GeoTerra

XSTRATA COAL – TAHMOOR COLLIERY

END OF LONGWALL 24A SURFACE WATER, DAMS & GROUNDWATER MONITORING REPORT

Tahmoor, NSW

TA8-R2

16 JANUARY 2009

GeoTerra PTY LTD **ABN 82 117 674 941**

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: geoterra@iinet.net.au

Date	Rev	Comments
20.10.2008	1	Initial
16.01.2009	2	Final (updated final subsidence values)

GeoTerra Pty Ltd ABN 82 117 674 941

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: geoterra@iinet.net.au

TABLE OF CONTENTS

TABLES

PHOTOGRAPHS

FIGURES

DRAWINGS

APPENDICES

EXECUTIVE SUMMARY

The following table summarises the potential effects on surface water and groundwater systems within the Longwall Panel 24 to 26, 20mm subsidence zone (Geoterra Pty Ltd, 2006) and the observed effects due to subsidence related to extraction of the subject longwalls.

Potential Impacts	Observed Impacts Due to Extraction of Longwall 22 to 24A
SURFACE WATER	
Bargo River may crack at the main bend in the river, and / or uplift of the river bed may occur	No cracks or river bed uplift observed
Observable loss of stream flow in the Bargo River may occur	No loss of stream flow observed
Pool depth reduction may occur in the Bargo Gorge	No pool depth reduction observed
Transfer of Bargo River stream flow to shallow groundwater (up to 10m below surface) may occur	No transfer to shallow groundwater observed
Adverse changes in Bargo River stream water quality may occur	No observable change in Bargo River water quality due to subsidence
Adverse effects on the Bargo River stream water flow and / or quality not anticipated to occur at Mermaid Pool	No adverse stream flow or water quality effects observed at Mermaid Pool
Bedrock cracking and loss of plateau stream flow not anticipated in Myrtle Creek, Redbank Creek or smaller gullies over 24A due to mitigating effects of stream sediment cover	No adverse effect on plateau stream flow
No adverse ecological changes to plateau streams due to subsidence	No adverse effect on plateau stream ecology
Possible localised ponding may occur in plateau streams	No plateau stream ponding due to subsidence observed
No adverse effects on plateau stream water quality anticipated	No adverse change to plateau stream water quality due to subsidence effects have been observed
Plateau stream bed incision may occur	No plateau stream bed incision observed
Dams	
Subsidence, strain or tilting may cause adverse effects on dam walls or may affect dam storage capability	No dam wall cracking and no adverse effects on dam wall integrity or dam water storage reduction observed

Potential Impacts	Observed Impacts Due to Extraction of Longwall 22 to 24A
GROUNDWATER	
Enhanced groundwater seepage from the cliffs of up to 0.2ML/day may occur, which may increase stream flow, increase stream salinity or increase Fe / Mn hydroxide precipitation	No change in cliff seepage flow or water quality observed
Adverse interconnection of aquifers and aquitards is not anticipated within 20m of the surface	No adverse interconnection between aquifers and aquitards has been observed within 20m of the surface
Potential increased rate of recharge into the plateau	No increased rate of recharge into the plateau has been observed
Temporary lowering of piezometric surface by up to 10m which may stay at that level until maximum subsidence develops	Lowering of piezometric surface by up to 8.9m in piezometer P2 has been observed
Groundwater levels should recover over a few months and no permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops	Groundwater levels in P2 have recovered by approximately 8.6m from their lowest point over approximately the last 12 months
No permanent reduction in groundwater levels under the Bargo River	No reduction in groundwater levels under the Bargo River have been observed
The yield and serviceability in 1 DWE registered bore (P4,) may be affected by subsidence	No private bores have been undermined or adversely affected by subsidence due to longwalls 24A and 24B
Horizontal displacement may make the private bore inaccessible	No private bores have been affected by subsidence related effects
Strata dilation and subsequent re-filling of secondary voids may temporarily lower standing water levels and increase the potential private bore well yields	No private bores have been affected by subsidence related effects from Longwalls 24A or 24B
Private bore groundwater may experience increased iron / manganese hydroxide precipitation and / or lowering of pH	No private bores have been affected by subsidence related effects from Longwalls 24A or 24B
Lowering of perched ephemeral seeps along the Bargo River gorge cliffs may occur	No lowering of perched ephemeral seeps along the Bargo River gorge cliffs has been observed
Interface drainage, ferruginous, brackish seeps may be generated in streams on the plateau	No interface drainage, ferruginous, brackish seeps have been generated in streams on the plateau
Ferruginous seeps may develop in the Bargo River	No ferruginous seeps have developed in the Bargo River
Increased groundwater seepage inflow into the Bulli Seam workings should not occur	No increased groundwater seepage inflow into the Bulli Seam workings has occurred
Strata gas discharge into private bores may occur	No strata gas discharge into private bores has occurred

To date, no TARP triggers have been reached or exceeded as a result of Longwall 24A or 24B extraction.

1. INTRODUCTION

Xstrata Coal - Tahmoor Colliery have extracted the Bulli Seam in Panels 22, 23A, 23B, 24B and 24A by retreat longwall mining within the Tahmoor North Lease Area since June 2004.

The five previous panels and the current panel (Longwall 25) are located underneath Tahmoor and Thirlmere villages, as well as surrounding urban and semi-rural areas as shown in **Drawing 1,** which are approximately 4km south of Picton in the Southern Coalfields of NSW.

Longwall 25 had progressed by 285m at the time of report preparation.

This document provides a compilation of physical and geochemical groundwater, upland plateau stream and Bargo River stream monitoring that has been conducted in the vicinity of the subject panels since August 2004.

Surface water and groundwater features within the Longwall 22 to 26 monitoring area and 20mm subsidence zone (Geoterra, 2006) include;

- the Bargo River gorge
- the main channel and tributaries of Myrtle Creek, which flows ENE to the Nepean River,
- the main channel and tributaries of Redbank Creek, which flows ENE into Stonequarry Creek and subsequently, the Nepean River
- the southern tributary flanks of Matthews Creek, but not the stream channel or banks. Matthews Creek flows to the northeast and joins with Cedar Creek and Stonequarry Creek, then flows into Racecourse Creek and subsequently the Nepean River
- 55 small to medium, predominantly earthen wall dams, and;
- One Department of Water and Energy (DWE) licensed well, three licensed piezometers (P1, P7, P8) two unlicensed open uncased coal exploration bores (P2, P3) and an additional five DWE licensed private bores (P4, P5, P6, Douglas, McPhee).

The main channel of the Bargo River as well as Myrtle Creek and Redbank Creek are classified as Category 2 streams with 3rd order or higher channels (DIPNR, 2005), whilst the tributaries of Myrtle and Redbank Creeks are Category 1 streams, being 1st or 2nd order channels, and are defined as minor watercourses in the State Dams Policy.

The dams range from small garden ponds to medium sized urban dams and industrial effluent storage / treatment ponds.

Monitoring has been conducted between June 2004 and October 2008 by assessing the;

- ephemeral or perennial nature and flow in streams over the panels;
- creek bed and bank erosion and channel bedload;
- stream and dam water quality;
- stream bed and bank vegetation;
    - nature of alluvial land along stream banks;

- presence, size and integrity of dams and their water levels,
- presence and use of groundwater bores, and;
- assessment of standing water levels and water quality.

2. SCOPE OF WORK

This report provides a summary of surface water and groundwater related monitoring and observation of any subsidence related changes due to extraction of Panels 22, 23A, 23B, 24B and 24A.

3. PREVIOUS STUDIES

Potential subsidence levels and impacts for Panels 24 to 28 were studied in 2005 (MSEC, 2006). Assessment of the baseline characteristics and prediction of possible subsidence related effects on the surface water and groundwater system were developed in 2006 (Geoterra, 2006).

A pre-mining and an end of panel report on surface water and groundwater monitoring for Panels 22, 23A, 23B and 24B was prepared (Geoterra, 2008).

Ongoing monitoring of water flows and water quality in the Bargo River, plateau streams, dams and groundwater bores is being conducted throughout extraction of Panel 24A by colliery staff, Geoterra Pty Ltd and HCS Pty Ltd.

4. GENERAL DESCRIPTION

4.1 Mine Layout and Progression

Tahmoor Colliery has extracted coal by longwall mining Panels 1 to 24A to the south, southwest and northwest of the current panel (LW25).

Panel 25 commenced on the 22nd August 2008 as outlined in **Table 1,** and mining is continuing updip in the Bulli Seam from south to north.

TABLE 1 Panel Extraction Details

Panel	Start	Finish	Length (m)	Depth of Cover (mbgl)
22	2/6/04	11/7/05	1877	420 – 432
23A	7/9/05	20/2/06	775.9	430 – 450
23B	15/3/06	21/8/06	771	430 – 440
24B	15/10/06	26/8/07	2071.8	430 – 440
24A	15/11/07	19/7/08	983	420 - 448
25	22/8/08	ongoing	3730	440 - 460

None of the previous or proposed panels will undermine the gorge, with all panels stepped back from the gorge edge by at least **289m.**

Panels 23A and 23B were subdivided in two sections with a gap of approximately 300m due to the presence of a doleritic dyke, whilst Panels 24A and 24B were also subdivided to manage subsidence underneath the Main Southern Railway line.

Extraction of Panels 22 to 26 will occur between 420m and 480m below surface, with the depth increasing to the northeast.

Seam thickness varies from 1.8m at the finish end of Panel 24B / Panel 25 to 2.2m at the start of Longwall 26.

The panels are 283m wide rib to rib, with 34.5m to 40m wide chain pillars and are between 784m to 4140m long as shown in **Drawing 2** and **Drawing 3.**

4.2 Topography and Drainage

The plateau is generally flat to undulating and incised by the Bargo River gorge which is up to 104m deep in the 20mm subsidence study area, with steep to vertical sandstone cliff faces and vegetated scree slopes, whilst the gorge and river bed comprise a series of exposed sandstone shelves interspersed with sandstone boulder fields and pools.

The study area is also overlain by the main channel and tributaries of Myrtle and Redbank Creeks, which flow both to the Nepean River, with the Nepean River being at least 900m outside the 20mm subsidence zone.

Both creeks drain the residential areas of Tahmoor and Thirlmere, as well as semi-rural fallow, orchard and grazing areas outside of the villages.

4.2.1 Bargo River

The Bargo River is present in the southeastern part of the Panel 22, 23(A,B), 24(A,B), 25 and 26 study area, which covers approximately 1130m of the river bed, with the closest panel (24A) being at least **289m** from the edge of the gorge and **354m** from the centre of the river.

The Bargo River over Panels 12 and 13 has previously sustained up to 550mm of subsidence, 2mm/m of tensile and 3mm/m of compressive strain in the “potholes” area and Rockford Road Bridge (Geoterra, 2006) where the gorge was directly undermined.

4.2.1.1 Geomorphology

The Bargo River dissects the Hawkesbury Sandstone plateau, forming significant scarps and discrete cliffs on either side of the gorge which ranges from 40m to 104m deep.

Where the channel trends along the systematic joint direction, the cliff line is usually close to the channel. Cliffs are usually formed under competent sandstone which can contain stratigraphically controlled cavernous zones and ephemeral seeps.

The river bed drops by 40m within the study area along the river bed, with an average gradient of 35 mm/m. This exceeds the previously mined sections of Bargo River which have an average gradient of 5 mm/m as shown in **Figure 1**.

Exposed bedrock and interspersed boulder fields are dominantly located in the base of the gorge and on the alluvial flanks, with minor sand deposits along the banks and, to a much lesser degree, within the river. The smaller rockbars are generally shallow and have small hydraulic gradients between pools (Rockbars 10, 11, 12) whilst the larger rockbars have maximum falls of 5m to 6m (Rockbars 8, 9), with lengths varying between 20m and 130m, with the longest being Rockbar 12.

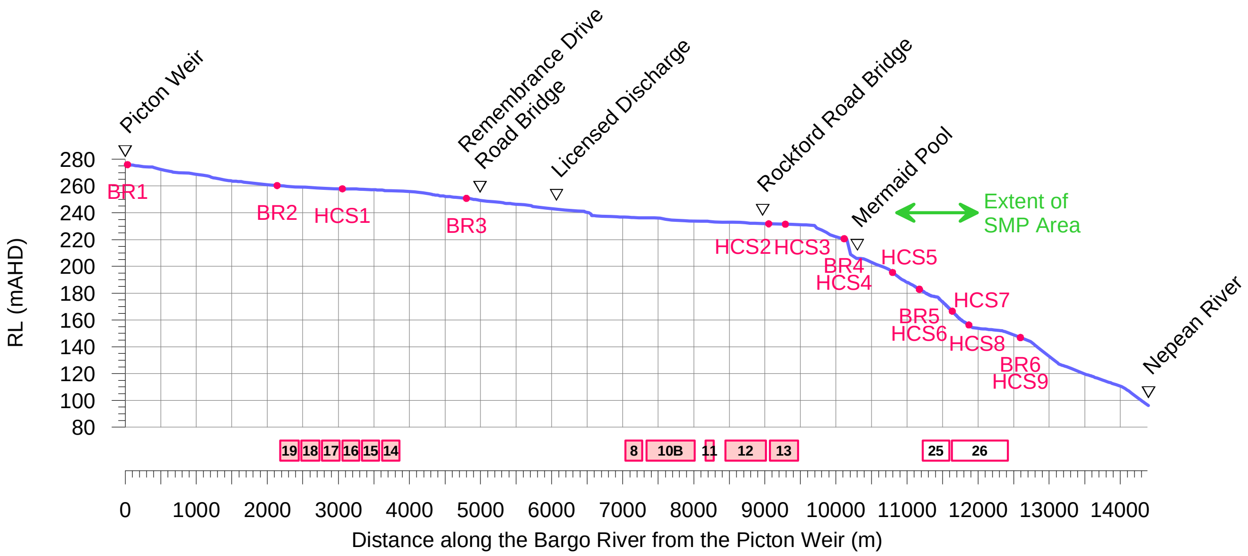


FIGURE 1 Bargo River from Picton Weir to Nepean River (MSEC, 2006)

4.2.1.2 Flow

The Bargo River flows into the Nepean River approximately 1.5km east of the Panel 22 to 26, 20mm subsidence zone, whilst its headwaters are located near the towns of Hill Top and Yerrinbool.

The Bargo River is regulated by Picton Weir, which is approximately 9km upstream of the study area. The weir was constructed in the late 19th century as a water supply structure near the town of Bargo and is now heavily silted, is no longer used and has a constant leak through a seized open valve and outlet pipe at the base of the weir.

Water flow in the Bargo River is derived from ephemeral unnamed first and second order gullies located on the western plateau in the study area, overflows from Picton Weir and streams draining off the eastern plateau.

Tahmoor Colliery has a DECC licensed discharge into Teatree Hollow, which flows into the Bargo River, with the discharge maintaining a continuous flow in the river, whilst Dogtrap Creek and Sugarloaf Gully flows are ephemeral.

Flows from Myrtle Creek and Redbank Creek (via Stonequarry and) Creeks do not enter the Bargo River, but discharge into the Nepean River approximately 4km to 7km along the stream channel downstream from the SMP area.

The majority of flow in the river is regulated by Picton Weir, which is upstream of Panel 19, and upstream of the Panel 22 to 26 study area. Flow from the weir varies depending on the frequency and intensity of rainfall, with flows between rain events typically less than 5 ML/day, gradually reducing in response to lowered head behind the weir. Overtopping has occurred on at least five occasions since early 2002, whilst the weir pond has been almost empty on a number of occasions during the extended drought period, which essentially ended around early February, 2007.

Due to Colliery discharges, flow in the Bargo River is continuous downstream of Teatree Hollow, except where natural partial sub-surface diversions occur through rockbars and boulder fields. If the Colliery discharge did not occur, the river would probably consist of disconnected pools after periods of extended dry weather.

Regular flow monitoring of the Bargo River in the Panel 22 to 26 study area has been conducted since January 2006 through manual flow gauging, reference to embedded nails and pressure transducer recording of river heights at locations shown in **Table 2**, with the locations plotted as shown in **Drawing 2** and **Drawing 3**.

