

5. ENVIRONMENTAL FEATURES AND PRELIMINARY ASSESSMENT

This section reviews the range of features of the environment within and surrounding the Site that would or could be impacted during and/or beyond the life of the Rocky Hill Coal Project. A brief description is provided of the existing environment, together with discussions of the design and operational safeguards already incorporated into the preliminary design of the Proposal. The Applicant's planning and investigations to date have provided a considerable level of confidence that the safeguards to be adopted would ensure the mine could be developed with a satisfactory level of impact. This section introduces how impacts of the Proposal will be assessed and, where possible, a preliminary assessment of impacts is provided.

This section has been structured with the issues discussed in an order reflecting a preliminary prioritisation of all issues. The prioritisation has been established through a combination of stakeholder consultation, preliminary environmental investigations, a review of available literature and outcomes from an internal broad brush risk assessment.

5.1 AIR QUALITY

PAEHolmes has assembled the following overview of the existing environment and the approach to the assessment of air quality based upon site specific data assembled by the Applicant to date and their experience with numerous other coal mining projects.

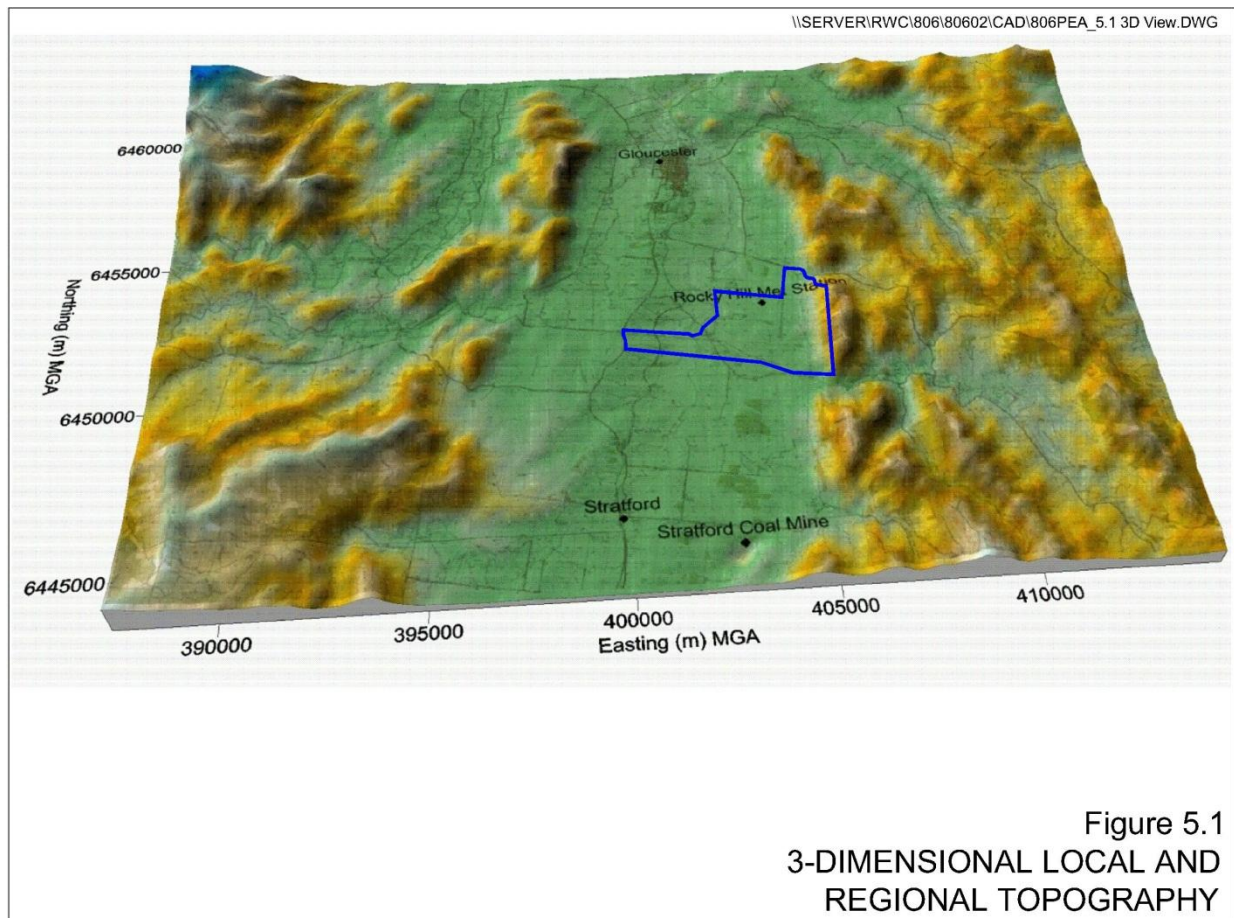
5.1.1 Existing Environment

5.1.1.1 Local and Regional Topography

Topography plays an important role in steering winds, generating turbulence and large scale eddies and in generating drainage flows at night and upslope flows in the day. Regional topography in the Stroud - Gloucester Valley has a strong influence on prevailing meteorology. The major topographical features that would be expected to influence air movements in the valley are displayed in **Figure 5.1**. It can be seen that on a broad scale the valley is orientated with a north to south orientation near Gloucester. Closer to the Stratford Coal Mine, the orientation of the valley changes slightly to a north-northeast to south-southwest alignment. The margins of the valley contain complex structures that influence air movement close to the margins.

5.1.1.2 Dispersion Meteorology

Meteorological data including wind speed, wind direction, temperature, humidity and sigma-theta have been collected at a meteorological station specifically installed for the Rocky Hill Coal Project in July 2010.



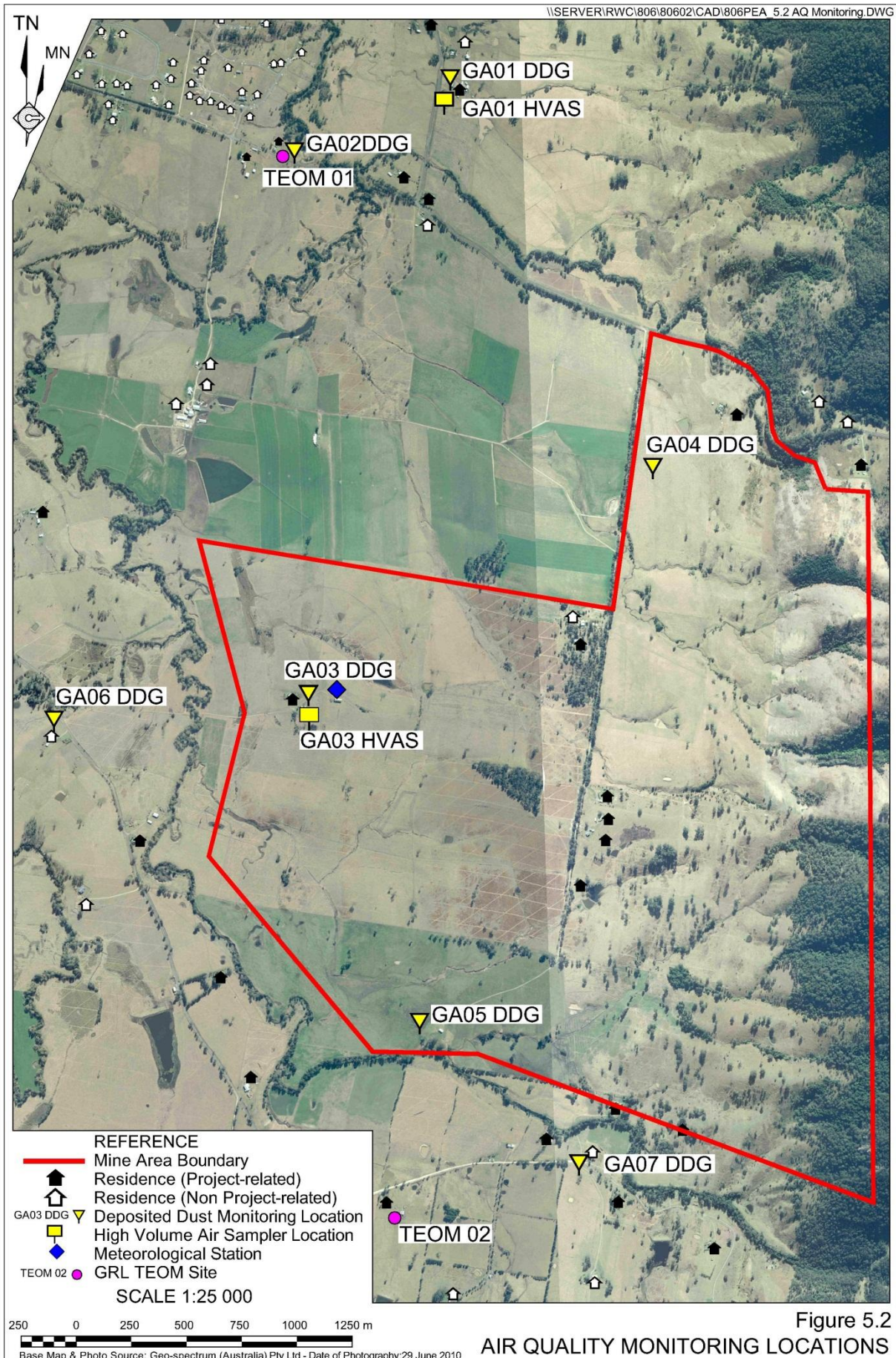
An overview of the wind speed and direction data recorded at the Rocky Hill meteorological station has previously been presented in Section 3.4.

5.1.1.3 Dust

Air quality standards and criteria refer to pollutant levels that include the contribution from specific projects and existing sources of dust. In order to assess impacts against all the relevant air quality standards and criteria, it is necessary to assemble information or estimates on existing dust concentration and deposition levels in the area in which the proposed activities are likely to contribute to these levels.

An air quality monitoring program was established in July 2010 to monitor dust deposition and dust concentration (as PM_{10}) in the vicinity of the proposed activities. The locations of the current monitoring sites in place for the Rocky Hill Coal Project are shown on **Figure 5.2** and include:

- Two High Volume Air Samplers (HVAS) monitoring PM_{10} ; and
- Seven dust deposition gauges.



Air quality monitoring data has also been collected since 1994 at the Stratford Coal Mine located approximately 11km south of the Mine Area and includes:

- Five High Volume Air Samplers (HVAS) monitoring PM₁₀; and
- Seven dust deposition gauges.

