21-May-15	7	8760													
	26-Aug-15	7.2	8910	2.24	<0.001	2.54	0.097	164	243	1500	10	1920	198	859	<0.01	0.72
	Minimum	6.9	6790	0.19	0.001	0.28	0.010	136	186	1220	10	1920	154	562		0.39
	Maximum	7.2	9875	19.10	0.004	20.60	0.764	183	275	1610	14	3410	399	900		1.29
	Average	7.1	8004	7.20	0.002	8.01	0.246	161	237	1436	12	2440	213	754		0.77

Results presented in Table 4, Table 5, and Table 6 indicate:

- Neutral pH in all bores,
- Elevated Conductivity in all bores, typical of local groundwater, with P3 recording the highest average of approximately 8,000 µS/cm;
- An increasing Conductivity trend in GW 11,
- Generally stable Total Metals, and
- Generally stable Major Cations/Anions.

5.3 Monitoring Program

Table 7 presents the proposed surface and groundwater monitoring program based on the post-mining data review.

Table 7 - Surface and Groundwater Monitoring Program

Monitoring Location	Frequency	Parameter(s)
Surface Water		
Lower Void	6 monthly	Water Level, pH, Conductivity, TSS, Grease and Oil,
Groundwater		
GW-11, P3	6 monthly	SWL, pH, Conductivity, Cl, Na, Grease and Oil
GW-7, GW-8, GW-9	6 monthly	SWL
Erosion and Sediment Control		
Mine Site	Monthly	Stability of water management structures

6 SURFACE AND GROUNDWATER RESPONSE PLAN

The zero discharge Lower Void is the only remaining surface water body on site to have proposed ongoing quality monitoring. Nevertheless, the discharge water quality criteria presented in Table 1 will be targeted for the ongoing monitoring program (refer Section 5.3) with any sustained records outside of the values, determined to be associated with the mine, being notified to DP&E and DRE.

7 DOCUMENT REVIEW AND REPORTING

This document will be reviewed in accordance with the requirements of Schedule 5 Condition 12 of DA 8-1-2005, as modified.

The Annual Review will include discussion on water quality results as required by Schedule 5 Condition 5 of DA 8-1-2005.