TABLE 2 HCS Pty Ltd Bargo River Flow Monitoring Locations

Site	Description	Parameter	Method
Bargo River Up	Upstream of Teatree Hollow site	Pool depth, flow	Logger / Flow meter
Teatree Up	Upstream of Teatree Hollow	Pool depth, flow	Logger / Flow meter
Teatree	Flow from Teatree Hollow licensed discharges	Pool depth, flow	Logger / Flow meter
Rockford Road	Rockford Road Bridge	Pool depth, flow	Logger / Flow meter
Mermaid Pool	Upstream of Mermaid Pool	Pool depth, flow	Logger / Flow meter
Pencil Falls (Pool N) Old HCS5 site	Near the confluence with "Turkey Creek"	Pool depth, flow	Logger / Flow meter
Pool 12 (Pool K) Old HCS6 site	Upstream of Pool K	Pool depth, flow	Logger / Flow meter
Pool 10 (Pool K) Old HCS7 site	Midstream in Pool J	Pool depth, flow	Logger / Flow meter
Pool 8 (Pool H) Old HCS8 site	Midstream in Pool H	Pool depth, flow	Logger / Flow meter

4.2.1.3 Water Quality

Bargo River water quality in the study area primarily depends on the volume and quality of flow from the licensed discharges into Teatree Hollow during low rainfall periods, with the Teatree Hollow outflow forming the majority or total flow in the river under dry conditions.

The mine discharge generally conforms to DECC license criteria, however they are elevated in salinity (to 1780uS/cm), alkalinity (to 897mg/L), copper (to 8ug/L), zinc (to 220ug/L), nickel (to 57ug/L) and arsenic (to 71ug/L) compared to the ANZECC trigger values for protection of 95% of freshwater aquatic species.

By the time the Teatree Hollow outflow joins the Bargo River and enters the study area, the river water quality improves, but still exhibits the influence of the licensed discharge.

This signature may potentially mask the effects on the Bargo River water quality from increased groundwater seepage or rock bar throughflow following subsidence, particularly for iron, nickel and zinc, whilst the elevated alkalinity could also potentially enhance precipitation of metal hydroxides in groundwater seepage to the river.

4.2.1.4 Ferruginous Seeps

Groundwater seepage of up to 0.2ML/day potentially discharges from the cliffs in the vicinity of the study area. The seeps, however, are dispersed along the river and, individually, have very small, and difficult to measure flow rates as they generally enter the river flow directly, rather than flowing out of a seepage point above the stream elevation.

Five pools within the study area were observed to contain small ferruginous seeps as shown in **Drawing 4, Photographs 1** to **6** and **Table 3.**

Seepage rates are all very low (<0.5L/sec), with the flows occurring as a “slow bleed” from joints and bedding discontinuities, which occur as thin sheet films of outflow that are generally “swamped” by the main channel flow during medium to high flows.

Mixing zones within the river pools are also very limited to being less than 1m from the source discharge point, with discolouration of the river bank at the outflow point, although no discolouration or “plumes” within the main river or its substrate have been observed to date.

TABLE 3 Ferruginous Seeps

Pool	No. of Seeps	Flow Rate
F	1	<0.5L/sec
i	1	<0.5L/sec
K	1	<0.5L/sec
V (East)	2	<0.5L/sec
V (West)	6	<0.5L/sec
W (South)	2	<0.5L/sec
W (West)	1	<0.5L/sec

Leaching of diffuse iron sulfide (marcasite), iron carbonate (siderite) and iron hydroxides from the matrix cement and secondary deposits within the sandstone based gorge walls precipitates where low flow seeps discharge into the river as orange-brown iron “seeps”.

At the point of discharge, sulfuric acid is generated and dissolved, reduced species of iron, manganese, nickel and zinc, which can exceed the ANZECC 95% protection of aquatic species trigger values, precipitate as a gelatinous layer at the seepage point as a naturally occurring process.

The effect of the seepage is lowered through dilution with the river’s alkaline buffering capacity from bicarbonates & hydroxides sourced in the mine discharge waters, with increased acidity, dissolved metals and low dissolved oxygen in the river observed within 1m of the discharge point. The extent of the effect depends on the proportional mixing between the river flow volume and seepage flow rates.

Downstream dilution of the discharge as well as precipitation of metallic hydroxides, adsorption of dissolved Ni and Zn onto iron hydroxide and binding / adsorption onto dissolved / total organic carbon significantly can improve water quality downstream of the seepage point.

The river can also be affected by elevated salinity close to the discharge point, however this diminishes over a short distance (<5m) downstream of the mixing zone.

PHOTOGRAPH 1 POOL F Seep

PHOTOGRAPH 2 POOL i Seep

PHOTOGRAPH 3 POOL K Seep

PHOTOGRAPH 4 POOL V Seep East

PHOTOGRAPH 5 POOL V Seep West

PHOTOGRAPH 6 POOL W Seep West

4.2.1.5 Recreation

The Bargo River within the study area is an area of environmental sensitivity and is listed as an Indicative Place on the Register of the National Estate due to its aesthetic significance with its diverse flora and fauna, significant cliffs, cascades and pools. The river is also of significance to the local indigenous community.

The river is used for various recreational activities such as bushwalking and swimming, primarily in the vicinity of the Scout Camp and Mermaid Pool, which is shown in **Photograph 7.**

PHOTOGRAPH 7 Mermaid Pool

Mermaid Pool is approximately 1km south and upstream of longwalls 22 to 26 and is upstream of the 20mm subsidence zone.

4.2.2 Myrtle Creek

Myrtle Creek flows directly into the Nepean River approximately 1.7km northwest of the 20mm subsidence zone. Its headwaters are located upstream of Panel 22 and generally consist of small grass covered channels over and upstream of Panel 22, that become larger and more incised downstream of Panels 23 to 26.

The western headwaters of Myrtle Creek have been undermined to date by Longwalls 3, 4, 20, 22, 23B and 24B.

The riparian flanks have been significantly altered by residential development in Tahmoor, whilst the channel has not been significantly affected except where general rubbish or solid waste has been dumped in the creek or it is overgrown by invasive weeds. Some isolated weeding and stream bank regeneration works have been conducted in the last 2 years, however many of the areas are re-infested with weeds.

The stream bed and banks are generally well vegetated, and do not show significant erosion or bank instability.

No DWE registered water extraction is listed within the creek, however an unlicensed pump is present over the middle of Longwall 25, off Castlereagh Street.

4.2.3 Redbank Creek

Redbank Creek drains into Stonequarry Creek over the proposed Panel 34, which subsequently flows to the Nepean River approximately 3km downstream of the SMP area.

To date, Redbank Creek has not been undermined.

Within the study area it has a poorly defined, small channel with a wetland upstream of the Panel 23, 20mm subsidence envelope. The creek overlies the western end of Panel 25 as a small channel with an incised bed 1m to 2m deep which evolves into a channel up to 3m deep and 10m wide downstream of Panel 26.

The headwaters of Redbank Creek, outside of the proposed 20mm subsidence zone, lie within the residential development area of Thirlmere, with housing and road development significantly affecting the banks of the creek.

Over Panels 25 and 26, the creek flows out of the main residential area, through the urban fringe of Thirlmere.

The local residents have undertaken bed and bank restoration works at isolated locations over Panels 24 to 26, such as a Landcare wetland restoration area located near the intersection of Turner Street and Thirlmere Way, whilst the local Council subsequently conducted weed eradication works between the wetlands and Windeyer Street. The Windeyer St works have been re-infested with weeds since the works were conducted.

The creek does not exhibit significant bed and bank erosion, and is not significantly eroded due to the high vegetative and weed cover along the creek banks.

A section of Redbank Creek near Windeyer Street often shows a red iron hydroxide precipitate floating on the stream surface **(Photograph 8)** after heavier rain periods in the vicinity of a leaking sewer pipe that crosses under the creek and is leaking into the stream. The iron hydroxide precipitate can also be observed in the creek bed upstream of the sewer pipe following heavier rain events where leaking house sewer lines overflow into the stream.

PHOTOGRAPH 8 Windeyer Street (Redbank Ck) Iron Hydroxide Precipitate

4.2.4 Unnamed Gullies

The study area on the western plateau contains two unnamed ephemeral 1st and 2nd order streams over the eastern end of Panel 24 (within Inghams Turkey processing plant site) and over Panel 27 (within Pepes duck farm), which have small, grassed to minimally incised channels in essentially open grassed and lightly wooded country.

On the eastern plateau, Teatree Hollow and Dogtrap Creek enter the Bargo River approximately 5km and 2km upstream, whilst Sugarloaf Gully discharges from the eastern plateau, 1.2km downstream of the SMP area.

4.2.5 Dams

Surface runoff into the Tahmoor / Thirlmere streams and subsequently into the Bargo or Nepean Rivers is regulated by 24 dams over Panels 22 to 24A as shown in **Drawing 2** and **Drawing 3**.

The dams are constructed of earthen walls that collect and store surface runoff that would otherwise drain directly into Myrtle Creek.

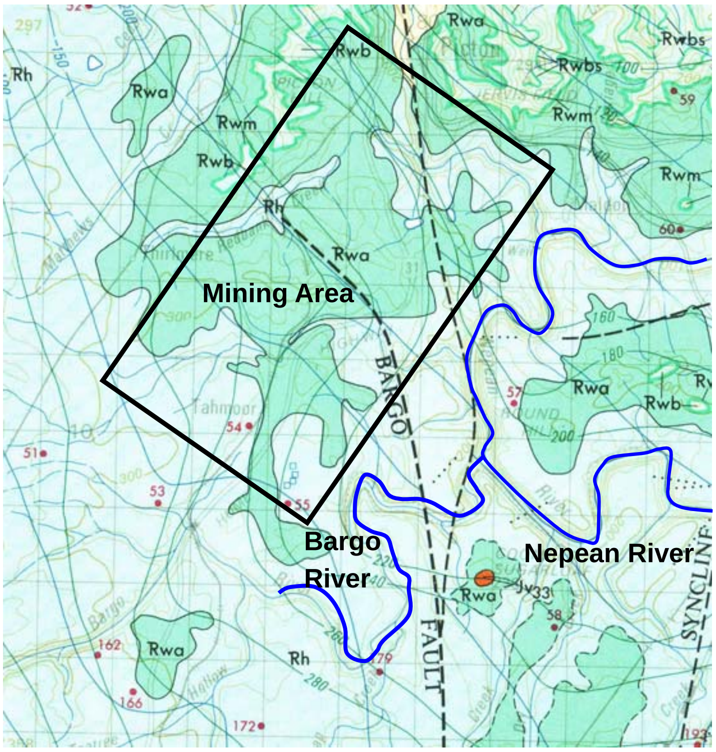
Six of the 24 dams are located within the Inghams turkey processing plant, with five of the six used for process plant water storage, settling and aeration purposes, with the process water eventually irrigated onto the Inghams property. The sixth dam is located in an unnamed stream on the Ingham property that collects rainwater and irrigation seepage water, with the overflow discharging into the Bargo River at “Pencil Falls”.

4.3 Geology

The plateau and Bargo River bed is underlain by the fine to medium to coarse grained Hawkesbury Sandstone, with Wianamatta Shale outcrop increasing to the north of the lease area, to the north of Myrtle Creek where a thin clayey soil profile has developed that is highly localised and variable across the area.

The surface geology of the study area is shown in **Figure 2**.

Further details on the area’s geology structure and stratigraphy are outlined in (Geoterra, 2006).



LEGEND

Rwb Wianamatta Gp shale, carb. claystone
Rwm Fine to medium lithic sandstone
Rwa Wianamatta Gp laminite, siltstone
Rh Hawkesbury Sandstone

FIGURE 2 Tahmoor / Thirlmere Surface Geology

4.4 Hydrogeology

The Bargo River is a ‘gaining’ system, where groundwater flows from the plateau under a regional hydraulic gradient to the river, with groundwater flow being dominantly horizontal within confined flow along discrete layers that are underlain by fine grained or relatively impermeable strata.

The Hawkesbury Sandstone sequence exposed in the gorge is characteristic of sedimentary deposition and erosion in a braided stream with individual facies representing local sedimentary processes that generally do not persist across the area.

The Hawkesbury Sandstone within the Sydney Basin generally provides low yielding aquifers with low hydraulic conductivities.

Five DWE registered bores, 1 well, two uncased coal exploration bores and three Xstrata (DWE registered) piezometers are located within the study area as shown in **Drawing 1** and **Table 4**.

Piezometer P1 was installed to the south of the Panel 22 20mm subsidence zone prior to extraction of panel 22, whilst P7 and P8 were installed during May 2008 between Panel 25, Panel 26 and the Bargo River, prior to the start of extraction in Longwall 25.

Piezometer P1 was installed to monitor the phreatic water table levels and water quality prior to, during and after extraction of Longwall 22, whilst P7 and P8 were drilled down to the equivalent depth of the base of the Bargo River Gorge (100-105 mbgl) and are being used to monitor any groundwater level or groundwater quality changes in the piezometers prior to, during and after extraction of Panels 25 and 26.

TABLE 4 Groundwater Bore and Piezometer Details

GW	Drilled	Depth (m)	SWL (m)	Aquifer (mbgl)	YIELD (L/s)	EC (mg/L)	pH	Purpose
SMP AREA								
P1 (GW pending)	2004	48	Fig 11	18 - 20	0.75	2650	5.30	monitoring
P2	-	150	Fig 11	-	-	2295	5.61	coal explor.
P3	-	100	Fig 11	-	-	850	6.13	coal explor.
P4 (GW67570)	1988	85	Fig 11	-	0.22	8210	6.63	domestic
P5 (GW63525)	1954 / 1990	76 / 91	Fig 11	60-66 & 70-91	1.0	3550	5.65	stck dom irr
P6 (GW42788)	1976	148	Fig 11	105 - 135	1.52	-	-	agriculture
P7 (GW pending)	2008	100	Fig 11	95 - 100	0.76	968	6.12	monitoring
P8 (GW pending)	2008	105	Fig 11	90 - 105	V low	822	6.40	monitoring
McPhee (GW105254)	2002	163	80.0	113-156	0.67	138	-	domestic
Douglas (GW105148)	1995	120	33.0	50 - 117	0.30	250	-	domestic
Well 1	-	4	Fig 11	-	-	365	7.05	domestic

Note: All bore water supply is from Hawkesbury Sandstone

redrill depth for bore replaced by Tahmoor Colliery

\- no data available

Fig 11 See Figure 11 for SWL data

Groundwater has been obtained from sandstone aquifers with yields ranging from 0.2L/sec to 5.0L/sec between 18m and 138m below surface. DWE bore data indicates it is likely that significant aquifers are intersected below depths of approximately 18m to 60m, depending on whether the bore is spudded on top of a hill or in a valley. Shallower, low yielding groundwater may be present above that depth range as perched ephemeral aquifers.

Alluvial sediments within the plateau gullies and river bed are too shallow to be used as aquifers for groundwater supply.

Drilling and installation of the P7 and P8 piezometers between the Bargo Gorge and the eastern end of Longwalls 25 / 26, indicated the sandstone plateau is dry down to approximately 90m to 95m below surface, which is approximately 5m above the base of the Bargo River gorge in the proximity of the piezometers, and that low airlift flows (<0.76L/sec) were generated from fractures within the sandstone.

Following installation of the piezometers, standing water levels in the completed piezometers rose up to 49.2mbgl (P7) and 83.3mbgl (P8), indicating the water inflow zones were within confined fractured aquifers with significant head pressures.

Packer tests of selected horizons beneath the first drilling water intersections indicates the hydraulic conductivity of bores P7 and P8 ranges from as shown in **Table 5**.

TABLE 5 Packer Test Results

Bore	First Water Inflow (mbgl)	Depth Interval (mbgl)	Hydraulic Conductivity (m/s)
P7	94-95	94 - 97	>1 x 10^{-4}
		97 -100	1.1 x 10^{-7}
P8	90	88.65 - 91.65	6.2 x 10^{-7}
		91.65 - 93.65	6.2 x 10^{-7}
		94.65 - 105	4.1 x 10^{-7}

5. MONITORING

5.1 Subsidence

The maximum monitored subsidence, tilt and strain following extraction of Panel 24A is shown in **Table 6**.