The following sub-sections provide an analysis and summary of the dust monitoring data collected at both the Applicant's Site and at the Stratford Coal Mine.

PM₁₀ Concentrations

Figure 5.2 shows the locations of the two HVAS used to monitor PM₁₀ concentrations within and surrounding the Site. The GA01 HVAS is located to the north and outside of the Site boundary and the GA03 HVAS is located within the Mine Area. Both monitors are located within close proximity to existing residences on land owned by the Applicant.

Table 5.1 provides a summary of the annual average PM₁₀ concentration data collected at the Site. Monitoring results show that there have been no exceedances of the impact assessment criterion of 30µg/m³ at either of the two HVAS sites. The average PM₁₀ concentration at both locations for the 18 month monitoring period to date is 11µg/m³. It is noted that this level is comparable with the average level of 12µg/m³ recorded at the five HVAS sites maintained on and surrounding the Stratford Coal Mine.

Table 5.1
Monthly Average PM₁₀ Concentration at the Rocky Hill Coal Project (µg/m³)

Date	Wilson (GA01)	Martin (GA03)	Date	Wilson (GA01)	Martin (GA03)
Jul-10	4	5	Apr-11	9	5
Aug-10	20	14	May-11	8	5
Sep-10	18	10	Jun-11	8	5
Oct-10	18	9	Jul-11	4	2
Nov-10	24	11	Aug-11	6	5
Dec-10	17	9	Sept-11	14	14
Jan-11	16	10	Oct-11	10	10
Feb-11	15	8	Nov-11	15	14
Mar-11	16	9	Dec-11	9	5
Average				13	8
Average over both sites					11
Source: GRL on-site HVAS monitoring stations. See Figure 5.2 for locations.					

TSP Concentrations

No TSP concentration data is available in the vicinity of the Site. However, annual average total suspended particulate (TSP) concentrations can be estimated from the PM₁₀ measurements by assuming that 40% of the TSP is PM₁₀. This relationship was obtained from data collected by co-located TSP and PM₁₀ monitors operated for long periods of time in the Hunter Valley (NSW Minerals Council, 2000).

Use of this relationship indicates that when taking the higher PM₁₀ average over all sites (from the Stratford Coal Mine data), the annual average TSP concentration is approximately 30µg/m³ which is well below the OEH assessment criterion of 90µg/m³.

Dust Deposition

Figure 5.2 shows the locations of the seven dust deposition gauges that are a part of the Applicant's air quality monitoring network. The gauges are located both within and outside Site boundary and again in the vicinity of existing residences.

Table 5.2 provides a summary of the annual average dust deposition data collected at the Site. Monitoring data obtained to date indicates compliance with the OEH's assessment criterion of 4g/m²/month, which is expressed as an annual average. The average across all locations for the 18 monitoring period is 0.8g/m²/month which indicates background levels are well below the OEH assessment criteria.

Table 5.2
Dust Deposition Data (insoluble solids) at the Rocky Hill Coal Project (g/m²/month)

Date	DDG - GA1	DDG - GA2	DDG - GA3	DDG - GA4	DDG - GA5	DDG - GA6	DDG - GA7
Jul-10	0.1	0.1	0.4	0.2	0.4	*NS	*NS
Aug-10	0.2	0.2	0.3	1.3	1.6	0.2	0.2
Sep-10	0.4	0.5	0.3	0.9	1.1	1.3	1.1
Oct-10	0.4	0.5	1.0	0.8	1.1	3.5	1.1
Nov-10	0.2	0.2	0.1	1.8	2.1	1.2	0.4
Dec-10	0.9	0.7	0.8	7.3	3.2	2.3	2.6
Jan-11	0.5	0.4	0.2	0.2	0.9	0.8	1.0
Feb-11	C	0.6	0.4	0.4	0.6	2.3	1.3
Mar-11	0.6	0.5	0.3	0.6	0.5	3.8	0.6
Apr-11	0.3	0.5	1.2	0.6	0.4	0.4	0.5
May-11	0.3	0.3	0.4	1.3	0.5	0.4	0.6
Jun-11	0.1	0.1	0.2	1.3	0.2	0.2	0.3
Jul-11	0.1	0.3	0.3	0.6	0.2	0.3	0.2
Aug-11	0.3	0.3	0.3	2.2	0.4	0.4	0.7
Sept-11	0.4	0.5	0.7	*	0.8	3.4	0.8
Oct-11	*	0.7	0.7	3.6	1.1	0.6	0.9
Nov-11	*	0.7	0.6	1.1	*	*	1.0
Average	0.3	0.4	0.5	1.4	0.9	1.4	0.8
Average over both sites							0.8
*NS = Not sampled, C = Contaminated							
Source: GRL on-site deposited dust gauge network. See Figure 5.2 for locations.							

The levels of dust deposition recorded within and surrounding the Rocky Hill Coal Site is slightly less than the levels recorded in seven gauges maintained at and surrounding the Stratford Coal Mine since 1994.

5.1.2 Dust-related Management Issues and Preliminary Assessment

A range of activities undertaken throughout the life of the Proposal would generate dust of varying particle sizes that would have the potential to disperse beyond the boundary of the Site. The implications of the increased dust levels in the surrounding community relate to both amenity (through the deposited dust) and potential health effects (through the fine PM_{2.5} and PM₁₀ particles).

The methods to manage dust in the coal mining industry are well known and would be adopted by the Applicant. The methods relate principally to minimising dust generated through:

- limiting the disturbance areas exposed at any one time, both in terms of new areas disturbed and areas being rehabilitated;
- suppression of dust on internal roads and activity areas through the application of water or dust suppressants; and
- control of dust at its source through collection and/or suppression.

Preliminary mine planning has already identified the most appropriate sequence of operations to limit the areas exposed at any one time. The air quality assessment will incorporate further details of the design and operational safeguards that the Applicant would implement so that compliance with the site specific criteria would be achieved.

The proposed design and operational safeguards would be consistent with those nominated in the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*.

The air quality assessment of the Proposal would involve the consideration of a number of representative operational scenarios. The scenarios selected would involve the proposed coal mining, processing, rehabilitation and related activities with the nominated static equipment positioned at their nominated locations and elevations and the mobile equipment considered along their movement paths.

The dust levels attributable to each of the proposed activities on site, i.e. after the adoption of the design and operational safeguards, would be entered into the CALMET/CALPUFF model and predictions made to each of the non project-related residences within 2km of the proposed activities, and a number of representative residences between 2km and 3km of the proposed activities. The meteorological inputs to the model would be drawn from the on-site meteorological station and any available relevant longer term data.

The air quality modelling would predict future air quality surrounding the Site through the use of the following descriptors relating to both the amenity and health effects of dust.

- Deposited Dust (annual average).
- PM₁₀ (annual average and 24 hour average).
- PM_{2.5} (annual average and 24 hour average).

The predicted air quality based upon the above descriptors will be assessed against the relevant criteria.

The inputs to the air quality model would include the dust generated by the Applicant's operations together with that from other existing and proposed developments to ensure the combined or cumulative dust levels comply with the nominated criteria.

The assessment of potential air quality impacts for inclusion in the *Environmental Impact Statement* will also incorporate details of the proposed air quality monitoring program.

Whilst it is likely that the Proposal would increase dust levels in the surrounding community to some degree, the controls and safeguards to be adopted by the Applicant would be designed to ensure that the levels of dust produced would satisfy all relevant amenity and health criteria.

5.1.3 Greenhouse Gases

Emissions of carbon dioxide (CO₂) and methane (CH₄) would be the most significant greenhouse gases (GHGs) emitted from the Rocky Hill Coal Project. Detailed inventories of greenhouse gas emissions will be presented in the *Environmental Impact Statement* for the three 'scopes' of emissions (Scope 1, Scope 2 and Scope 3). Sources that will be considered for the Rocky Hill Coal Project include:

- fuel consumption (diesel and gas) during mining operations – Scope 1;
- release of fugitive CH₄ from the coal during mining – Scope 1;
- indirect emissions resulting from the consumption of purchased electricity – Scope 2;
- indirect emissions associated with the production and transport of fuels – Scope 3;
- indirect emissions associated with transmission and distribution losses from electricity supply – Scope 3;
- emissions from coal transportation – Scope 3; and
- emissions from the burning of the product coal – Scope 3.

GHG emissions will be presented in the *Environmental Impact Statement* in the context of Australian baseline and NSW total emissions and global climate change. A qualitative assessment of the potential impacts of these emissions on the environment will be presented in the *Environmental Impact Statement*, including consideration of all reasonable and feasible measures to minimise emissions.

5.2 NOISE AND VIBRATION

Wilkinson Murray (Sydney) Pty Ltd has provided the following description of the existing noise climate around the Site and the approach to the assessment of noise and vibration based upon a comprehensive background assessment and their experience with numerous other coal mining projects.

5.2.1 Existing Noise Climate

Existing Noise Sources

Noise which is currently audible at the residences surrounding the Site is variously attributable to a range of sources including:

- traffic on local roads and The Bucketts Way;
- occasional trains on the North Coast Railway;
- domestic noises such as lawn mowers;
- rural noises such as tractors, stock and birds;
- wind in the trees;
- livestock/vehicles on properties and at the Gloucester Livestock Exchange Centre;
- a saw mill near the intersection of Jacks Road and The Bucketts Way; and
- occasional light aircraft using the Gloucester airfield.

Existing Noise Levels

The existing or background noise levels experienced in the local community have been established through a background noise monitoring program involving the measurement of noise levels at 12 locations within and around the Site (see **Figure 5.3**). Noise levels were recorded at:

- Locations 1 to 9 during July 2010;
- Locations 10 to 12 during March 2011; and
- Locations 1, 3, 9 to 12 during July 2011.

Table 5.3 lists the measured background levels at all 12 locations.

Table 5.3
Unattended Ambient Noise Environment *³

Location	Ambient ($L_{A90(15min)}$) Level* ¹ All Noise Sources – dB(A)			$L_{Aeq(Period)}$ Level* ¹ All Noise Sources – dB(A)		
	Day	Evening	Night	Day	Evening	Night
1	30	28	27	46	36	36
2	27	28	26	46	43	38
3	26	25	22	46	42	45
4	30	28	27	47	42	39
5	26	24	23	50	44	43
6	27	27	27	46	39	39
7	26	26	26	47	49	44
8	30	27	26	60	45	51
9	29	25	24	48	42	42
10* ²	31	27	25	48	42	43
11	38	29	27	58	53	52
12	35	27	27	52	50	48
Notes *1: (dB(A) re 20 μ Pa) *2: 5 days recorded *3: Results are presented for the most recent monitoring undertaken at each location.						