5.1.1 Plateau and Streams

TABLE 6 Maximum Post Panel 24A Plateau Subsidence (MSEC, 2008)

	Observed Movement (mm)
Vertical subsidence (mm)	1169
Tilt (mm/m)	12.7
Strain (mm/m)	-4.8 to 1.3

It was assessed (MSEC, 2008) that the additional subsidence, tilts and strains above predicted levels after extraction of Panel 24A were due to anomalous ground movements, however the cause for the unanticipated movement is still under investigation.

Myrtle Creek and Redbank Creek are located over 700 metres from the nearest goaf edge of Longwall 24A and have not been affected by this longwall.

Subsidence within Myrtle Creek has generated stream bed and / or bank cracking in two locations over Panels 22 and 23B, along with soil cracks in the upper bank and flanks over Panel 23B site as shown in **Drawing 3.**

Redbank Creek has not been undermined to date and has no observed subsidence tilt or strain effects.

5.1.2 Bargo River Gorge

To date, no observed subsidence effects have been noted in the Bargo River up to the final extraction of Panel 24A as shown in **Table 7**.

TABLE 7 Maximum Post Panel 24A Bargo Gorge Movement (MSEC, 2008)

	Observed Movement (mm)
Valley Floor Subsidence	15 ± 10
Valley Floor Upsidence	Nil
Valley Closure	0 to 3 (closure)

5.2 Bargo River

5.2.1 River Bed Geomorphology

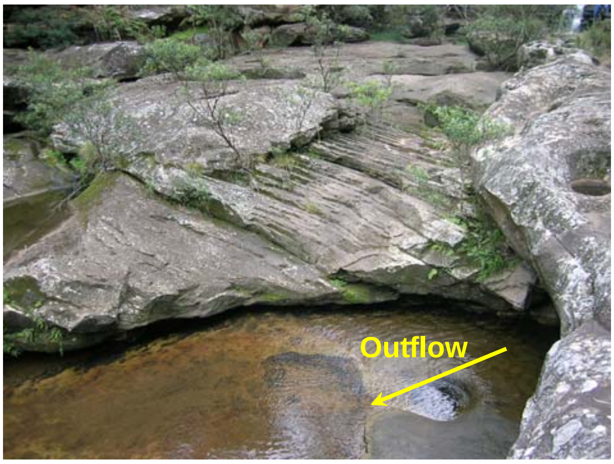
The series of pools, rockbars, waterfalls and boulder fields along the river bed within the Panel 22 to 26 study area were inspected irregularly from December 2004 to January 2006. Since January 2006, a minimum of monthly inspections were completed by staff from the colliery, Geoterra Pty Ltd and HCS Pty Ltd, which was raised to a minimum of weekly inspections during extraction of Longwall 24A.

No change to the river bed geomorphology has been observed up to the end of extraction of Panel 24A apart from a few small "fist" sized rocks that have fallen off the cliff walls and come to rest in the base of the gorge. The small size and isolated events of these falls does not indicate they are due to subsidence related effects (MSEC, 2008).

Field assessment prior to extraction of Panel 24A identified five locations shown in **Drawing 4** with varying levels of flow diversion. The most notable diversion in the study area is between Pools H and F, through Rock Bar G, where all flow monitored to date passes through cross bedded laminae with a bedding discontinuity at the top and base of the cross set as shown in **Photograph 9.**

Diversions can comprise flow through boulder races or open joints, washed out bedding planes and discontinuities in rock bars underneath and downstream of a pool.

No overland flow has been observed over Rock Bar G during the monitoring period, however it is likely to have occurred during flood events when gauging access to the site was not possible. With current data, at least 16.6ML/day of flow is required for Pool H to be full and overflowing, with a cease to flow rate at around ?ML/day (HCS????).



PHOTOGRAPH 9 Rock Bar G (Upstream) Rock bar G (Downstream)

It should be noted that no fresh cracking was observed in the base of the Bargo River gorge prior to extraction of Panel 24A, and no new cracks have been observed since Panel 24A was completed.

In addition, no visual change in change in stream flow diversions has been observed since extraction of Panel 24A was completed.

5.2.2 River Flow

A summary of flow monitoring in the Bargo River and Teatree Hollow through the use of monthly manual flow readings, daily water level logging and ratings curves developed by HCS Pty Ltd since January 2006 is shown in **Table 8**. The flow data is available in "EXCEL" spreadsheet format, however due to the large file size, the data is not included in hard copy in this report.

TABLE 8 Flow Monitoring Summary - 31/1/2006 to 29/9/2008

	Bargo River Up	u/s Teatree Ck	Bargo River Dwnstm Tea Tree Ck	Rockford Road	Mermaid Pool	Pencil Falls (Pool N)	Pool K	Pool J	Pool H	Rain
STD DEV	6.68	17.30	1.58	9.75	16.77	19.71	13.35	18.98	18.11	8.78
MAX	166	193	18.40	143	200	185	121	217	182	85.50
MIN	0.27	0.09	1.39	0.79	1.30	1.61	1.44	1.84	1.50	0.00
MEAN	2.62	5.15	4.86	8.70	10.90	10.75	9.26	10.59	10.76	3.60
MEDIAN	2.06	1.14	4.60	6.92	7.05	5.94	6.00	5.96	6.45	0.50

It should be noted that due to lack of calibration based on ratings curves that have been primarily developed during low to medium flow periods, data for the highest flow periods at some sites is either absent, or estimated.

Some anomalous maximum flow data from upstream of Teatree Hollow upstream is also present in the data base supplied by HCS Pty Ltd, however the minimum, mean and median flow data shows an minor increase in flows down the gorge as shown in **Figure 3**.

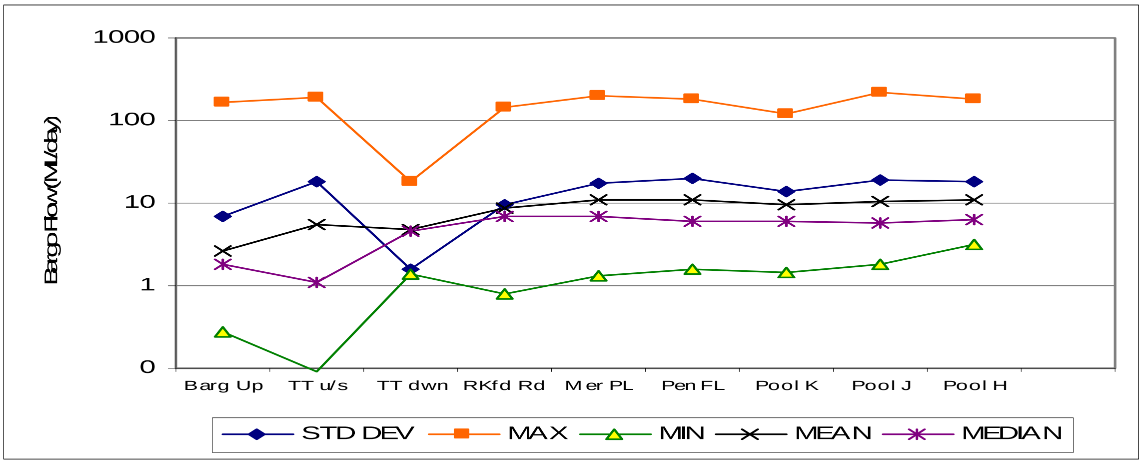


FIGURE 3 Bargo River Flow Summary (31/1/06 - 29/9/08)

Some data is also missing due to vandalism of the Mermaid Pool and Rockford Road sites.

In addition, the flow discharging from Teatree Hollow into the Bargo River has been extrapolated by subtracting the Bargo River flow upstream of Teatree Hollow from the flow in the river at Rockford Road, where data is available.

Maximum daily rainfall during the monitoring period has been up to 86mm/day (5/2/08). The pre Panel 24A period had a significantly higher average (mean) daily rainfall compared to the period after Panel 24A started extraction (6.02 versus 2.33mm/day). The drought runoff regime that was evident in the early period of monitoring subsequently reverted to flows more dominated by surface runoff baseflow and bank storage depletion after approximately early February 2007, with a lesser proportional contribution from groundwater seepage and the Teatree Hollow licensed discharge after around early February 2007 as shown in **Figure 4**.

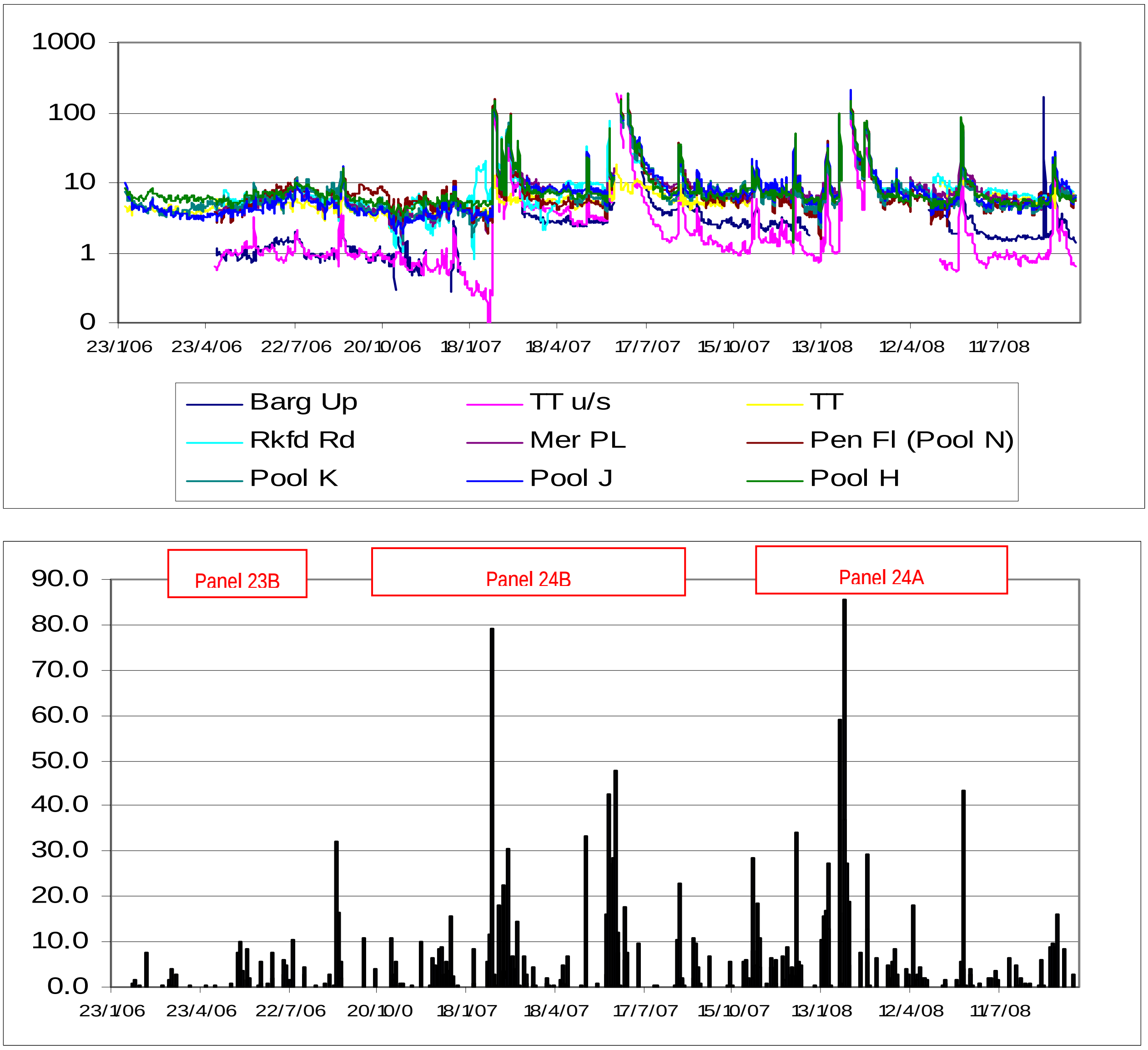


FIGURE 4 Bargo River Flows and Rainfall

To date, flows upstream of Teatree Hollow are generally around 1.14ML/day (median value), and range from 0.09ML/day to 193ML/day, whilst downstream of the mine's licensed discharge at Rockford Road Bridge, flows are generally around 6.9ML/day (median value), ranging from 0.79ML/day to 143ML/day.

River flows upstream of Teatree Hollow are modified by the lack of instantaneous release through the damming effect of Picton Weir during dry periods, as the pool has generally been below the spill height during the monitoring period, with a relatively constant slow release through a broken gate valve in the dam wall.

Flows downstream of Teatree Hollow are primarily affected by the quantum of daily release from the mine's licensed discharge, as well as catchment runoff and groundwater seeps. A plot of the calculated median flow rates in **Figure 5** indicates that the licensed discharge from the colliery into Teatree Hollow generally contributes around 5.1ML/day (ranging from 1.4ML/day to 18.4ML/day) into the Bargo River.

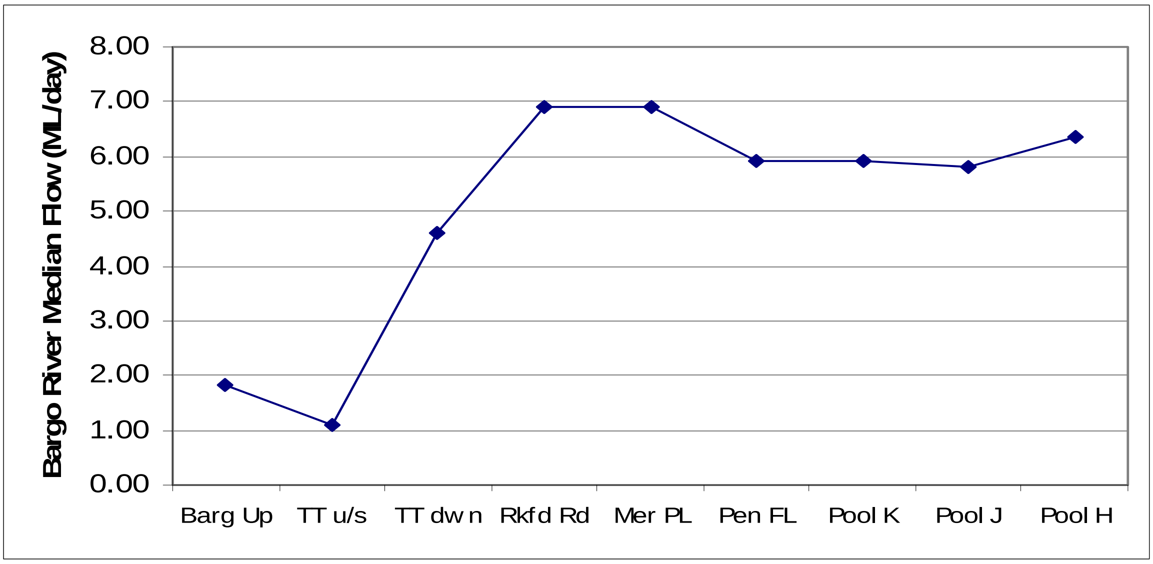


FIGURE 5 Median Flow Rates (31/1/06 - 29/9/08)

Figure 5 indicates, that, based on median flows, there is an essentially equivalent overland flow between Rockford Road Bridge and Pencil Falls (Pool N), with a loss of around 1.0ML/day of overland flow between Pencil Falls and Pool J, which resurfaces at Pool H. The area where the loss of overland flow occurs equates to the steeper gradient section of the river shown in **Figure 1**, where the density of boulder fields and bedrock throughflow increases.

Variability in river flow downstream of Teatree Hollow is due to;

- Teatree Hollow discharge changes;
- Sub-surface diversion through washed out joints and bedding plane discontinuities;
- Flow through boulder fields
- Variable rate of groundwater seepage, and;
- Runoff after rain events.

5.2.3 Subsidence Effects on Bargo River Flow

A summary of data supplied by HCS Pty Ltd since January 2006, which is subdivided into the period up to the start of Panel 24A and the period after Panel 24A started is shown in **Table 9** and **Figure 6.** The data has been "adjusted" to exclude values for all estimated readings, which are dominantly from the high rainfall periods. The "adjusted" data set interpretation therefore has a bias toward the lower flow regimes.

TABLE 9 Pre / Post Panel 24A Bargo River Flow (Adjusted Data)

	Bargo Upstream	Tea Tree Upstream	Rockford Road	Mermaid Pool	Pool N (Pencil Falls)	Pool K	Pool J	Pool H
Pre Panel 24A Std Dev'n	1.81	2.66	3.53	13.23	3.10	2.45	2.76	1.56
Post Panel 24A Std Dev'n	11.93	3.72	2.76	11.99	3.34	2.34	2.66	1.61
Pre Panel 24A Max.	13.90	23.2	26.00	141.0	24.4	16.4	17.00	16.60
Post Panel 24A Max	166.00	25.10	26.60	125.00	25.50	17.10	17.80	14.00
Pre Panel 24A Min.	0.30	0.09	1.03	1.30	1.92	1.44	1.84	3.20
Post Panel 24A Min.	1.36	0.54	5.24	2.51	1.61	2.29	2.66	1.50
Pre Panel 24A Mean	2.37	2.23	6.92	9.62	6.85	5.97	5.85	6.59
Post Panel 24A Mean	3.16	2.24	8.79	10.66	6.40	6.43	7.05	6.33
Pre Panel 24A Median	2.33	1.14	6.27	6.36	6.03	5.59	4.94	6.36
Post Panel 24A Median	2.04	1.00	8.10	7.35	5.48	5.83	6.29	5.95

The Panel 24 to 26 SMP area within the Bargo River gorge covers the stream reach from Pencil Falls (or Pool N) to upstream of Pool H as shown in **Drawing 4**.

As shown in **Figure 6**, within the SMP area, the Pre Panel 24A flow regime in the Bargo River shows a reduction in the minimum flow of 0.48ML/day between Pencil Falls (Pool N) and Pool K, with a subsequent rise of 0.4ML/day between Pool K and Pool J, then 1.36ML/day a rise between Pool J and Pool H. Following the start of Panel 24A, the trend is one of a 1.05ML/day rise in flow between Pool N and Pool J, then a 1.16ML/day reduction in flow between Pool J and Pool H.

In the same reach, the maximum flow (adjusted to exclude estimated flows, and not including flows at the upper end of the flow duration curve) reduced by approximately 7.4ML/day prior to the start of Panel 24A between Pool N and Pool J, then fell by 0.4ML/day between Pool J and Pool H. After the start of Panel 24A extraction the stream flow fell by 7.7ML/day between Pool N and Pool J, then fell a further 3.8ML/day between Pool J and Pool H.

Prior to the start of Panel 24A, the median (or most commonly occurring) stream flow reduced by 1.1ML/day between Pool N and Pool J, then rose by 1.43ML/day between Pool J and Pool H. After the start of Panel 24A, flow between Pool N and Pool J rose by 0.8ML/day the fell by 0.35ML/day between Pool J and Pool H.

The mean (or average) flow illustrated a 1.0ML/day flow reduction between Pool N and Pool J, then a rise of 0.74ML/day between Pool J and Pool H. Following the start of Panel 24A, the mean flow rose by 0.65ML/day between Pool N and Pool J, then a reduction of 0.72ML/day between Pool J and Pool H as shown in **Figure 6** and **Table 10**.

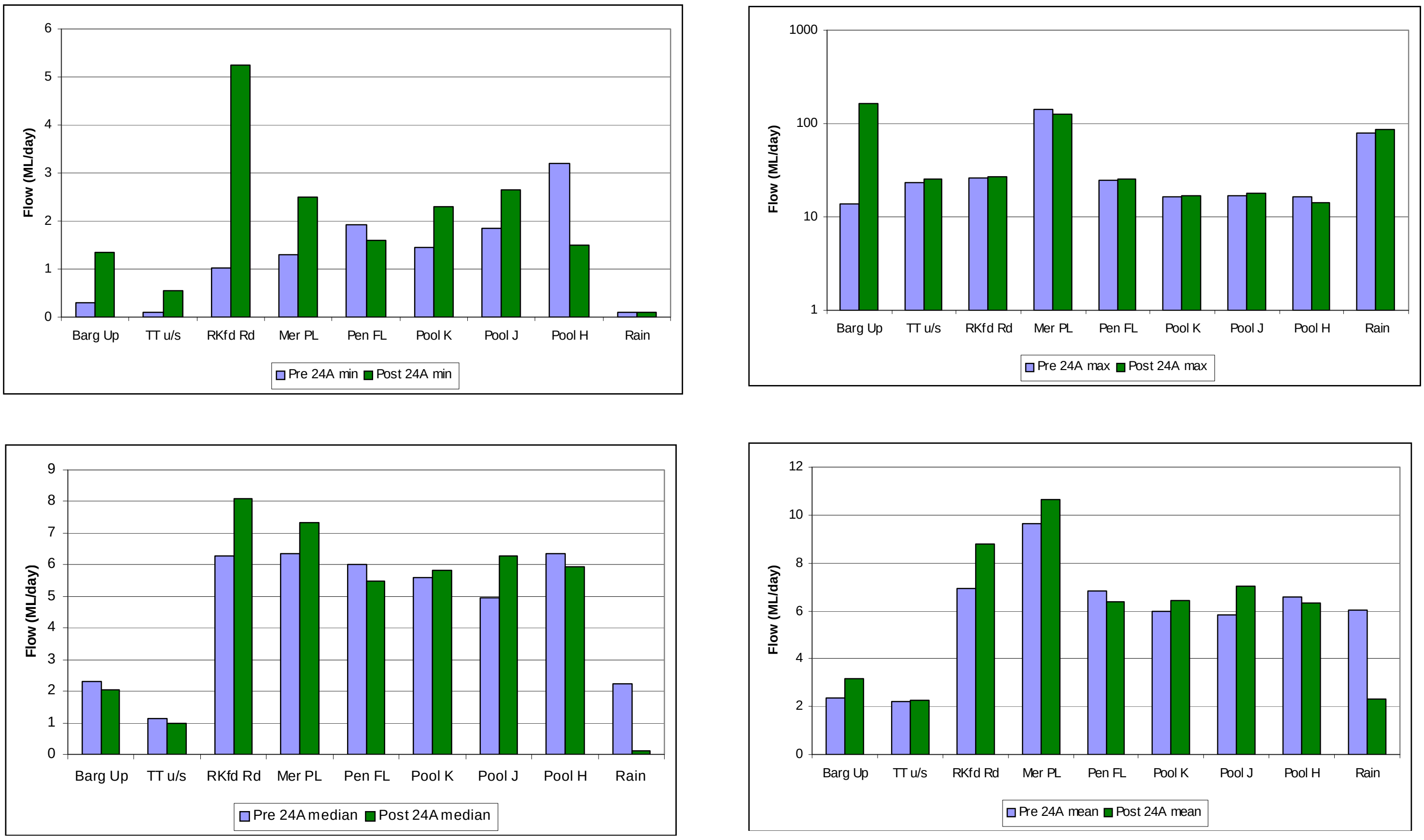


FIGURE 6 Bargo River Flow Before / After the Start of Panel 24A

TABLE 10 Measured Bargo River Flow Between Pools in the SMP Area (adjusted data)

Stream Flow Change	Pool N (Pencil Falls) to Pool K (ML/day)	Pool J to Pool H (ML/day)
Pre Panel 24A Minimum Flow	0.08 fall	1.36 rise
Post Panel 24A Minimum Flow	1.05 rise	1.16 fall
Pre Panel 24A Maximum Flow	7.4 fall	0.4 fall
Post Panel 24A Maximum Flow	7.7 fall	3.8 fall
Pre Panel 24A Median Flow	1.1 fall	1.43 rise
Post Panel 24A Median Flow	0.8 rise	0.35 fall
Pre Panel 24A Mean Flow	1.0 fall	0.74 rise
Post Panel 24A Mean Flow	0.65 rise	0.72 fall

The data indicates that between Pool N (Pencil Falls) and Pool J, stream flow has, in general, increased by 1.13 -1.9ML/day, whilst between Pool J and Pool H there has been a reduction in flow of between 1.46 - 3.4ML/day.

It should be noted that the difference between pool flows is highly affected by stream flow monitoring inaccuracies during both the high and low flow ends of the monitoring results, and that the median (most occurring) flow has a better representation of any changes in flow between pools. Based on the median values, there appears to be a rise of 1.9ML/day between Pool N and Pool J along with a reduction in flow of 1.8ML/day between Pool J and Pool H.

It should also be noted that the equipment used has an approximate ??% error in its flow readings.

5.2.4 River Water Quality

Water quality in the Bargo River is highly variable, and often exceeds the ANZECC 2000 (95% protection of aquatic species) trigger levels for pH, salinity, nickel, zinc and Total N, and to a lesser degree, Total P, arsenic, aluminium and copper as shown in **Appendix A.**

At present, the river water quality in the study area is primarily determined by the volume and quality of flow from the mine's licensed discharge into Teatree Hollow, along with the very large variability of runoff in the catchment and the wide range of urban, agricultural and industrial pollutant sources in the river.

Baseflow in the river was dominated by Teatree Hollow outflow during the drought affected period, and it is likely that without the discharge during drought periods, the Bargo River downstream of Teatree Hollow could have intermittent flow periods after rain, with the river forming a series of disconnected pools behind rock bars after extended dry periods.

Heavy rain that fell during June 2007 reduced the dominance of the mine discharge on water quality during the high flow event, so that only Total Nitrogen exceeded ANZECC 2000 criteria downstream of Teatree Hollow. The rains in February 2007 did not significantly affect the subsequent ANZECC criteria exceedances in water quality in March 2007.

Field monitored water quality in the Bargo River as shown in **Figure 7** during the earlier stage of monitoring, initially changed from around pH 4.4 to 5.8, upstream of Teatree Hollow, to pH 8.2 to 8.9 downstream of Teatree Hollow. In the latter phase of monitoring, the disparity between upstream and downstream pH has reduced as a higher proportion of rainfall runoff compared to groundwater baseflow is entering the river, with the upstream / downstream change now being from pH 7.8 to 8.5. With flow down the gorge pH becomes slightly more acidic, with a notable acidification during the June 2007 runoff event due to the higher dominance of runoff from the sandstone dominated catchment and the lower proportional contribution from the alkaline Tea Tree Hollow discharge .

The change in salinity from upstream to downstream of Teatree Hollow has been relatively constant and significant throughout the monitoring period (EC from 150-398 to 161-2220µS/cm), followed by an overall reduction in salinity with flow down the gorge during mine discharge dominated flow periods. The reduction in salinity is less distinct when there is a higher proportion of rainfall runoff in the catchment.

No particular pattern has emerged from the dissolved oxygen monitoring, whilst a distinct cyclical seasonal change in water temperature between 10^{o}C in winter and 24^{o}C in summer is observed. The Teatree Hollow discharge is generally warmer than the Bargo River, and it is generally observed that the river water cools down with transit through the gorge. No obvious water temperature changes due to upwelling of groundwater is evident in the data to date.

The Teatree Hollow discharge was generally more oxidised than the Bargo River in the initial stages of monitoring, however the disparity between the two is less evident in the later data.

The mine installed a polyaluminium chloride (with occasional acetic acid in LDP4) water treatment system in the licensed discharge from Teatree Hollow during November 2006, which significantly reduced suspended solids in the discharge to the Bargo River.

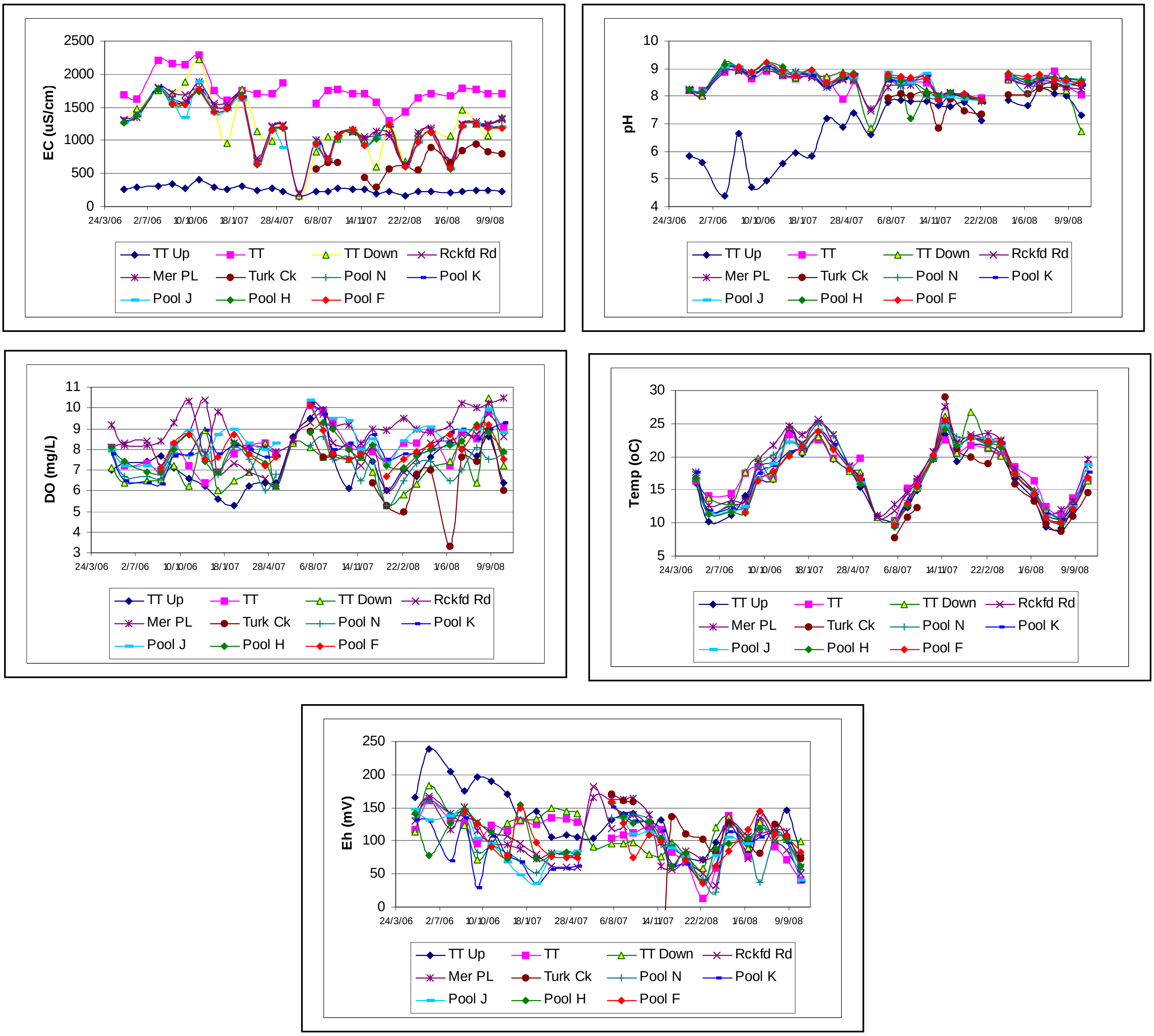


FIGURE 7 Bargo River Field Water Chemistry

Under "dry" flow conditions, with Teatree Hollow discharge dominating the river flow, the water progresses from being HCO3-Cl dominant immediately downstream of Picton Weir, through Na-Cl dominant to the confluence with Teatree Hollow, after which it becomes Na-HCO3 dominant through the study area, then slightly altering to Na-HCO3-Cl dominant toward the confluence with the Nepean River.

During wetter periods, such as during June / July 2007, the river is Na-Mg-Cl dominated upstream of Teatree Hollow, Na-HCO3 dominant in Teatree Hollow, then Na-Mg-Cl to Na-HCO3-Cl dominant downstream of Teatree Hollow.

Downstream of Teatree Hollow, the river was Na-HCO3 dominant in July and Na-Cl-HCO3 in June 2007.

As shown in **Figures 8 to 10** significant rises of up to 4mg/L for total nitrogen downstream of Teatree Hollow have been noted, whilst total phosphorous does not indicate a definitive rise due to inflow from Teatree Hollow. Total phosphorous does however rise significantly at the confluence of the licensed discharge and runoff in an unnamed creek draining from the Inghams Turkey plant via "Pencil Falls", with from 0.03 - 1.4mg/L Total Phosphorous discharging in the tributary.