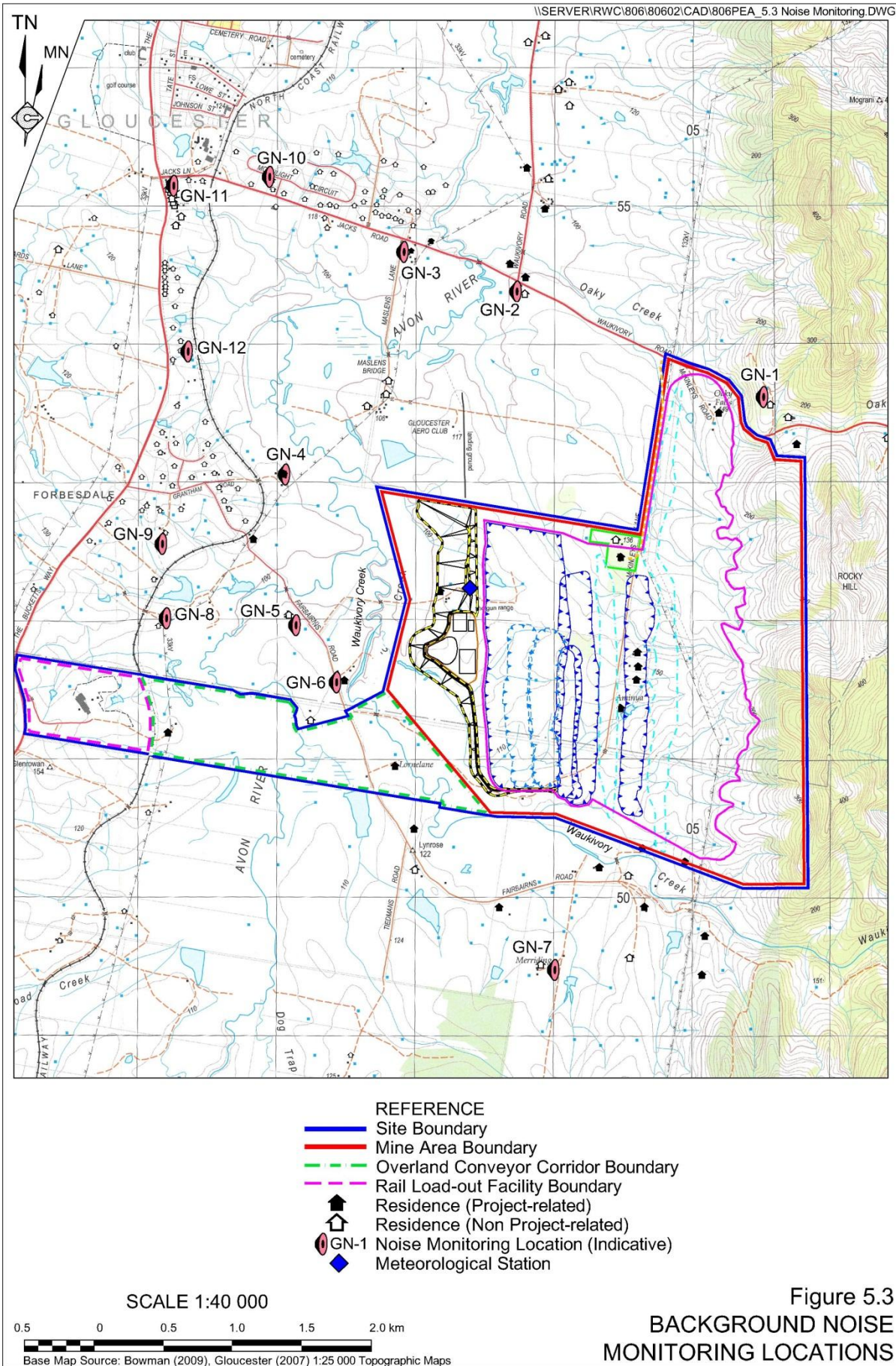


Figure 5.3
**BACKGROUND NOISE
MONITORING LOCATIONS**

The results of the monitoring have established that the proposed activities are located in a typical rural area with few noise sources and generally low noise levels, particularly background noise levels. For the two monitoring locations near The Bucketts Way and local industry (Locations 11 and 12), the day-time background noise levels were elevated above those recorded elsewhere due to the noise generated by these sources.

Noise monitoring undertaken during March 2011 showed higher noise levels than July 2010 and July 2011 reflecting the presence of insects. Whilst reliance will not be placed upon the March 2011 noise levels when establishing noise criteria, the results identify the higher levels of background noise that are already present in the surrounding community during those periods of the year when insects producing noise are present.

5.2.2 Noise-related Management Issues and Preliminary Assessment

The quiet nature of the area within and around the Site dictates that noise management will be an important issue for coverage in the *Environmental Impact Statement*. The Applicant recognises that the use of a wide range of mobile earthmoving equipment and machinery would cause noise levels within the activity areas to increase and has already incorporated a range of safeguards into the design of the Proposal to reduce noise. The Applicant would investigate and introduce further design and operational safeguards to ensure that the levels of noise experienced in the local community satisfy the relevant noise criteria.

The principal criteria to be satisfied by the Proposal would relate to operational noise (including sleep disturbance), off-site rail and road traffic noise, and operational vibration (from blasting).

The noise assessment of the Proposal would involve the consideration of a number of representative operational scenarios, similar to those used for the air quality assessment. The scenarios selected would involve the proposed construction, coal mining, processing, transportation, rehabilitation and related activities with the nominated mobile and static equipment positioned at typical locations and elevations. The noise levels of the various items of equipment and their locations/elevations will be entered into the approved noise model and predictions made to each of the non project-related residences within 2km of the proposed activities and a number of representative residences/receptors between 2km and 3km of the proposed activities.

The noise modelling will predict future noise levels under both neutral (calm) and adverse weather conditions, e.g. temperature inversion/gentle breeze towards residences. The existing meteorological conditions will be reviewed over an entire year and a 10th percentile exceedance noise level calculated which will then be compared with the relevant criteria. Based upon the background noise measurements outlined in **Table 5.3**, it is likely that the rating background levels at most assessed residences will be in the order of 30dB(A) with an associated intrusiveness criterion in the order of $L_{Aeq\ 15mins}$ 35dB(A). For the residences near The Bucketts Way and Jacks Road intersection (Locations 11 and 12), where daytime background levels are higher, a higher intrusiveness criterion would also apply. The applicable sleep disturbance screening criterion at all residences would be in the order of $L_{Aeq1min}$ 45dB(A).

The noise modelling and assessment will assist in the refinement, and establish the effectiveness, of the various design and operational safeguards to be adopted to attenuate the noise generated by the mobile and static earthmoving equipment so as to achieve compliance with the relevant criteria under both calm and adverse weather conditions.

The noise assessment will also assess the noise generated by the Applicant's proposed mining operations together with the noise from other existing and proposed developments to ensure the combined or cumulative noise levels comply with the nominated criteria.

Given predicted noise levels are required to be compliant at non project-related residences during adverse weather conditions and such conditions only occur periodically, operational noise levels at most other times would be lower and therefore acceptable throughout the community throughout the life of the proposed coal mine.

The noise and vibration assessment will include an assessment of the proposed blasting activities throughout the life of the Rocky Hill Coal Project. The assessment would focus on identifying the blast parameters necessary to achieve compliance with both ground vibration and airblast overpressure levels. It is likely that some blasts would be noticed throughout the local community but the noise and ground vibration levels would be designed to be within all relevant blasting criteria.

The assessment will also address both road traffic and rail noise impacts, identify the design and operational safeguards required to achieve compliance with the relevant criteria, and conclude with details of the proposed noise and vibration monitoring program.

5.3 TRANSPORTATION

Constructive Solutions Pty Ltd, specialist traffic consultants, have provided the following overview of the existing road network based upon a preliminary site inspection and review of data held by the Roads and Maritime Services (RMS) and Gloucester Shire Council.

5.3.1 Existing Road Network

Access to the Mine Area from the south is currently provided via The Bucketts Way, with vehicles turning right onto Jacks Road (which becomes Waukivory Road), and travelling for a distance of approximately 4km before turning right onto McKinleys Lane. Access from the north is provided via The Bucketts Way south of Gloucester and Jacks/Waukivory Roads or The Bucketts Way east of Gloucester township, turning into Waukivory Road before turning right onto McKinleys Lane. Fairbairns Road, which traverses the proposed Overland Conveyor Corridor, is located south of Waukivory Creek and does not provide a ready access to the Mine Area.

The Bucketts Way south of Jacks Road provides access to the proposed Rail Load-out Facility.

A summary of the existing status of these roads is as follows.

- **The Bucketts Way**

In the vicinity of the Site, The Bucketts Way (Main Road 90) consists of two lanes of one way traffic from 3.0m to 3.5m wide with a sealed shoulder varying from 0m to 2.5m wide. This road is a key regional road providing access from the Pacific Highway near Taree to the Pacific Highway north of Raymond Terrace via Gloucester.

2008/2009 Annual Average Daily Traffic (AADT) levels on The Bucketts Way vary from 1488 at the Gloucester/Great Lakes boundary (9km south of Jacks Road) to 2978 adjacent to the Gloucester Golf Club, approximately 0.5km north of Jacks Road.

- **Jacks Road**

Jacks Road is a local road managed by Council and provides access from The Bucketts Way to both the Thunderbolts and Avon River Estates, joining Waukivory Road 2.7km to the east. The road consists of a 6m to 7m seal on an 8m formation and includes both a railway line crossing and bridge over the Avon River. The railway line crossing incorporates flashing lights in conjunction with boom gates. The bridge over the Avon River provides for one traffic lane and a footpath and comprises a timber sub-structure and timber girders, with a timber/concrete superstructure.

The existing AADT level on Jacks Road east of the entrance to the Avon River Estate is estimated to be less than 200.