Total (unfiltered) iron does not generally show a distinctive rise with Teatree Hollow inflow, and does not generally show any notable rise downstream of the identified groundwater seeps.

Filterable manganese in the Bargo River notably drops from up to 1.2mg/L, to at or below the detection limit, on mixing with Teatree Hollow discharge and downstream of the confluence, primarily due to the buffering action of bicarbonate in the Teatree Hollow discharge and the associated change to more alkaline pH in the river downstream of the creek. As previously stated however, the rise in pH between upstream and downstream of Teatree Hollow is becoming less marked as the river becomes more rainfall / runoff than groundwater baseflow dominated since the February 2007 and June 2007 rains.

Filterable copper does not show a distinctive rise with inflow from Teatree Hollow.

Filterable zinc shows a distinctive rise downstream of the Teatree Hollow inflow by up to 0.09mg/L, which gradually reduces with flow downstream. Following, and since the February 2007 rains, zinc has shown a more marked rise in Teatree Hollow discharge, however by the time the river flow reaches Pool N, the zinc concentration is similar to before the February 2007 rains.

Filterable nickel and arsenic also show a distinctive rise within Teatree Hollow to 0.12mg/L and 0.1mg/l respectively, which reduce at the confluence with the Bargo River to a maximum of 0.08mg/L and 0.08mg/L respectively. The dissolved metals then generally stay at the same "mixed" downstream concentration with further flow downstream following and since the February 2007 rains.

Filterable aluminium generally peaks in Teatree Hollow at up to 0.09mg/L and then gradually reduces on mixing with, and continued flow downstream in Bargo River, except for the March and August 2007 sampling events, where it generally rose with flow downstream.

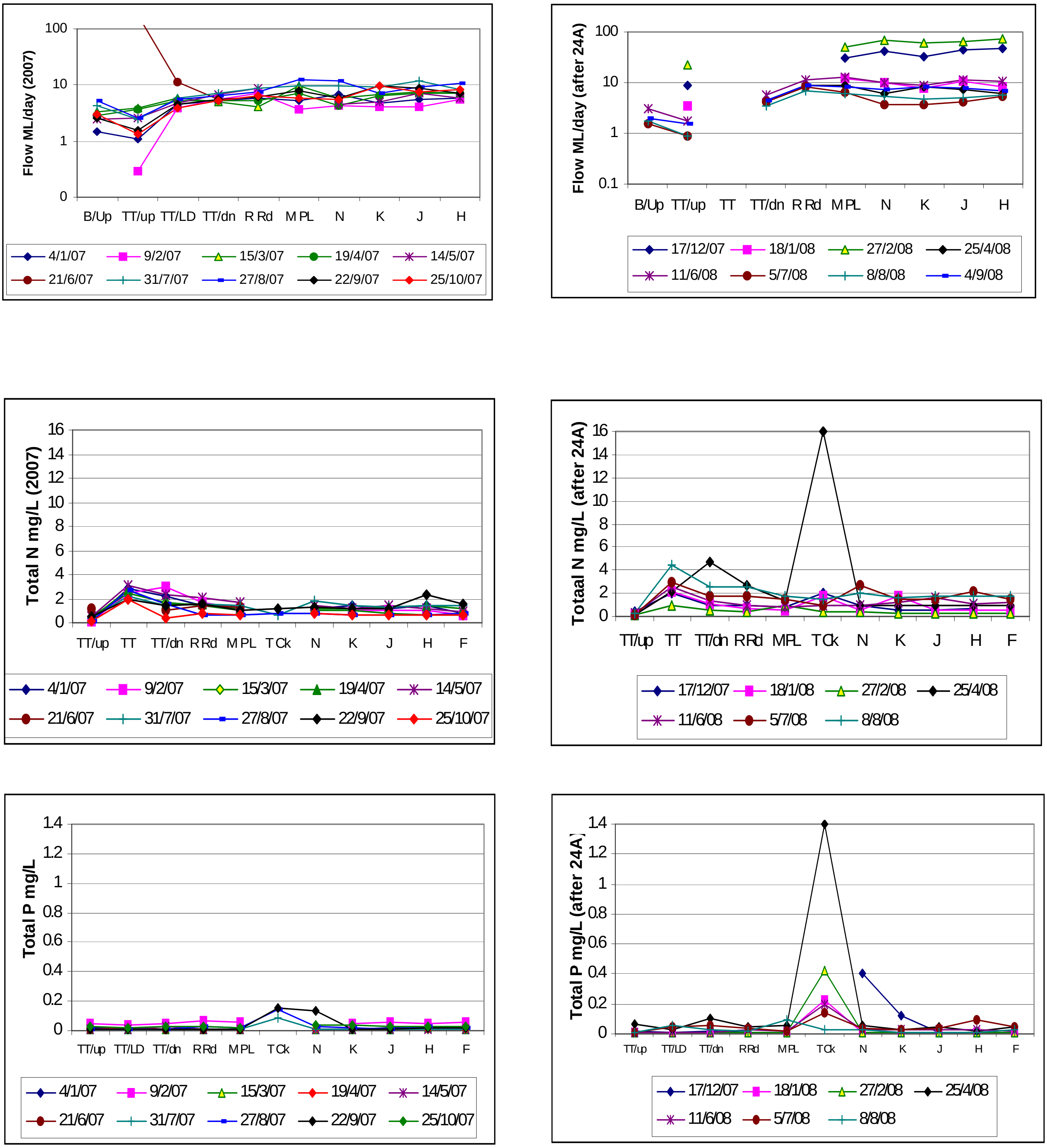


FIGURE 8 Bargo River Water Quality Analyses

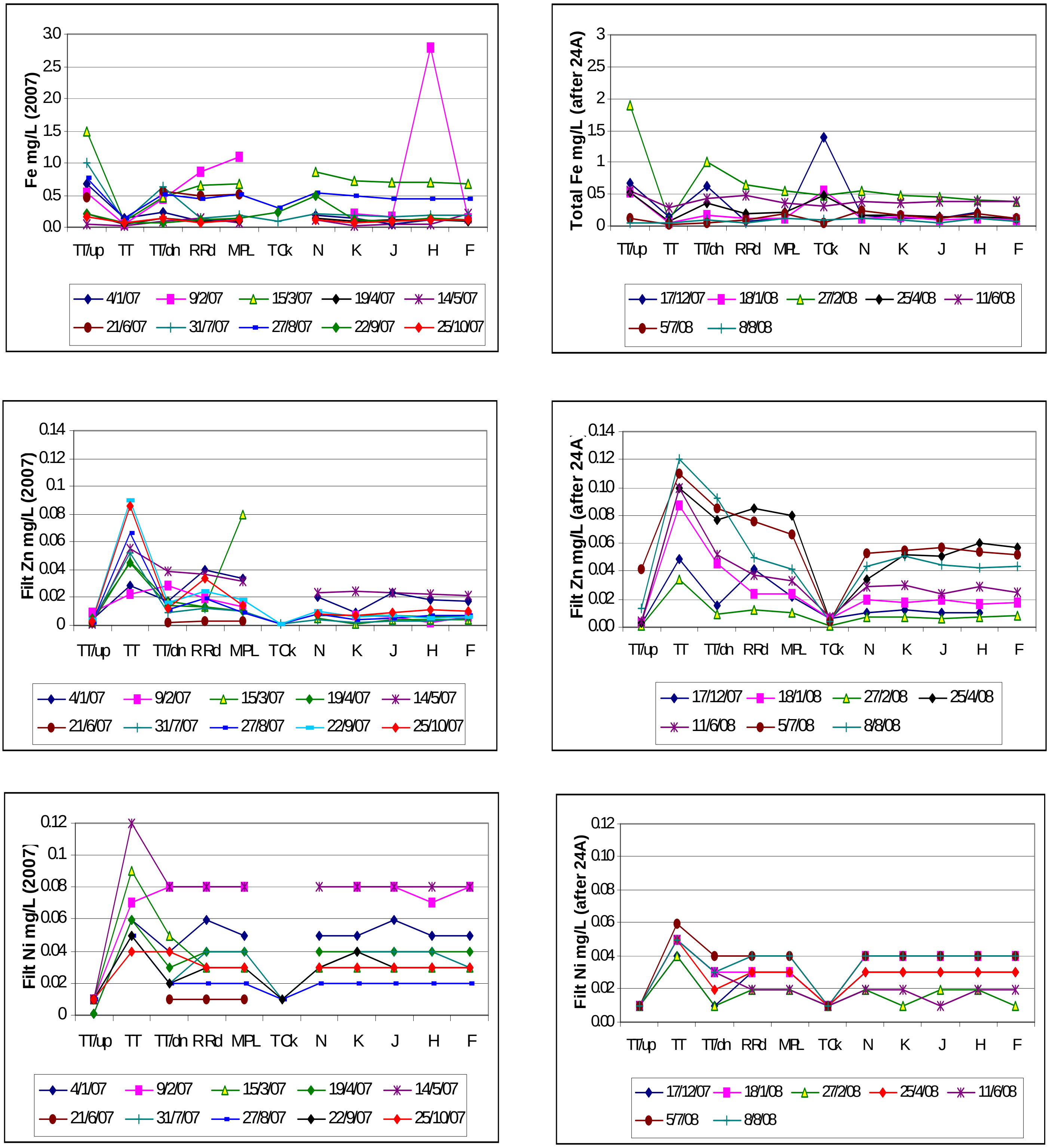


FIGURE 9 Bargo River Water Quality Analyses

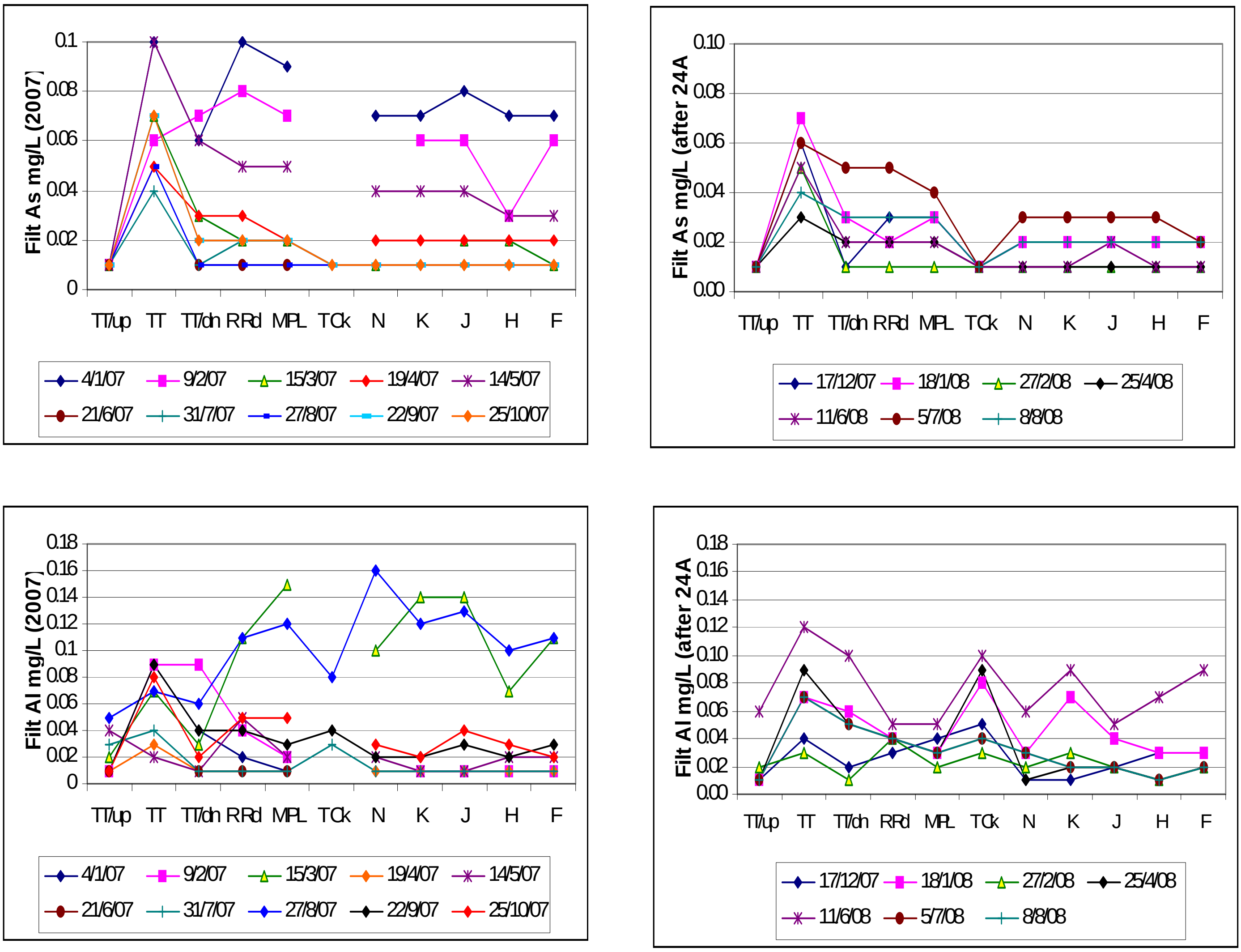
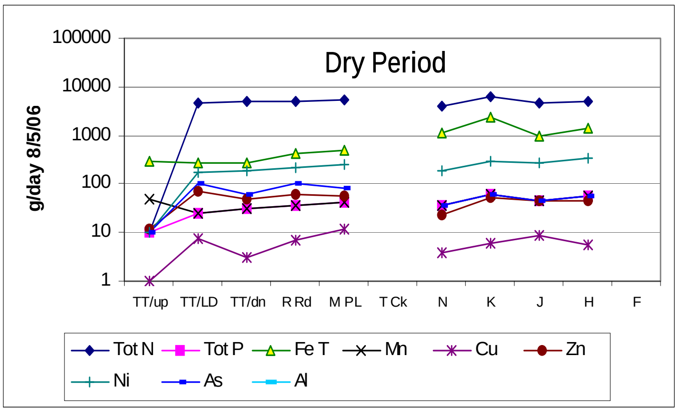


FIGURE 10 Bargo River Water Quality Analyses

Total flux of selected parameters in the river shown for a selected “dry” and “wet” sampling event in **Figure 11** was derived by multiplying the monitored / interpreted river flow at selected points in the gorge with the relevant laboratory analysis. Based on the calculated data (which is primarily reliant on the accuracy of the measured flow data), the main input from the mine discharge is

- total nitrogen, with a rise downstream of Teatree Hollow of up to almost 3 orders of magnitude in the dry and 2 in the wet period, followed by;
- nickel with a 1 to 2 order of magnitude rise, then;
- zinc and arsenic with a rise of over 1 order of magnitude.

It should be noted that where analyses were below the lower detection limit (LDL), the LDL was used in the calculations, thereby marginally enhancing the actual flux of that parameter at that point in time.



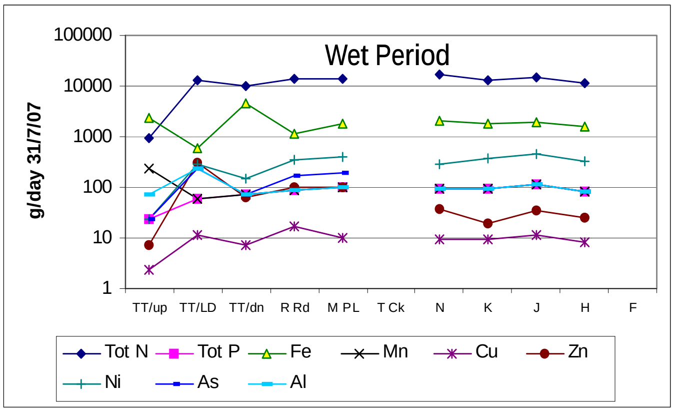


FIGURE 11 Bargo River Analyte Flux

In summary, no adverse effect on stream water quality due to subsidence effects following extraction of Longwall 24A have been observed in the Bargo River for the monitored salinity, metals and nutrients. This is supported by the observation that the sulfate, as well as lithium, barium and strontium concentrations within the SMP Area also do not show any increase or decrease from changes in groundwater flow into or out of the river following extraction of Longwall 24A.