- **Waukivory Road**

Waukivory Road is a local road managed by Council that carries traffic from The Bucketts Way east of Gloucester through to Waukivory, 8km southeast of the proposed Mine Area. The sections of Waukivory Road between The Bucketts Way and McKinleys Lane comprise an approximately 6m wide sealed pavement with 1m unsealed shoulder. The existing AADT level on Waukivory Road is estimated to be less than 100.

- **McKinleys Lane**

McKinleys Lane is a local road managed by Council that services four project-related and one private residence. The road experiences low traffic levels and consists of a gravel pavement approximately 6m in width between table drains. The existing AADT level on McKinleys Road is estimated to be less than 50.

- **Fairbairns Road**

Fairbairns Road is a local road managed by Council. This road provides access to the Forbesdale subdivision east of The Bucketts Way and a number of rural lifestyle blocks and agricultural properties south of the Mine Area. The existing AADT level on Fairbairns Road is estimated to be less than 200.

Where up-to-date counts are not available, traffic counts will be conducted to assist with the design of the required road improvements discussed in Section 5.3.2 and assist with the assessment of impacts attributable to the Proposal.

5.3.2 Road Management Issues and Preliminary Assessment

Key management issues relating to traffic include potential impacts on road pavements, bridge structures, traffic congestion and road safety.

In order to accommodate the traffic to be generated by the Proposal, including over size/weight vehicles, upgrading of local roads along the preferred route would be required. The Applicant recognises that a range of management procedures would also need to be adopted to ensure that its and any sub-contractors' vehicles operate in a manner that do not cause unacceptable impacts. Subject to the outcomes of investigations being undertaken by Constructive Solutions, these upgrading works and procedures may include, but not necessarily be limited to, the following.

- Upgrading/widening the road formations along Jacks Road and the east-west section of Waukivory Road.
- Replacement of the bridge over the Avon River on Jacks Road and re-alignment of the approaches to the bridge.
- Upgrading McKinleys Lane for the first 50m from the Waukivory Road intersection and constructing the Mine Area access road running generally parallel to the existing alignment (to avoid otherwise unnecessary clearing of roadside vegetation) to the site office and amenities.
- A requirement for all drivers of heavy vehicles to adhere to a "code of conduct" or similar.
- Installation of appropriate signage.

The use of a conveyor to transport coal to the Rail Load-out Facility would significantly reduce the volume of heavy vehicles potentially associated with the Proposal and therefore minimise the potential impacts on the road network. Following the site establishment/construction period and the delivery of the mining equipment to the site, the principal vehicle movements associated with the Proposal would comprise light vehicles driven by mine employees and contractors, and heavy vehicles supplying consumables to and servicing the mine.

The impact of the increased volumes of traffic on the existing road network and users will be considered in greater detail as part of the *Environmental Impact Statement* for the Proposal. This assessment will be undertaken in accordance with the *Guide to Traffic Generating Development, Road Design Guide* (Roads & Traffic Authority), relevant Austroad standards and other relevant guidelines.

The Proposal would result in increased levels of traffic on local roads, however, with road improvements, the likely impacts upon the road pavements, traffic congestion and road safety would be acceptable.

5.3.3 Rail Network

The North Coast Railway Line is the principal rail route for the north coast of NSW providing access north to Brisbane and south to Maitland and, subsequently, the Port of Newcastle. The North Coast Railway is located approximately 900m west of the Mine Area and comprises a

single track generally aligned north-south and parallel to and east of The Bucketts Way. The closest railway station site is the closed Berrico platform (see **Figure 1.1**).

A total of six rail passenger services currently pass through Gloucester on a daily basis, namely three northbound from Sydney, two southbound from Brisbane and one southbound from Grafton.

Freight services also operate on the North Coast Railway with the Australian Rail Track Corporation (ARTC) January 2012 schedule indicating that the total number of contracted freight trains passing the Gloucester/Berrico area amounts to 47 trains weekly and on average, seven trains daily. The ARTC schedule shows that the majority of northbound freight trains pass the Gloucester/Berrico area between 7:30am to 10:30am and 2:30pm to 8:30pm, whilst the schedule of the southbound trains is more regular, with trains scheduled to pass through Berrico between 5:30am and 7:30am each morning followed by trains scheduled at approximately 10:30am, 14:30pm and 16:10pm, four or five days each week. In addition to this, there are uncontracted services, the frequency of which depend on the level of production and associated rail transportation relating to agriculture in the region.

Further south beyond Stratford, the activities of Gloucester Coal Ltd generate additional rail traffic on the North Coast Railway Line destined for the Port of Newcastle and numerous smaller trains transporting coal from the Duralie Coal Mine northwards to the Stratford Coal Mine CHPP for processing and subsequent despatch.

5.3.4 Rail Management Issues and Preliminary Assessment

The principal rail management issues will be the provision of safe access to the North Coast Railway Line and the minimisation of noise and dust impacts associated with rail movements arising from the Proposal.

The Applicant's initial discussions with the ARTC have established that the adoption of industry best practice safeguards and operating procedures for the Proposal would assist to achieve acceptable outcomes for the despatch of the product coal to the Port of Newcastle.

5.4 SURFACE WATER

WRM Water and Environment Pty Ltd has provided the following overview of the existing environment which reflects the results of both a literature review, field investigations and the Applicant's program of surface water monitoring conducted to date.

5.4.1 Existing Environment

The Mine Area is situated to the east and north of Waukivory Creek, a tributary of Avon River, which is itself a tributary of the Gloucester River. Further downstream, the Gloucester and Barrington Rivers join, eventually feeding into the Manning River which flows eastward to the coast. **Figure 3.1** displays the catchments of both Waukivory Creek and the Avon River.

The catchment area of the Avon River to the Gloucester River confluence, approximately 5km downstream (north) of the Mine Area, is approximately 290km² whilst the total catchment of the Manning River is approximately 8 190km² (see **Figure 3.1**).

The local catchments within the Mine Area are relatively small and the flow in local gullies is ephemeral. A number of small farm dams are constructed across these gullies collecting flows before they enter Waukivory Creek and the Avon River (see **Figure 3.2**).

The Overland Conveyor Corridor traverses Waukivory Creek and the Avon River, whilst the Rail Load-out Facility is located to the west of these watercourses. The existing topography within the Rail Load-out Facility area provides an easterly-flowing drainage system in that area.

The nearest streamflow gauge is located on the Avon River (GS208028) adjacent to the Mine Area, downstream of the Waukivory Creek confluence (see **Figure 3.1**). This gauge has been operated by the NSW Office of Water since September 2004 and has a catchment area of 225km². The flow records at this gauge indicate that baseflow tends to persist over long periods. With the exception of prolonged dry periods, flows generally exceed 20ML/day. This is likely due to groundwater inflows from the alluvial aquifers adjacent to the Avon River and its tributaries. **Figure 5.4** displays the 1 in 100 year flood level for both the Avon River and Waukivory Creek.

The Avon River catchment defines the Avon River Water Source, which is part of the Water Sharing Plan for the Lower North Coast Unregulated and Alluvial Water Sources. Water use from the Avon River Water Source makes up 2.2% of the total Manning Extraction Management Unit Entitlement.

Surface water in the Gloucester area is used mainly for irrigation. A total of 43 surface water licences have been granted from the water source, with a total entitlement of 1 997ML/year (Avon River Water Source Report Card – August 2009). Peak daily demand is estimated to be 26.3ML/day, which is in excess of available summer flow. It is noted that the Gloucester town water supply is drawn from the Barrington River.

In addition, one 20ML/year groundwater licence has been granted for irrigation. Alluvial groundwater extraction in this area can potentially impact on surface water flows in the adjoining streams.

Regular surface water monitoring has been undertaken since July 2010 at 11 sites within and surrounding the Site to fully understand the existing water quality in the various watercourses and dams. Surface water grab samples have been collected on a monthly or quarterly basis with some opportunistic samplings at the locations shown in **Figure 5.4** and analysed at a NATA-accredited laboratory for the following parameters.

- pH, EC, TDS, Suspended Solids, Turbidity, SAR
- Major ions (Cl, SO₄, Ca, Mg, Na, K, Si, F, Alkalinity)
- Heavy Metals (Ag, Cd, Cr, Cu, Pb, Mn, Ni, Se, Zn, Fe)
- Nutrients (NO₂, NO₃, Total N, Total P)
- Oil and Grease, C Fractions, TPH(u)/BTEX Surrogates, E. coli, Coliforms

Additional routine sampling commenced in August 2011 at location Waukivory Upstream (US)/2, and in September 2011 within Dams 1, 2 and 3 within the Rail Load-out Facility (on the former Boral property) and upstream within the Avon River (Upper Avon AGL).