5.2.5 Ferruginous Seeps

Field inspections, monitoring and laboratory analyses conducted to date have shown no increase the seepage volume, iron hydroxide precipitation or changes in other monitored water quality parameters within any pool containing a ferruginous groundwater seep within or outside the SMP area, either before or since Longwall 24A was extracted.

5.3 Teatree Hollow

5.3.1 Stream Flow

See previous sections.

5.3.2 Water Quality

See previous sections.

5.4 Myrtle and Redbank Creeks

Subsidence has occurred in Myrtle Creek over Panel 22, 23B and 24B with no adverse effect observed on stream flow, stream bed stability, stream bank stability or water quality.

Longwall 24A did not undermine either Myrtle or Redbank Creeks.

5.4.1 Subsidence Effects

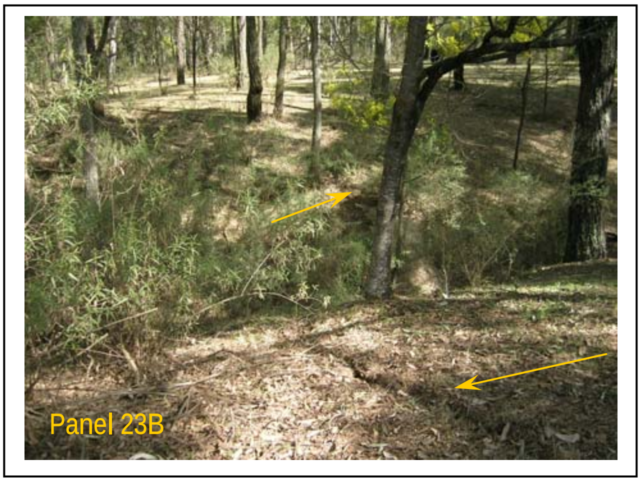
Cracking of the soil and bedrock over Panels 22 and 23B have been observed in Myrtle

Creek as shown in **Photograph 10** from locations shown in **Drawing 2**.

Redbank Creek has not been undermined to date by Panels 22 to 24A.

Up to 10mm wide bedrock cracking was observed, although was limited to the base of the creek within a small rock bar over Panel 22, whilst the soil cracking occurred at the southern end of Panel 23B, close to the barrier pillar between Panels 23A and 23B.

The soil cracking was up to 65mm wide and extended into the soil to approximately 1.5m - 2.0m over an approximate length of 40m, however, the crack did not develop within the bed of Myrtle Creek, even though it was observed on both the upper banks and flank of the creek.



PHOTOGRAPH 10 Myrtle Creek Cracks

No creek bed cracking was observed over Panel 24B, and no observable adverse effects on stream bed or bank stability were observed in Myrtle Creek or the small unnamed gullies within the Panel 22, 23A, 23B and 24B subsidence area during the monitoring period.

Even though soil cracking has been noted in Myrtle Creek over Panel 23B, it is not anticipated that the bed or bank stability will be adversely affected as the crack can be easily rehabilitated and revegetated prior to the next main flow event.

The bedrock crack located over Panel 22 is within a small, restricted sandstone rock bar outcrop and has not observably had an adverse effect on stream flow, and therefore, no rehabilitation of the Panel 22 cracking is proposed.

A remnant subsidence “high” in Myrtle Creek of up to 0.75m is located over the chain pillar between Panels 22 and 23B, and approximately 0.4m over the Longwall 23B and 24B chain pillar, however due to the low quantum of subsidence and high vegetative cover in the creek, no erosion from the creek bed or banks or sediment accumulation in subsidence troughs has been observed.

Reversal of flow in the creek has not occurred due to subsidence as the creek gradient exceeds the subsidence tilt in the stream bed.

5.4.2 Myrtle and Redbank Creek Flow

Stream depth monitoring using water depth transducers and loggers was instigated in Myrtle Creek prior to extraction of Panels 22 to 23B and subsequently extended into lower Myrtle Creek and Redbank Creek in April 2005.

The raw data is contained in an "EXCEL" spreadsheet, which is not included with this report, however data summaries and plots are presented this document.

Both creeks had extended periods of no-flow during the monitoring period due to lack of rainfall runoff prior to the February 2007 rains, with interspersed short periods of flow followed by static pondage as the creeks gradually dried up. More regular flows have been observed in the Plateau streams during and since the June 2007 rains.

No change in stream flow has been observed within Myrtle Creek or Redbank Creek during or after extraction of Panels 22 to 24B, with creek flow at monitored locations shown in **Figure 12**.

Long standing pools are noted to occur at locations MYC3, RC2 and RC3, however it should be noted that these are in currently unsubsided areas, and are naturally occurring.

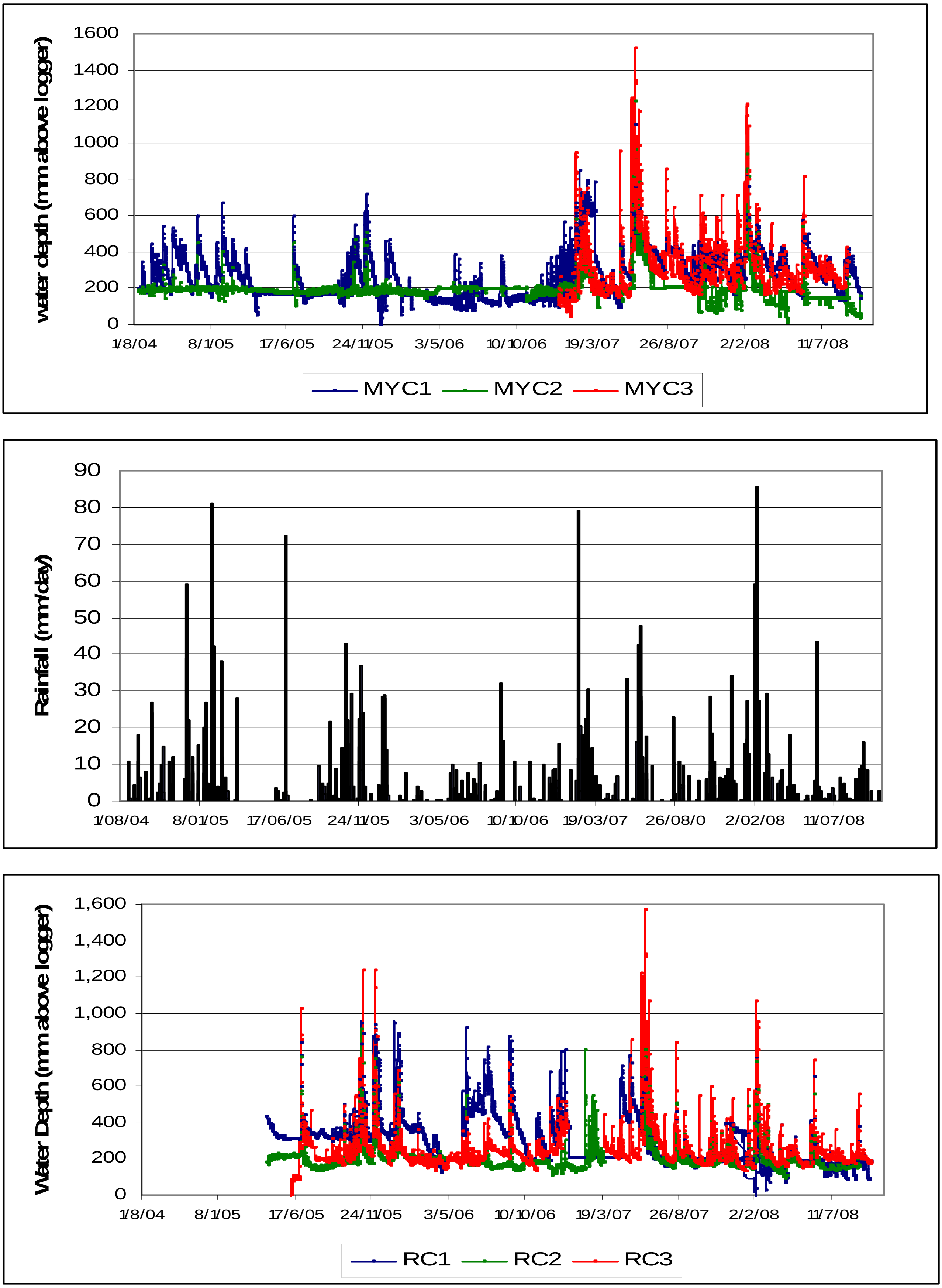


FIGURE 12 Stream Water Depth in Myrtle and Redbank Creeks

5.4.3 Myrtle and Redbank Creek Water Quality

Field and laboratory water quality monitoring and analysis from samples collected in Myrtle Creek and Redbank Creek between December 2004 and the present is shown in **Appendix B**.

Prior to the February 2007 rains, Myrtle Creek has been generally dry at MYC1, however MYC2 and MYC3 are generally ponded. Myrtle Creek has a pH range between 5.31 and 8.34, with EC between 125uS/cm and 2630uS/cm, with the creek becoming more alkaline and saline downstream as shown in **Figure 13**.

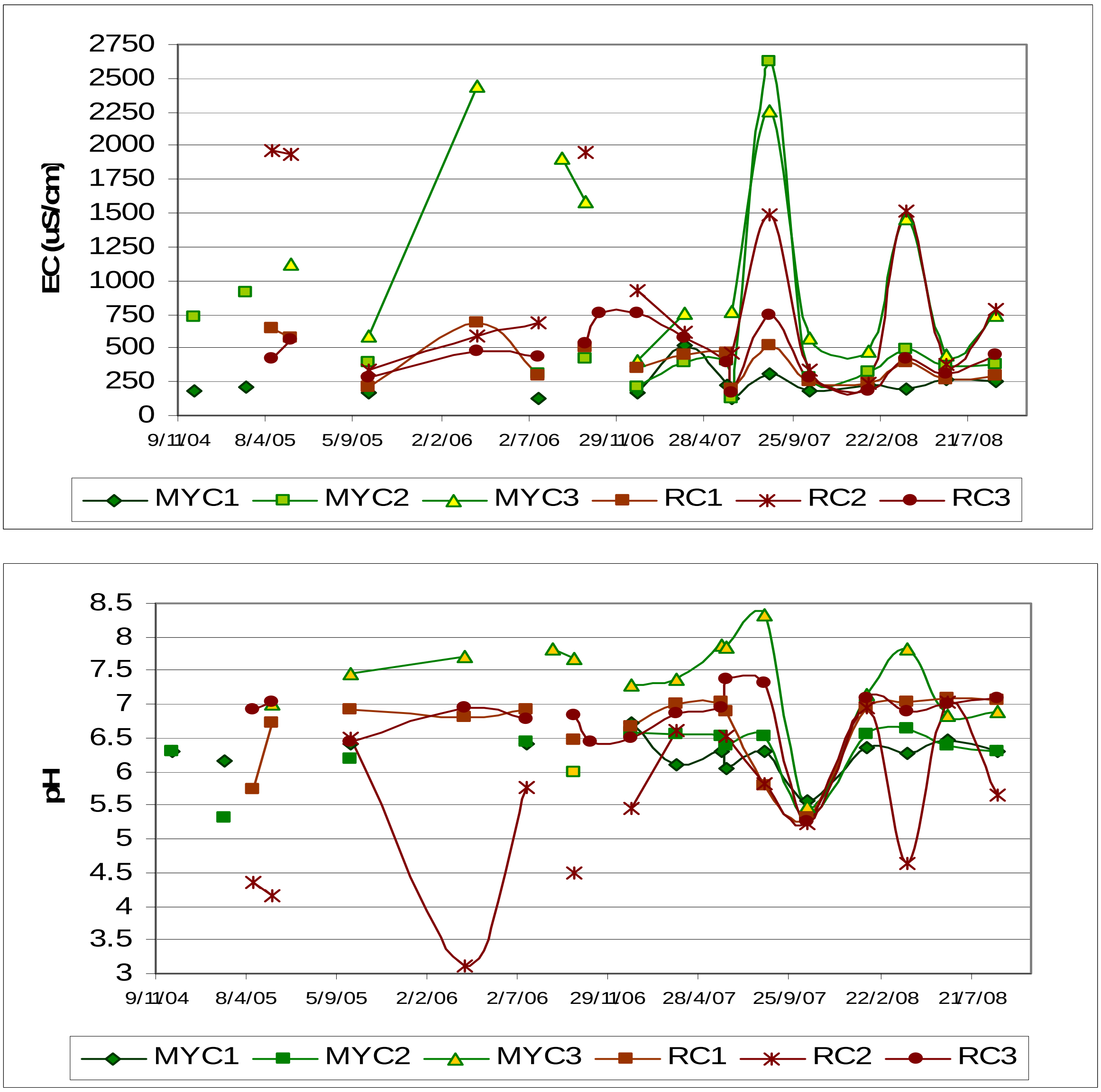


FIGURE 13 Upland Stream Field Water Quality

Prior to the February 2007 rains, Redbank Creek has been generally dry at RC1, however a perennial pond is located at RC2, and RC3 is generally ponded. Redbank Creek has a pH range between 4.15 and 7.38, with EC between 163uS/cm and 1950uS/cm, with the creek becoming generally being more acidic and saline in the RC2 pond, which also contains high levels of iron from a permanent groundwater seep into the creek as shown in **Photograph 11** and **Table 11**.

PHOTOGRAPH 11 Iron Hydroxide in Redbank Creek (RC2)

TABLE 11 Myrtle / Redbank Creek Water Quality Summary to November 2007

	pH	EC	TN	TP	Fe(T)	Al (f)	Cu (f)	Zn (f)	Ni (f)	DOC
SITE	_	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MYC1	5.58-6.72	128-514	0.7-3.7	0.01-0.13	1.0-3.0	0.01-1.0	0.002-0.007	0.005-0.01	0.01	11-27
MYC2	5.31-6.6	125-2630	0.8-5.7	0.03-0.66	2.5-23	0.01-0.24	0.001-0.004	0.002-0.009	0.01	7-18
MYC3	5.47-8.34	406-2440	29-190	5.2-30	0.94-4.2	0.01-0.1	0.001-0.009	0.004-0.027	0.01	17-47
RC1	5.3-7.03	195-694	0.5-7.6	0.01-0.11	1.1-3.2	0.01-0.1	0.001-0.007	0.007-0.015	0.01	7-11
RC2	4.15-6.6	338-1950	0.1-3.5	0.01-0.1	2.2-7	0.01-0.1	0.001-0.005	0.04-0.079	0.01-0.04	1-8
RC3	5.26-7.36	163-748	1-2.7	0.01-0.14	1.2-3	0.01-0.1	0.001-0.004	0.001-0.011	0.01	6-13

Water sampling indicates Myrtle Creek can have total nitrogen up to 190mg/L and total phosphorous at site MYC3. The high nutrient levels in this pond originate as the site is a watering hole for a mob of goats that live around the now decommissioned Jay-R Horse Stud, whilst is also downstream of an abattoir.

Myrtle Creek can also exceed the ANZECC 2000 trigger levels for filterable copper (<0.009mg/L), zinc (<0.027mg/L) and aluminium (<1.0mg/L).

Water sampling indicates Redbank Creek can have total nitrogen up to 7.6mg/L and total phosphorous to 0.14mg/L. Redbank Creek can also exceed the ANZECC 2000 trigger levels for filterable copper (<0.007mg/L), zinc (<0.079mg/L) and nickel (<0.04mg/L).

No observable adverse effects on water quality in Myrtle Creek or Redbank Creek due to subsidence have been observed following extraction of Panels 22 to 24A.

5.5 Unnamed Gullies

No stream flow or water quality monitoring has been conducted in the unnamed gullies over the eastern edge of the study area near the Bargo River gorge, nor in Dogtrap Creek or Sugarloaf Gully as they were mostly dry up to February 2007, with flow being ephemeral and highly dependent on short term interflow storage following rainfall / runoff and groundwater seepage in their respective catchments during and after the June 2007 rains.