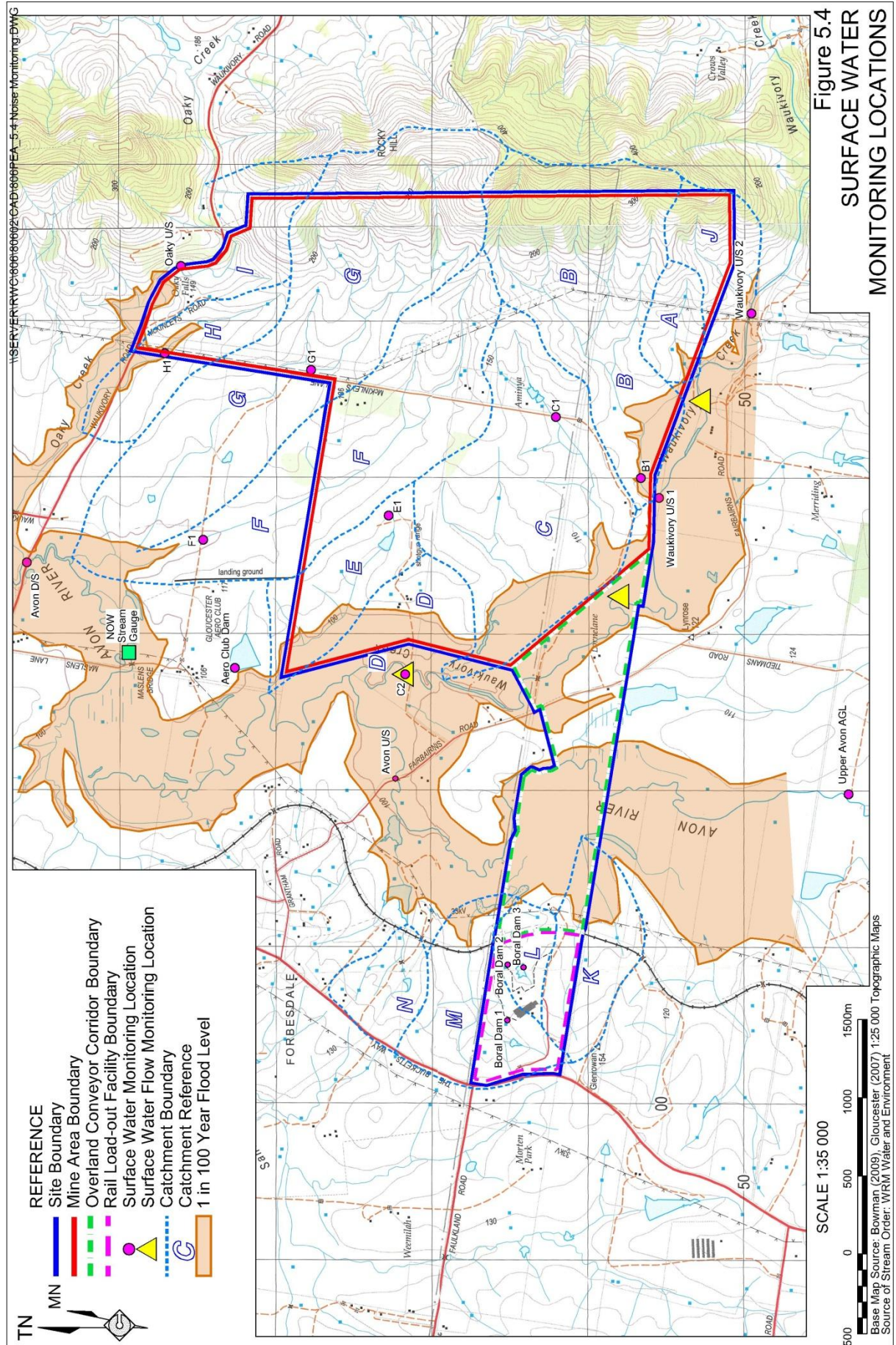


Figure 5.5 shows that when most samples were collected, there had been low flow conditions in the downstream reaches of the Avon River and Waukivory Creek. However, samples taken on 2 December 2010, 18 April 2011, 1 June 2011 and 14 December 2011 were during high flow conditions.

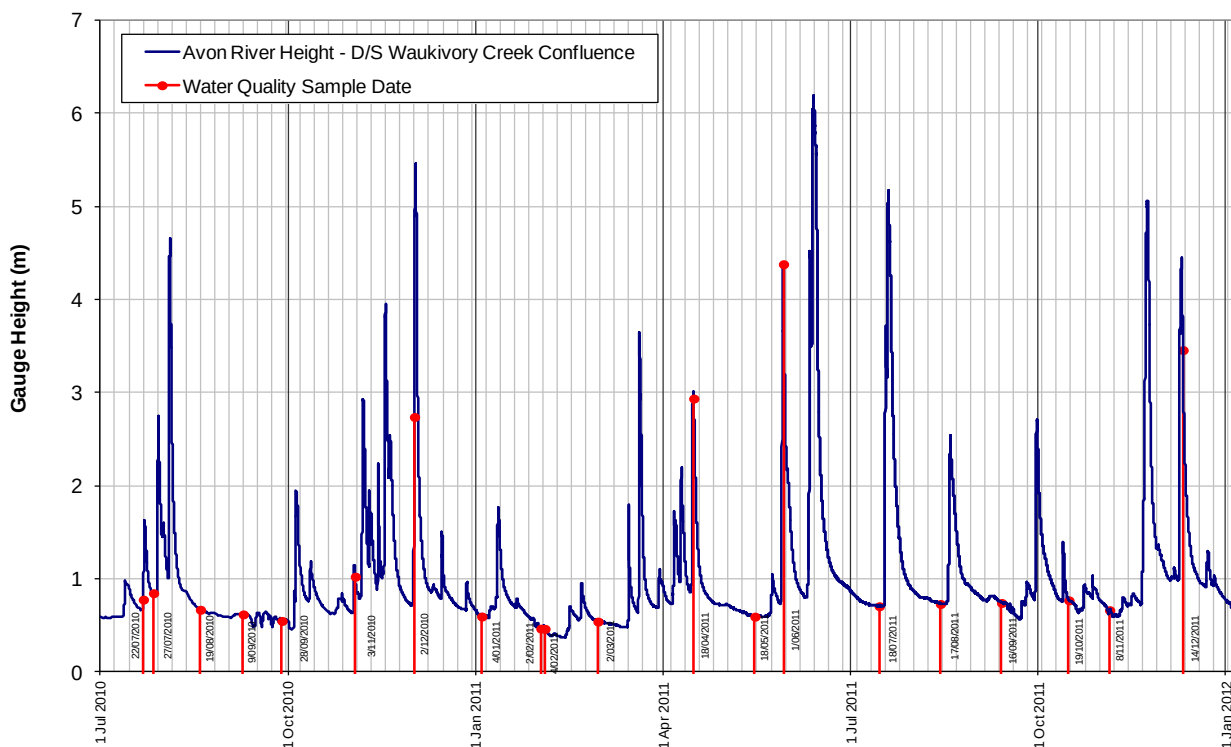


Figure 5.5 Co-Incident Flow Conditions in Avon River at Sampling Times

The results of the analyses for the key analytes of interest are summarised in **Table 5.4**. The NSW Water Quality Objectives (WQOs) for aquatic ecosystems protection in upland rivers of the Manning River catchment or other relevant water quality objectives are also shown for comparison.

Table 5.4
Surface Water Quality Summary Table

Sample Location [#]	pH (pH Unit)		Electrical Conductivity (µS/cm)		Suspended Solids (mg/L)		Turbidity (NTU)	
	Range	Av.	Range	Av.	Range	Av.	Range	Av.
<i>Water Quality Objective</i>	6.5-8.0		30-350		<5-29		2-25	
B1	6.8-8.3	7.4 (15)	213-906	563 (15)	6-1210	111 (15)	3.9-64.5	73.8 (14)
C1	5.9-7.0	6.5 (2)	470-609	540 (2)	4-15	10 (2)	9.9	9.9 (1)
C2	6.9-7.6	7.2 (14)	106-477	338 (14)	<5 - 76	16 (14)	1.5-79.4	19.4 (13)
E1	6.5-8.6	7.2 (15)	78-215	144 (15)	8-548	75 (15)	3.5-95.0	24.6 (14)
F1	6.6	6.6 (1)	390	390 (1)	64	64 (1)	~	~
G1	7.3-7.7	7.6 (3)	257-868	543 (3)	8-26	19 (3)	13.9-70.1	42.0 (2)
Oaky Upstream*	6.8-7.6	7.3 (16)	138-437	309 (18)	2-55	12 (16)	1.0-44.5	10.6 (15)
Waukivory Upstream 1*	6.8-8.0	7.5 (18)	125-563	348 (16)	<5-28	10 (16)	1.1-59.8	13.0 (15)
Waukivory Upstream 2	7.6-7.8	7.7 (4)	164-416	327 (4)	<5-13	6 (4)	0.6-42.5	12.9 (4)
Avon Upstream*	6.6-7.6	7.1 (15)	108-567	320 (15)	4-75	19 (17)	1.8-103.0	25.5 (14)
Avon River - Midstream*	7.6	7.6 (1)	371	371 (1)	80	80 (1)	~	~
Avon Downstream*	6.6-7.7	7.2 (16)	111-596	367 (16)	<5-99	22 (16)	1.3-104.0	24.2 (15)
Boral Dam 1	6.8-7.3	7.1 (4)	70-127	101 (4)	8-38	19 (4)	4.3-33.2	16.3 (4)
Boral Dam 2	5.1-6.0	5.6 (4)	66-122	100 (4)	12-140	50 (4)	4.0-88.5	29.2 (4)
Boral Dam 3	6.3-7.1	6.7 (4)	91-131	106 (4)	12-22	18 (4)	1.1-24.4	11.9 (4)
Upper Avon AGL	6.8-7.1	6.9 (2)	207-534	371 (2)	10-38	24 (2)	5.0-69.3	37.2 (2)
Sample Location [#]	TDS (mg/L)		Iron (mg/L)		Coliforms		Sulfate (mg/L)	
	Range	Av.	Range	Av.	Range	Av.	Range	Av.
<i>Water Quality Objective</i>	18-207 (based on TDS = 0.59xEC)		0.3 (low reliability ANZECC guideline)		< 1000 faecal coliforms per 100 mL (secondary contact recreation WQO)		250 (ANZECC drinking water guideline)	
B1	173-470	334 (15)	0.22-1.98	1.06 (15)	100-2920	NA	<1-40	23 (15)
C1	314-364	339 (2)	0.47-0.65	0.56 (2)	2400	NA	52-87	70 (2)
C2	150-292	212 (14)	0.56-4.40	1.45 (14)	<18-3130	NA	2-12	7 (14)
E1	71-502	164 (15)	1.35-7.21	3.75 (15)	<18-8840	NA	<1-<10	3 (15)
F1	422	422 (1)	3.71	3.71 (1)	~	~	11	11 (1)
G1	225-448	314 (3)	0.83-3.47	1.76 (3)	560-1100	NA	14-36	26 (3)
Oaky Upstream*	100-294	202 (16)	0.12-2.18	0.68 (16)	<18-2130	NA	<1-25	12 (16)
Waukivory Upstream 1*	116-364	214 (16)	0.30-14.10	2.12 (16)	<100-3600	NA	2-100	19 (16)
Waukivory Upstream 2	158-236	209 (4)	0.26-2.51	0.90 (4)	18**-470	NA	3-12	9 (4)
Avon Upstream*	118-338	211 (15)	0.56-2.88	1.55 (15)	<18-2430	NA	<1-37	10 (15)
Avon River – Midstream*	330	330 (1)	3.34	3.34 (1)	~	~	18	18 (1)
Avon Downstream*	155-378	248 (16)	0.76-2.97	1.45 (16)	<18-1200	NA	<1-26	12 (16)
Boral Dam 1	83-172	114 (4)	0.70-3.94	2.15 (4)	<18-180	NA	<1-<5	1 (4)
Boral Dam 2	210-346	279 (4)	5.56-7.89	6.51 (4)	18**-630**	NA	<1-5	3 (4)
Boral Dam 3	75-142	98 (4)	0.53-3.22	1.60 (4)	<18-440	NA	<1-4	1 (4)
Upper Avon AGL	240-300	270 (2)	1.49-3.55	2.52 (2)	150**-270	NA	5-24	15 (2)
# See Figure 5.4 for Sample Locations								
* Receiving water quality sample sites								
** Estimate only								
Note: Figures in () represent the number of samples collected and analysed.								
NA – Not Applicable								



The surface water monitoring results to date indicate the following.

- Receiving water quality was reasonably consistent between the Avon River, Waukivory Creek, and Oaky Creek monitoring locations. Total dissolved solids (TDS) levels ranged between 100mg/L and 380 mg/L and as such are considered “fresh” as displayed in **Table 5.5**. pH values were close to neutral (between 6.6 and 8.0). Turbidity and suspended solids levels were generally low (<1NTU and <10mg/L respectively) under low flow conditions, but elevated (up to 104NTU and 99mg/L) during the high flow events sampled on 2 December 2010, and 18 April, 1 June and 14 December 2011.

Table 5.5
Salinity and TDS Ranges

Salinity	TDS (mg/L)
Fresh	<500
Slightly brackish	500 to 1 000
Brackish water	1 000 to 3 000
Moderately saline	3 000 to 7 000
Saline	7 000 to 14 000
Highly saline	14 000 to 35 000
Brine	>35 000

- The WQOs for electrical conductivity, suspended solids and turbidity were all exceeded at most sampling locations from time to time.
- Oaky Creek and Waukivory Creeks had generally better water quality than the Avon River.
- Samples taken in the gullies across the mining lease indicate slightly higher salinities (electrical conductivities) and TDS values than in the receiving waters.

Water quality results for samples collected in May 2010 by Coffey Environment from dams within the former Boral timber mill site within the proposed Rail Load-out Facility display elevated nutrient and some heavy metal levels. During further water quality monitoring conducted in 2011, the elevated nutrient and heavy metal (iron, manganese, zinc, etc.) continued to be consistently above other monitored sites such as in Waukivory Creek and the Avon River. The management of this water, together with the results of all water quality monitoring undertaken by GRL will be included in the *Environmental Impact Statement* for the Proposal.

5.4.2 Key Surface Water Management Issues and Preliminary Assessment

The key surface water management issues relate to the avoidance of impacts associated with the flood plains of the Avon River and Waukivory Creek and prevention of sediment-laden water flowing into Waukivory Creek or the Avon River, the diversion of up-slope runoff east of the Mine Area and ensuring any discharge water is of an acceptable quality.

A comprehensive suite of surface water and erosion control structures would be required on the Site to ensure as much water as possible can be diverted around areas of disturbance and sediment-laden water is collected and contained on site. All structures would be designed in accordance with the latest version of the Managing Urban Stormwater: Soils and Construction Handbook (DECCW, 2008). The final landform would be designed to generally re-create the existing drainage catchments as closely as possible.

The surface water to be captured and used on site would be undertaken with recognition of the Maximum Harvestable Rights Dam Capacity (MHRDC) for the Applicant's aggregated landholding. Water licences would be obtained for the surface water collected and used in excess of the MHRDC entitlement.

It is assessed that such controls can be designed and implemented such that the overall impact on the surface water resources would be acceptable.

5.5 GROUNDWATER

Australasian Groundwater and Environmental Consultants Pty Ltd has provided the following description of the existing hydrogeological setting based largely upon a literature review and the preliminary groundwater investigations undertaken to date within the Mine Area.

5.5.1 Existing Environment

5.5.1.1 Aquifer Systems

Three distinct aquifer systems are present within and surrounding the Site, namely:

- Permian coal seam aquifers;
- shallow weathered bedrock (regolith) aquifers with associated colluvial deposits; and
- shallow alluvial aquifers associated with the flood plains of Waukivory Creek and the Avon River.

The systems are invariably related to the geological setting previously described in Section 3.2.

The coal seams are the main continuous aquifers throughout the Gloucester Basin. The Permian strata can therefore be further categorised into the following hydrogeological units.

- Hydrogeologically "tight" and hence very low yielding to essentially dry sandstone and lesser siltstone that comprise the majority of the Permian overburden/interburden.
- Low to moderately permeable coal seams which are the prime water-bearing strata within the Permian coal measures sequence.

The coal seams are recharged by direct rainfall in subcrop areas or via leakage from the regolith or overlying colluvial deposits. The pristine water table surface is a subdued reflection of the topography. Groundwater levels in higher elevated areas of the Mine Area vary from between approximately 5m and 15m below the surface whereas Waukivory Creek and Avon River groundwater levels below the flood plains vary between 0m and 5m. Groundwater flow is to the west-northwest with potential for discharge to the basal alluvial aquifer along the creek/river system via fractured overburden.

The coal seams are extensively faulted which is understood to have compartmentalised groundwater flow. The hydraulic parameters of the coal seams can vary over a number of orders of magnitude depending on the depth of burial of the seam and degree of jointing and cleat density.

Regolith/Colluvial Aquifer

Groundwater occurs in the weathered zone (regolith) and colluvial deposits. Colluvial deposits occur at the base of the steep slopes on the eastern side of the Mine Area along the margin of the basin, and also inter-finger with alluvial sediments at the edge of the flood plains.

The colluvial deposits, which are of higher permeability than the underlying coal seams, are recharged by rainfall and by runoff from the steep slopes and have been interpreted as the principal recharge source of the underlying coal seam aquifers.

Groundwater flow within the regolith and colluvium is from the margins of the basin to its centre, i.e. towards Waukivory Creek and the Avon River. Groundwater within the regolith has been reported to be brackish to saline.

Shallow Alluvial Aquifer

The unconfined shallow alluvial aquifer is associated with the alluvial floodplain deposits of the Avon River and Waukivory Creek which are of limited areal extent (see **Figure 5.6**). The alluvial boundary is invariably delineated by changes in the slope, with the boundary most evident adjacent to convex slopes and less evident adjacent to concave slopes (GSSE, 2011). The alluvial deposits are reported to comprise a sequence of silty sands, gravelly sands and clays and, in areas, the aquifer is known to yield sufficient quantities and quality of water for farm water supplies. The alluvial sediment comprises 4.0m to 6.5m of mixed gravels sitting on a siltstone basement. The gravels are overlain by 2m to 5m of clay and up to 1m of topsoil.

The majority of recharge to the shallow alluvial aquifer within and adjacent to the Mine Area is expected to be from direct infiltration of rainfall.

5.5.1.2 Groundwater Levels

Table 5.6 lists the groundwater levels recorded to date within the Site. Depths to the existing groundwater table across the Mine Area are all less than 15m.

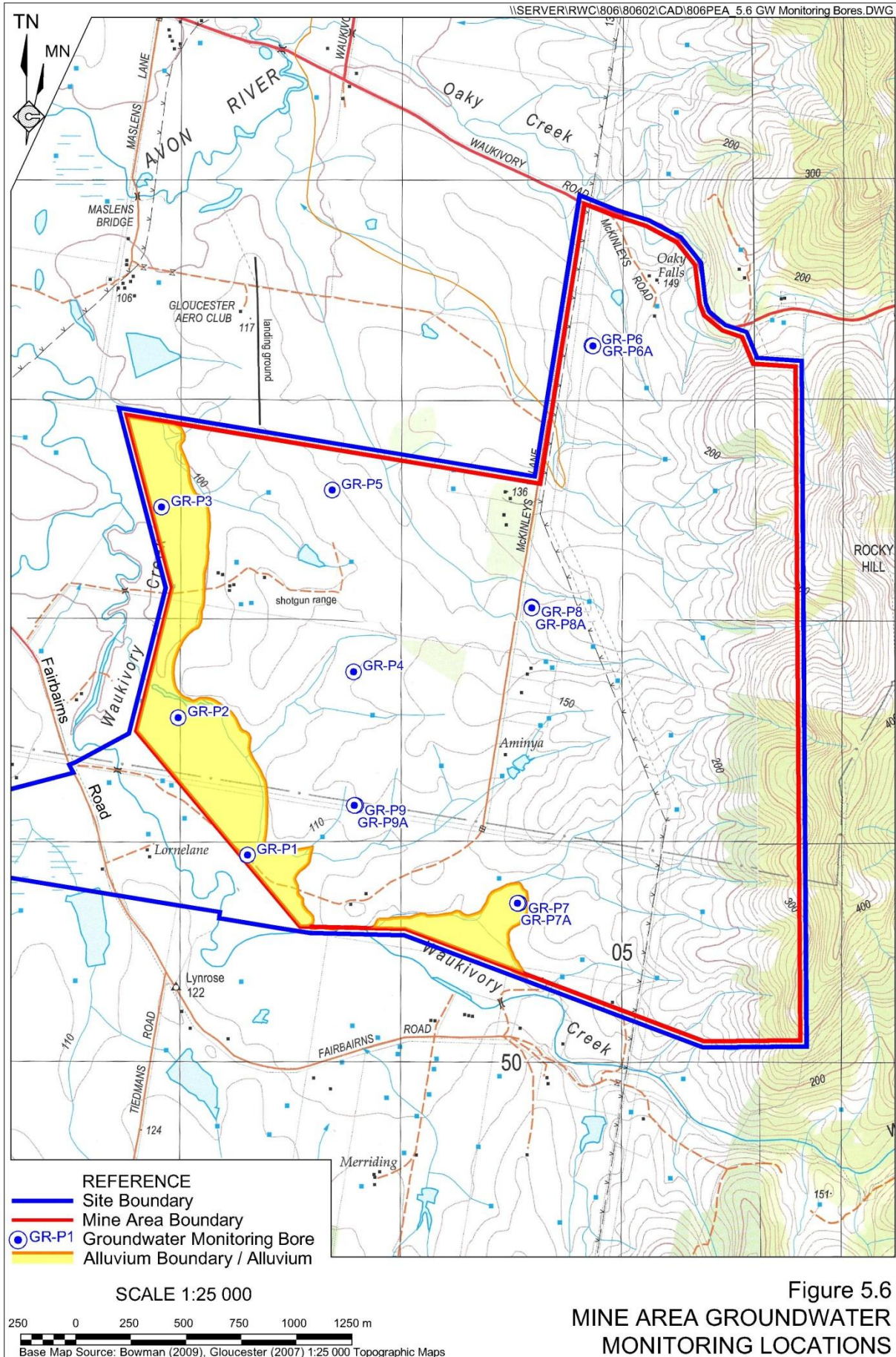


Figure 5.6
MINE AREA GROUNDWATER
MONITORING LOCATIONS

The groundwater table, and hence groundwater flow within the alluvial aquifer, is expected to be a subdued reflection of the topography and generally grade from the edge of the floodplain to the river. As such, the depth to the water table within the alluvial plain typically ranges between about 0.5m and 4m below ground level. Groundwater in the alluvium generally discharges into the creek and river. However, following dry periods, stream flow may also form a source of recharge to the shallow alluvial aquifer when groundwater elevations are lower than the base of either Waukivory Creek or the Avon River.