Water quality and semi-quantitative water flow monitoring in the gully “Turkey Creek” that drains the Inghams turkey processing plant, which is located on the western plateau over Panel 24A and flows into the Bargo River, commenced in July 2007. The Turkey Creek water quality results are discussed in the Bargo River section of this report, where the creek water enters the Bargo River via “Pencil Falls”.

Based on monitoring conducted at “pencil falls”, no adverse effects on stream water quality draining out of “Turkey Creek” have occurred as a result of subsidence of Panels 22 to 24A.

5.6 Dams

A total of 22 dams are located within the Panels 22 to 24A 20mm subsidence zone as shown in **Drawing 2** and **Table 12**.

Seventeen of the dams are located within rural residential properties, with 5 process water dams located within the Inghams Turkey processing plant property.

Field inspection and photographing of the dams was conducted prior to and after undermining of each dam, between November 2004 and October 2008.

The majority of dams are constructed through a combination of excavation and emplacement of an earthen bund wall, with one dam constructed within Myrtle Creek, whilst the small dams are excavations on the slopes of Myrtle Creek with a small earthen bund wall at the downslope end.

All dams contained low water levels up to the June 2007 rains, then significantly rose after the rains.

No evidence of adverse effects due to subsidence of Panels 22 to 24A have been observed following site inspections or have been reported by landowners.

TABLE 12 Dams Over Panels 22 to 24A

Dam	Size	Construction	Subsidence Effects
K86e	Small	Small earth bank on slopes	None observed or reported
K86f	Small	Small earth bank on slopes	None observed or reported
MO8i	Small	Small earth bank on slopes	None observed or reported
MO8j	Small	Small earth bank on slopes	None observed or reported
MO8k / MO9j	medium	2 dams sharing common wall	None observed or reported
MO9i	Medium	Earth Wall in Myrtle Creek	None observed or reported
O13d	Small	Small earth bank on slopes	None observed or reported
O14e	Medium	Medium earth bank on slopes	None observed or reported
O15d	Medium	Medium earth bank on slopes	None observed or reported
O16d	Medium	Medium earth bank on slopes	None observed or reported
O17e	Small	Small earth bank on slopes	None observed or reported
Q06n	Medium	Medium earth bank on slopes	None observed or reported
Q08h	Medium	Medium earth bank on slopes	None observed or reported
W06c	Medium	Medium earth bank on slopes	None observed or reported
W07c	Medium	Medium earth bank on slopes	None observed or reported
W08e	Medium	Medium earth bank on slopes	None observed or reported
Z75k	Small	Earth bank process water pond	None observed or reported
Z75l	Medium	Earth bank process water pond	None observed or reported
Z75m	Medium / Large	Earth bank process water pond	None observed or reported
Z75n	Medium / Large	Earth bank process water pond	None observed or reported
Z75o	Medium	Earth bank process water pond	None observed or reported
Z75x	Small - Medium	Earth bank in stream bed	None observed or reported

5.7 Groundwater

5.7.1 Groundwater Levels

Regular manual and data logger based standing water level monitoring in the study area began in June 2004 with the drilling of P1 by the colliery, which is located on the southwest periphery of Panel 22, with water levels monitored every 12 hours.

Piezometers P2 and P3 also have water levels monitored at 12 hourly intervals in remnant coal exploration bores over Panel 23B and the chain pillar between Panels 25 and 26.

Piezometer P4 is a manually monitored bore in an undeveloped, unsecured block of land, 300m northeast of Panel 26. P5 is a disused private bore 950m north west of Panel 26 that was used for general domestic / irrigation water, with water levels logged at twelve hourly intervals.

Piezometer P6 was originally drilled as a water supply bore for the Jay-R-horse stud, 1.1km east of Panel 26, however it was never used as the water was too deep. The standing water levels are manually monitored in P6. The

The "Douglas" private bore is located 450m south of Panel 24A over ground that has only been undermined by first working driveages, whilst the "McPhee" private bore is located over Panel 26, which has not yet been mined. Both the private bores do not have suitable access into the bore wellhead, and as a result, standing water levels are not currently monitored. Both bores are used for domestic garden water supply.

Piezometers P7 and P8 are located within the Inghams Turkey property, and lie between the eastern end of Panels 25 and 26 and the Bargo Gorge.

A plot of water levels shown in **Figure 14**, with manual readings listed in **Appendix C**, indicates that the groundwater level in P1, which is 450m south of Panel 22, fell by approximately 4.3m due to extraction of Panel 22 over 7 months between mid / late November 2004 to early / mid December 2004. This was superimposed on a gradual, drought related decline of around 0.1mm / month, which existed both before and after extraction of Panels 22, 23A and 23B. Piezometer P1 then continued to fall a further 1.63m over 24 months to mid June 2007. The P1 water levels began to recover after June 2007 to around 4.1m beneath the earliest recorded standing water level in August 2004.

The initial decline in P1 is interpreted to result from both drought and mining related effects, with the longer period, lower gradient decline due to both the advance of the panel away from the piezometer to the west and the advance of mining into adjacent panels further to the north. No correlation between groundwater level recovery and rainfall recharge is apparent in P1 until around mid June 2007, however the recovery would also be due to the progression of coal extraction further to the north in Panels 23 and 24.

At the same time that P1 dropped, P2 (located in Glenanne Place over Panel 23) initially rose by around 2.2m, then fell by less than 1m below the pre-Panel 22 extraction period water level. The cause of the initial rise in P2, and its subsequent 3.3m fall over 7 months to late July 2005 is interpreted to be related to both a delayed response to rain that fell in late 2004/early 2005 and the far field effect of subsidence following extraction of Panel 22. When Panel 22 ceased extraction, P2 rose by around 0.5m, then remained relatively static until Panel 23A was completed in late February 2006 after which it rose by approximately 2.1m.

When Panel 23B started extraction and undermined P2, the groundwater fell by approximately 6.1m. The P2 water level then recovered by approximately 2.15m when Panel 23B finished, then fell again by around 6.3m during extraction of Panel 24B, with a rise of 1.8m which coincided with a both a reduction in panel advance and the June 2006 rains. Water levels in P2 have continued to rise since the June 2007 rains and completion of Panel 24B, and are currently approximately 2.2m below the initial monitored standing water level.

Groundwater levels in P3 (over Longwall 25/26 chain pillar) has not responded to subsidence effects related to extraction of Panels 22 and 23A/23B and essentially rose by 2.4m over the time that Panels 22, 23A and 23B were extracted. Water levels in P3 fell by around 2.2m when Panel 24B was extracted, with the fall reverting to a rise of 4.4m following the June 2006 rains, whilst the panel was still being extracted. The rise then subsequently reverted to a 1.1m water level decline, which then rose again toward the end of Panel 24B extraction, and the standing water level is continuing to rise after extraction of Panel 24A.

No significant change in Piezometers P4, P5, P6 and Well 1 have been observed during extraction of Panels 22 to 24A, with P4 being essentially static, P5 rising by 0.2m and P6 falling by 0.1m over the monitoring period as shown in **Table 13**.

No subsidence effects on P7 or P8 have been observed due to extraction of LW24A and the start of LW25.

TABLE 13 Groundwater Level Variations

Bore	Initial Water Level (mbgl)	Minimum Water Level (mbgl)	Current Water Level (mbgl)	Comment
P1	7.47	12.95	11.54	Subsidence affected within LW22 20mm subsidence area
P2	40.33	48.44	39.55	Subsidence affected within LW23B 20mm subsidence area
P3	50.70	50.42	38.38	No subsidence affect, bore located over LW 25 / 26 chain pillar
P4	37.05	37.04	37.30	No subsidence affect, bore located over western end of LW 27
P5	24.85	24.85	24.66	No subsidence affect, bore outside of LW 22 to 26 20mm subsidence area
P6	94.23	94.76	94.32	No subsidence affect, bore outside LW22 to 26 20mm subsidence area
P7	55.14	55.14	49.19	No subsidence affect, bore located between east end of LW25 and the Bargo Gorge
P8	84.63	84.63	83.29	No subsidence affect, bore located between east end of LW26 and the Bargo Gorge

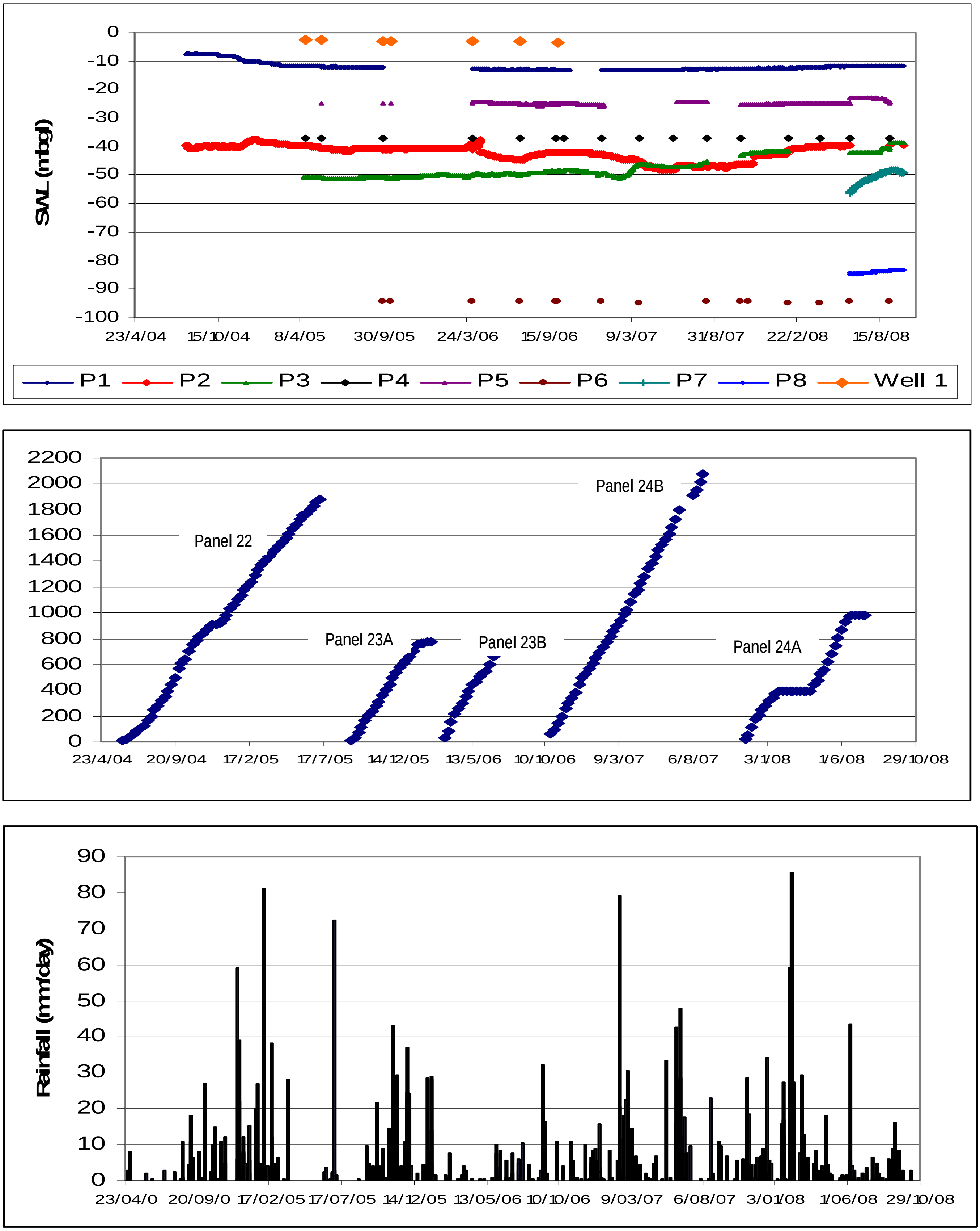


FIGURE 14 Standing Water Levels and Panel Extraction

5.7.2 Groundwater Quality

Groundwater in the study area has generally brackish salinity (564µS/cm to 14,940µS/cm) with acid to circum-neutral pH (3.53 to 7.36) as shown in **Figure 15**.

Laboratory analyses indicate that the bore water generally is outside ANZECC 2000 criteria (default trigger values for physical & chemical stressors in SE Aust upland rivers / 95% protection of freshwater species / livestock / irrigation) for;

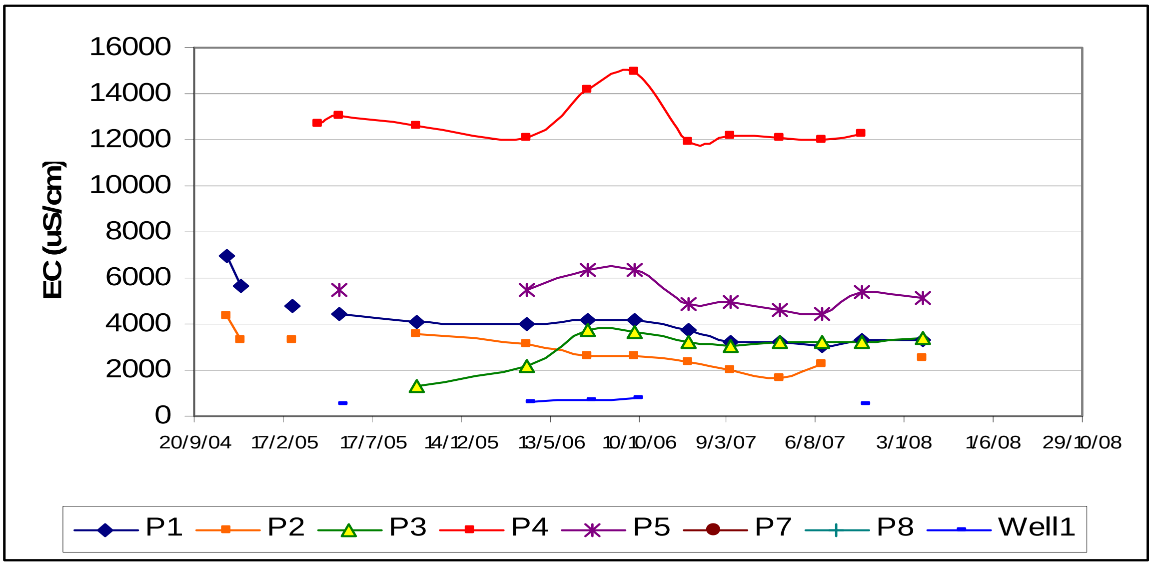
- pH,
- electrolytical conductivity,
- sodium,
- hardness,
- total nitrogen, total phosphorous, as well as,
- filterable manganese, copper, zinc, nickel, aluminium and, to a small degree, lead

The exceedance varies depending on the applicable guideline applied for the end use of the water as shown in **Appendix C.**

Groundwater in the Longwall 22 to 26 SMP area is suitable for selected livestock and limited irrigation use, but not for potable water.

No complaints regarding groundwater quality changes have been reported in the study area during the monitoring period.

No adverse changes to groundwater quality of the subsided bores has been observed, with no distinctive increase in dissolved total iron or salinity and no distinctive lowering of pH.



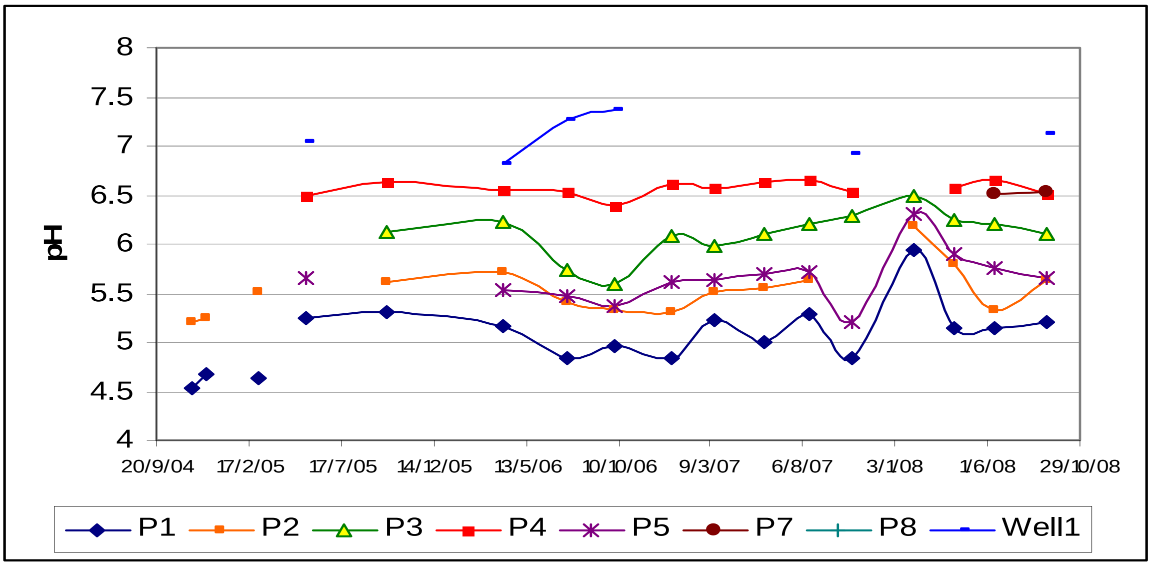


FIGURE 15 Field Groundwater Quality

6. REFERENCES

ANZECC 2000 Australian and New Zealand Guidelines For Fresh and Marine Water Quality

Geoterra, 2004 Longwall Panels 22 and 23 Surface Water, Stream, Alluvial Land and Groundwater Subsidence Management and Monitoring

Geoterra Pty Ltd, 2006 Longwall Panels 24 to 26 Surface Water & Groundwater Subsidence Management Plan

Mine Subsidence Engineering Consultants Pty Ltd 2003 The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Natural Features and Surface Infrastructure (In support of a section 138 application)

Mine Subsidence Engineering Consultants Pty Ltd 2006A The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Surface and Sub Surface Features Due to Mining Longwalls 24 to 26 at Tahmoor Colliery in Support of and SMP Application

Mine Subsidence Engineering Consultants Pty Ltd 2006B End of Panel Monitoring report for Longwall 23B at Tahmoor Colliery

Mine Subsidence Engineering Consultants Pty Ltd 2008 End of Panel Subsidence Monitoring Report for Longwall 24B at Tahmoor Colliery

Mine Subsidence Engineering Consultants Pty Ltd 2008 Supplementary Information on the Potential Ground Movements and Impacts Along the Bargo River Due to Mining of Longwall 25

Mine Subsidence Engineering Consultants Pty Ltd 2008 Results of Monitoring of Inghams Infrastructure During Mining of Longwall 25

NSW Dept Planning, 2008 Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield – Strategic Review

Strata Control Technologies, 2008 Packer Test Summary Hole P1 and P2 (now amended to P7 and P8)

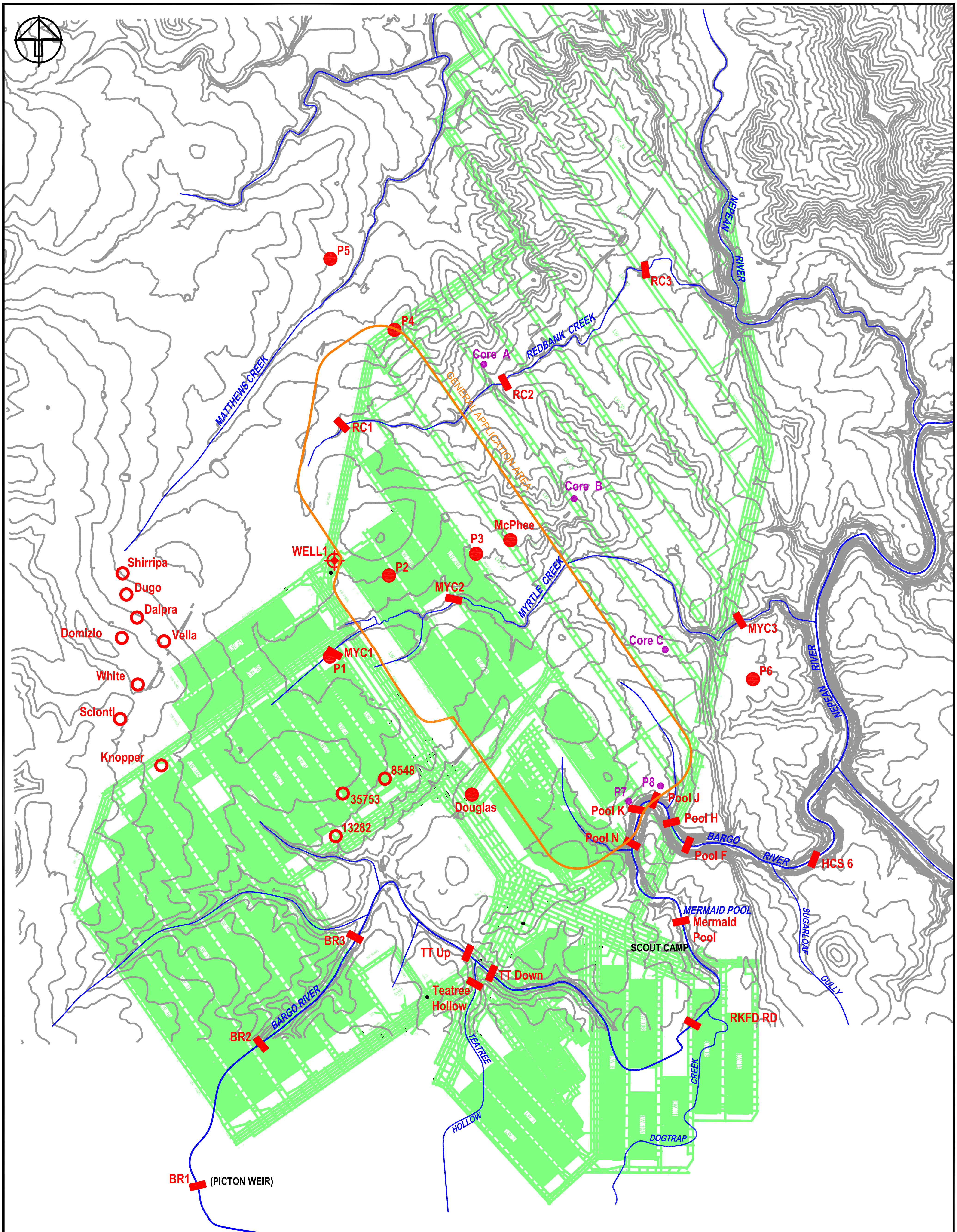
LIMITATIONS

This report was prepared in accordance with the scope of services set out in the contract between Geoterra Pty Ltd (Geoterra) and the client, or where no contract has been finalised, the proposal agreed to by the client. To the best of our knowledge the report presented herein accurately reflects the clients requirements when it was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document.

In preparing this report, Geoterra has relied upon information and documentation provided by the client and / or third parties. Geoterra did not attempt to independently verify the accuracy or completeness of that information. To the extent that the conclusions and recommendations in this report are based in whole or in part on such information, they are contingent on its validity. Geoterra assume the client will make their own enquiries in regard to conclusions and recommendations made in this document. Geoterra accept no responsibility for any consequences arising from any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to Geoterra.

The findings contained in this report are the result of discrete / specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site in question. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

Interpretations and recommendations provided in this report are opinions provided for our Client's sole use in accordance with the specified brief. As such they do not necessarily address all aspects of water, soil or rock conditions on the subject site. The responsibility of Geoterra is solely to its client and it is not intended that this report be relied upon by any third party. This report shall not be reproduced either wholly or in part without the prior written consent of Geoterra.



LEGEND

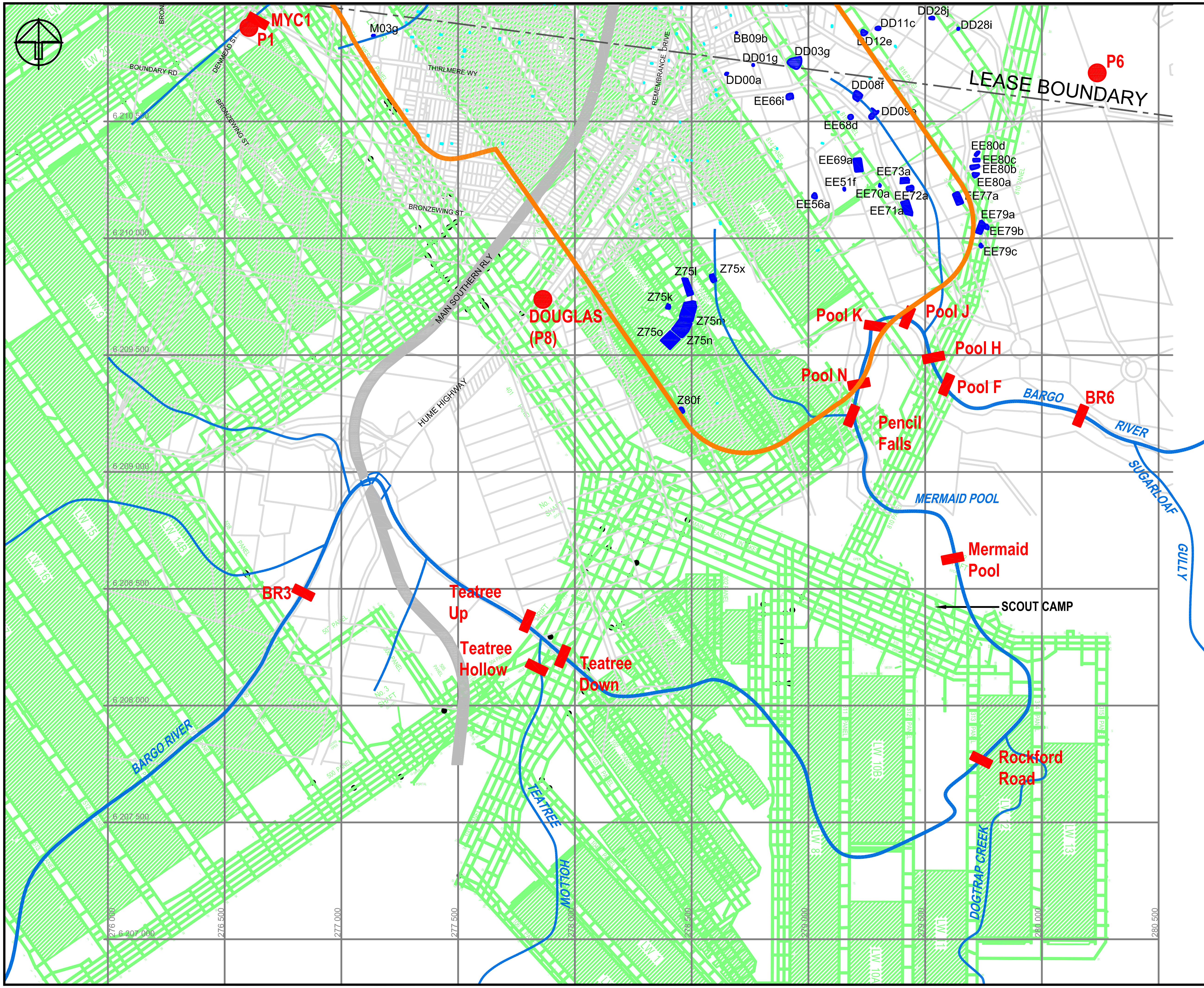
- PIEZOMETER LOCATIONS
- STREAM MONITORING LOCATIONS
- WELL LOCATION
- DNR REGISTERED BORE

PROJECT:	TA6
DRAWN:	A. DAWKINS
DATE:	17 OCT 2008
SCALE:	1:30 000

XSTRATA COAL PTY LTD
TAHMOOR COLLIERY
PIEZOMETERS AND STREAM MONITORING SITES

GeoTerra

DRAWING1



LEGEND

- DAMS
- PIEZOMETER / BORE
- STREAM SITE
- WELL

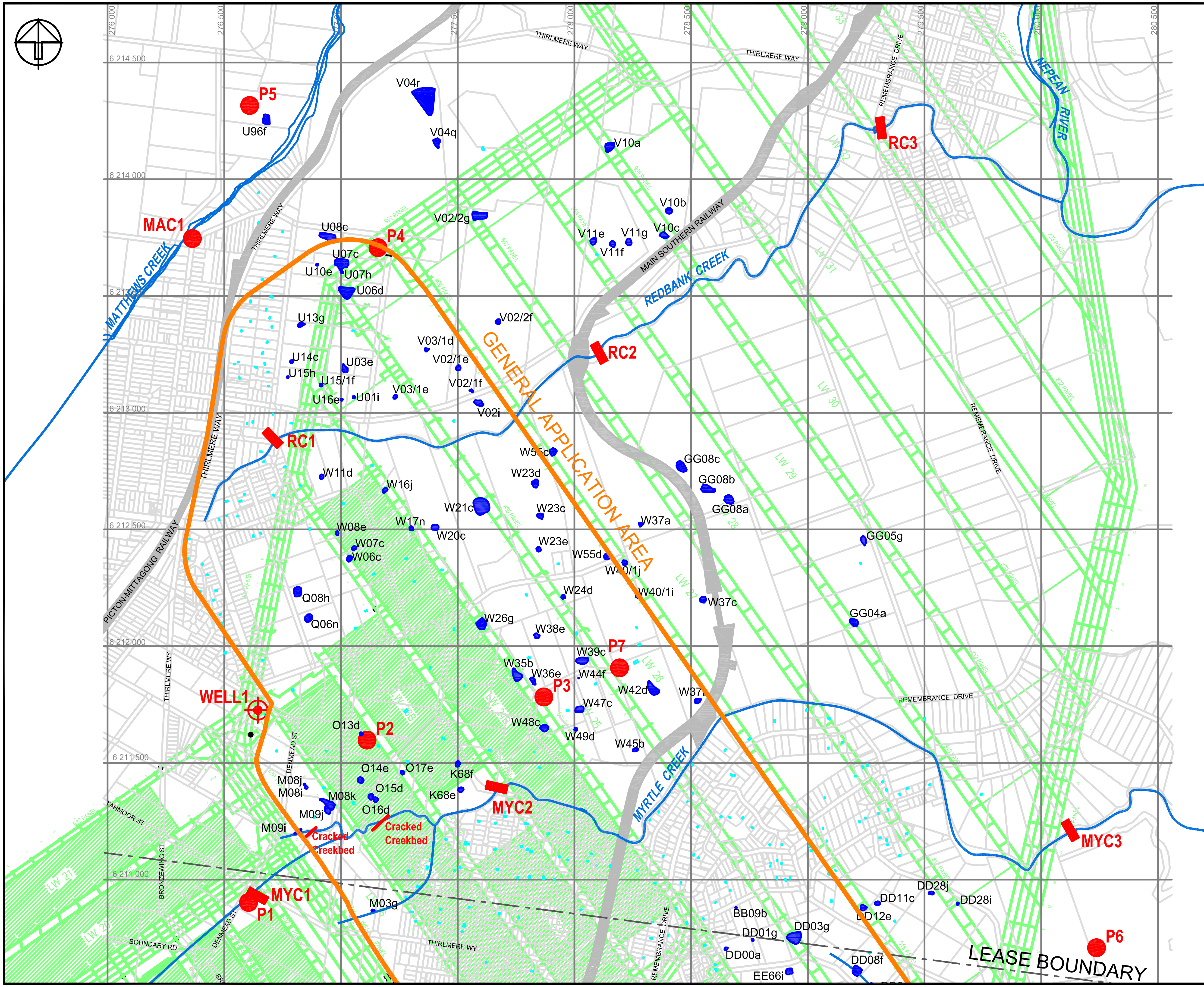
PROJECT:	TA5-R2
DRAWN:	A. DAWKINS
DATE:	17 OCT 2008
SCALE:	1:15 000

XSTRATA COAL TAHMOOR COLLIERY LONGWALLS 24 TO 26

Monitoring Sites (South)

DRAWING 2

GeoTerra



LEGEND

- DAMS
- PIEZOMETER / BORE
- STREAM SITE
- WELL

PROJECT:	TA5-R2
DRAWN:	A. DAWKINS
DATE:	17 OCT 2008
SCALE:	1:15 000

XSTRATA COAL TAHMOOR COLLIERY LONGWALLS 24 TO 26

Monitoring Sites (North)

DRAWING 3

GeoTerra