5.5.1.3 Groundwater Quality

Thirteen monitoring bores were installed for the groundwater study in February 2011. The bores were screened in alluvium, interburden or coal seam zones to allow collection of water samples from the key aquifer units. Water samples have been collected and analysed on a minimum monthly basis since March 2011 for the following suite of parameters.

- pH, EC;
- Major Ions (Ca, Mg, Na, K, Cl, SO₄, Si, F, Alkalinity);
- Trace elements (As, Cd, Cr, Cu, Li, Pb, Mn, Ni, Se, Sr, Zn, Fe, B, Br); and
- Nutrients (NO₂, NO₃, Total P).

Eleven rounds of water sampling were completed between March and November 2011. The results of the analyses for each monitoring bore are summarised in **Table 5.6**.

The available pH data indicates a generally neutral water quality and little variation between the coal seam, overburden and alluvial aquifers. The exception is bore GR-P4, screened in the interburden, which yields slightly acidic samples.

Salinity in the alluvium is variable from slightly brackish to moderately saline (**Table 5.6**). Water samples from the interburden and coal seam monitoring bores also show variability from brackish to moderately saline. The recorded salinity results indicate that much of the groundwater is only of marginal use for stock, or is too saline.

The concentrations of nutrients are relatively low in all aquifers, except for one bore in the alluvium that is yielding slightly elevated concentrations of total phosphorus.

Sulfate and iron are elevated above the background in interburden bore GR-P4, likely due to the slightly acidic quality of the groundwater in this area.

Dissolved oxygen concentrations are between 1mg/L and 3mg/L, which are relatively high given groundwater in coal measures is commonly anoxic.

5.5.1.4 Hydraulic Conductivity

On-site testing has established that the hydraulic conductivity of the alluvium varies according to the proportion of gravel present. Typically, values vary between 50m/day to 150m/day. Immediately below the alluvium, hydraulic conductivity values range between 0.0015m/day and 0.6m/day with the difference largely attributable to localised fracturing.

The hydraulic conductivity values of the coal seams are highly variable ranging from 0.002m/day to 0.15m/day.

Table 5.6
Groundwater Depths and Quality Summary Table

ID	Geology	Depth to Water Table (m)		Field pH (pH Unit)		Field Electrical Conductivity (µS/cm)		Total Phosphorus (mg/L)	
		Range	Av.	Range	Av.	Range	Av.	Range	Av.
GR-P1	Alluvials	2.7-3.8	3.2	5.9-7.1	6.5	5000-6450	5812	0.03-0.26	0.1
GR-P2	Alluvials	-0.3-1.4	0.7	6.0-7.0	6.4	1003-1885	1327	0.01-0.14	0.1
GR-P3	Alluvials	1.5-2.3	1.9	6.4-7.1	6.7	3110-3880	3545	0.01-0.03	0.2
GR-P4	Interburden	5.8-6.1	6.0	5.3-6.4	6.0	5870-7480	6665	0.03-0.25	0.1
GR-P5	Interburden	13.5-13.8	13.7	6.1-7.0	6.5	2940-4400	3441	0.11-0.41	0.2
GR-P6	Interburden	1.8-2.9	2.4	6.8-7.8	7.1	2470-2810	2584	0.01-0.19	0.1
GR-P6A	Coal	7.6-10	8.8	7.1-11.9	7.9	2800-5230	4719	0.03-0.12	0.1
GR-P7	Alluvials	-0.1-1.4	0.2	6.0-7.4	7.1	1228-1357	1289	0.06-4.82	0.9
GR-P7A	Coal	-0.6-0.7	-0.4	6.2-7.3	6.9	3150-3900	3575	0.03-0.31	0.2
GR-P8	Interburden	7.2-7.9	7.6	6.6-7.5	7.0	3710-5700	4345	0.01-0.14	0.1
GR-P8A	Coal	4.4-6.2	5.2	6.9-7.6	7.2	5020-6550	5627	0.02-0.18	0.1
GR-P9	Interburden	8.4-9.8	9.5	6.3-7.2	6.8	4170-6840	6173	0.03-0.61	0.2
GR-P9A	Coal	7.8-9	8.4	6.3-6.9	6.6	3650-6400	4196	0.03-0.38	0.2
ID	Geology	Sulfate (mg/L)		Iron (mg/L)		Nitrate (mg/L)		Dissolved Oxygen (mg/L)	
		Range	Av.	Range	Av.	Range	Av.	Range	Av.
GR-P1	Alluvials	45-68	60.6	0.13-1.42	0.7	0.01-0.14	0.03	0.62-2.95	1.7
GR-P2	Alluvials	17-24	20.4	0.08-2.02	1.0	0.01-0.72	0.10	0.82-2.90	1.8
GR-P3	Alluvials	40-70	61.2	0.2-0.94	0.5	0.02-0.09	0.06	0.43-2.36	1.6
GR-P4	Interburden	592-1000	792.1	171-364	290.2	0.01-0.12	0.03	0.62-2.40	1.3
GR-P5	Interburden	176-348	262.1	4.59-33.8	22.8	0.02-0.14	0.06	0.81-2.21	1.5
GR-P6	Interburden	28-43	35.8	0.06-1.84	1.0	0.01-0.50	0.25	1.02-3.05	1.9
GR-P6A	Coal	37-373	289.0	0.05-4.07	1.4	0.02-0.50	0.16	1.50-4.9	1.9
GR-P7	Alluvials	38-153	91.0	0.06-5.50	1.2	0.01-0.08	0.04	0.73-3.90	2.1
GR-P7A	Coal	34-131	80.3	0.14-3.10	1.6	0.02-0.48	0.19	1.01-4.80	2.1
GR-P8	Interburden	12-139	45.4	0.16-1.81	0.8	0.01-0.06	0.03	0.81-2.85	1.9
GR-P8A	Coal	2-196	35.7	0.11-2.31	0.8	0.01-0.03	0.02	0.68-2.20	1.5
GR-P9	Interburden	257-411	346.8	2.14-14.2	3.8	0.01-0.07	0.04	0.78-2.44	1.4
GR-P9A	Coal	277-543	366.1	1.42-14.3	10.1	0.01-0.05	0.03	0.66-2.15	1.4

Source: Carbon Based Environmental Pty Limited

* See **Figure 5.6** for Sample Locations

5.5.1.5 Registered Bores

A search of the NSW Natural Resource Atlas indicates that there are no registered groundwater bores within 1km of the Mine Area or Rail Load-out Facility. The closest registered groundwater bore is approximately 1.2km west of the Mine Area.

5.5.2 Key Groundwater Management Issues and Preliminary Assessment

The key groundwater management issues will relate to the management and minimisation of any groundwater inflows into the open cuts from the alluvial aquifer or loss of baseflows to Waukivory Creek or surrounding groundwater users.



The groundwater assessment for the Proposal would therefore include the following.

- Identification of groundwater resources which could potentially be impacted.
- An assessment of potential impacts of the Proposal during and post operations.
- An assessment of any cumulative impacts with surrounding industries.
- Identification of required impact mitigation measures during and post operations.

A detailed hydrogeological model is currently being prepared that will enable each of the above impacts to be established.

5.6 VISIBILITY

Richard Lamb & Associates has undertaken a preliminary assessment of the Site and its surrounds to identify visual opportunities and constraints with regard to visual exposure and visual character.

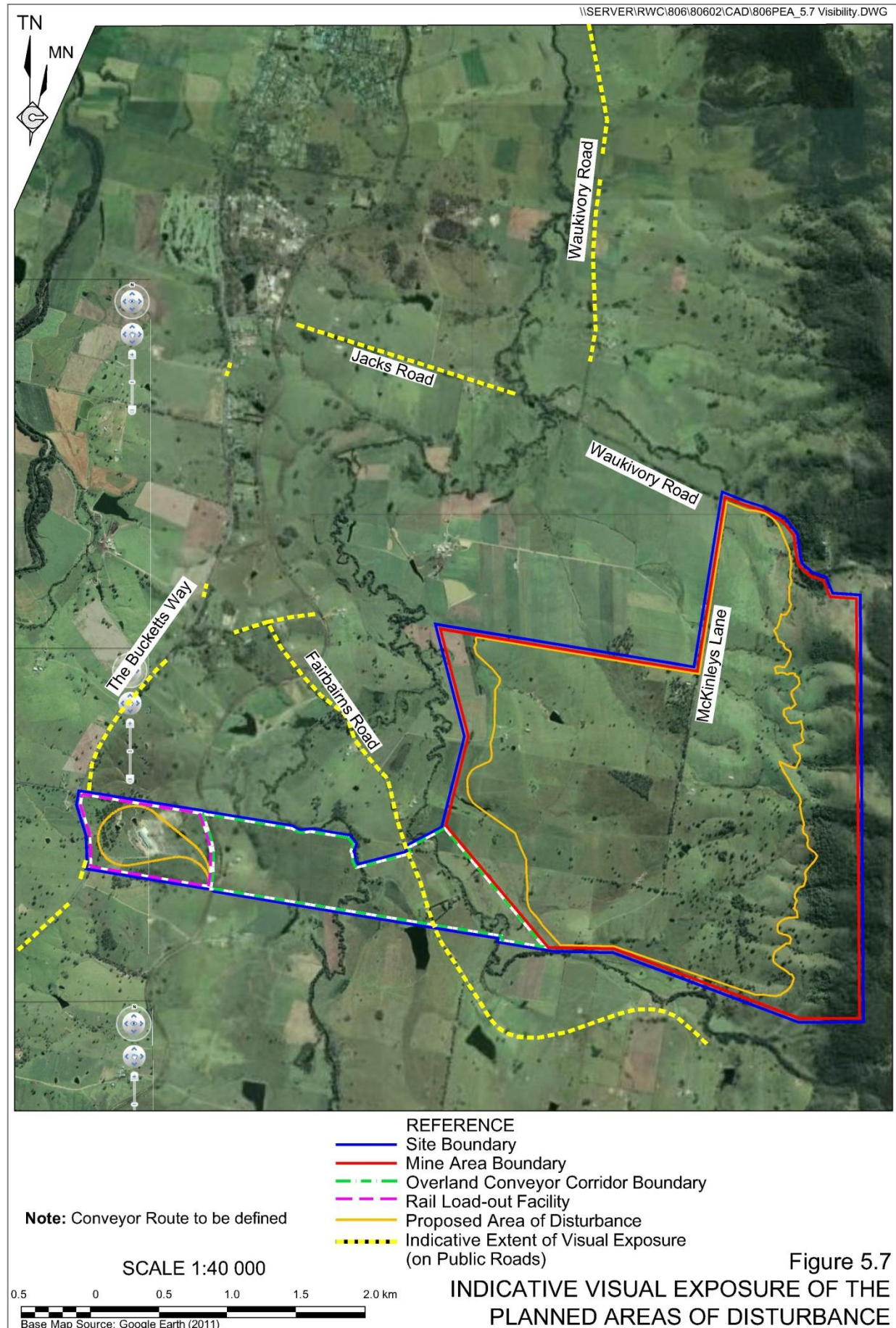
5.6.1 Existing Environment

The existing visual landscape around the Site is defined by the steep linear hills and ridges that confine the various river valleys and the agricultural activities on the valley floors within the Stroud – Gloucester Valley. These features combine to form landscapes that range from moderate to high scenic quality. Historically, the Stroud – Gloucester Valley landscape has been assessed to have both visual and heritage significance and at times has been referred to as the “Vale of Gloucester” given its similarity to a landscape of that name in Britain (Smith, 2011).

The visual catchment is confined by the same features which determine the structure of the physical landscape. The boundary hills also confine the north-south orientation of the drainage and transport corridors. The Mine Area, being located on the eastern side of the valley is, to varying degrees, exposed to views from The Bucketts Way, itself also located on a lower north-south ridge within the Stroud – Gloucester Valley. Although Gloucester is only 3.5km to 7km from the Mine Area, intervening topography and vegetation prevents significant visual exposure from most areas within and on the outskirts of the township.

Components of the Site are variously exposed to obstructed or unobstructed views from sections of The Bucketts Way between its intersection with Jacks Road and a point approximately 3.5km to the south. Components of the Site are also visible from local roads, generally to the west and south, such as Grantham Road, Fairbairns Road, Angophora Road, Maslens Lane; from Jacks Road to the northwest and from Waukivory Road to the north. A comprehensive site investigation of the potential visibility issues relating to the Mine Area, Overland Conveyor Corridor and Rail Load-out Facility has commenced with the outcomes to be included in the Environmental Impact Statement.

Figure 5.7 presents the indicative extent of visual exposure of the planned areas of disturbance within the Site.



5.6.2 Key Visual Issues and Preliminary Assessment

The main visual exposure in the public domain is to The Bucketts Way. Although the sections of The Bucketts Way from which unobstructed views are possible are relatively short, it is a high sensitivity viewing location because of the number of viewers that travel through those sections and their likely high expectation for scenic quality. It is noteworthy that distant views (>1.5km) of parts of the coal mining operations near Stratford are available from The Bucketts Way, albeit not being excessive due to the colour of the exposed materials and infrastructure. Local roads are considered less significant public domain locations because of the low volumes of traffic, but will be closely considered.

Overall, there is a minor exposure of the Site to private views. The most significant concentration of private views is in the Grantham Road/Fairbairns Road area of the Forbesdale rural-residential area from which a limited number of residents will have unimpeded views towards exposed areas of the Site. It is the views from this area that have influenced the location and design of the three visibility barriers within the Mine Area.

Consideration of both the public domain and private views has already been a major factor in the formulation of the preliminary design of the Mine Area. Emphasis has been placed upon minimising the views of operational areas during the life of the Proposal and the creation of a final landform that is compatible with and aesthetically acceptable in the long term visual landscape. The Applicant is currently undertaking tree planting on Company-owned land within and external to the Site to soften the views of the required visibility barriers as they are constructed and vegetated, and to shield views of much of the mining activities. The use of the land east of the proposed open cut pits for overburden emplacement is also proposed given it is more distant from both the public and private domain viewing locations and, more importantly, provides the opportunity to progressively construct and revegetate a more aesthetically pleasing final landform. Emphasis would be placed upon ensuring the final landforms trend in a similar manner to the existing surrounding topography.

It is concluded that the Proposal as currently planned is capable of achieving a satisfactory level of compatibility with the existing visual landscape and being undertaken in a manner which minimises visual impact.

5.7 TERRESTRIAL ECOLOGY

Between June 2010 and January 2012, desktop studies and field investigations were undertaken by Ecotone Ecological Consultants within and surrounding the Site (i.e. "the Study Area"), i.e. an area covering approximately 1 990ha. Field investigations were carried out to identify known or likely threatened species, populations, ecological communities or other matters relating to local biodiversity that may need to be addressed or considered in a further and more detailed impact assessment.

5.7.1 Existing Environment

Flora

Figure 5.8 displays the distribution of the five vegetation communities identified within the study area.

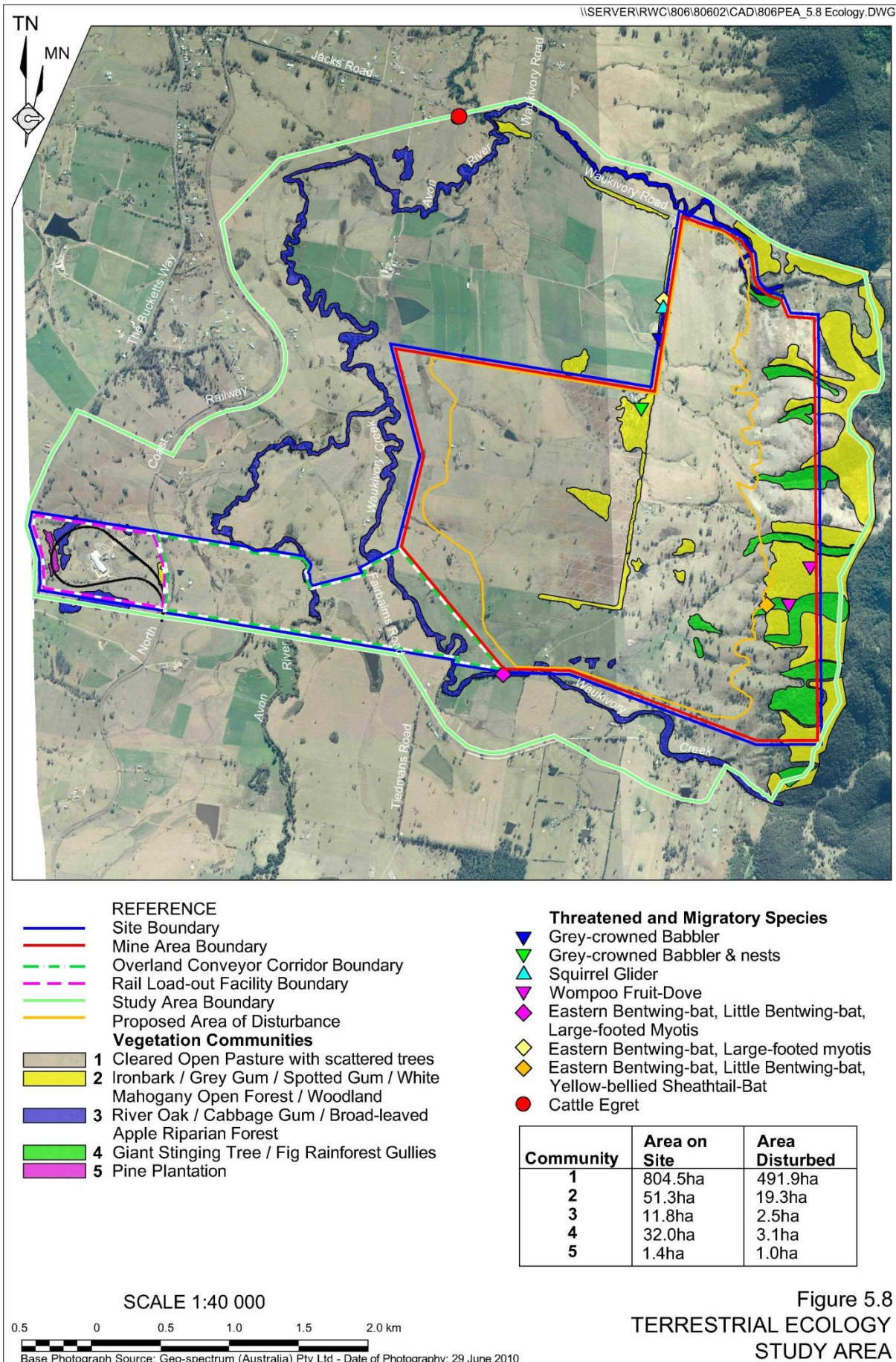


Figure 5.8
TERRESTRIAL ECOLOGY
STUDY AREA

The dominant vegetation community throughout the Site is Cleared Open Pasture with scattered trees (Community 1) which includes a mixed ground layer of native and introduced pasture grasses and herbaceous weeds. This community accounts for in excess of 90% of the vegetation across the Site.

Three remnant natural vegetation communities occur within and surrounding the Site, with varying levels of disturbance, such as tree and understorey clearing, grazing, burning in each.

Community 2: Ironbark / Grey Gum / Spotted Gum / White Mahogany Open Forest/Woodland.

Community 3: River Oak / Cabbage Gum / Broad-leaved Apple Riparian Forest.

Community 4: Giant Stinging Tree / Fig Rainforest Gullies.

The smallest vegetation community which comprises an introduced pine plantation (Community 5) covering 1.4ha, contains a few isolated remnant native eucalypt trees.

The natural vegetation within and surrounding the Site is highly modified with most having been cleared to provide pasture for cattle grazing. Small remnants of natural vegetation remain in the central and eastern parts of the Mine Area, albeit in a disturbed condition. These consist of linear strips of remnant natural vegetation on both sides of the road surface within the 20m wide easement for McKinleys Lane, two small remnant patches in the northern part of the Mine Area and small remnants adjacent to the drainage lines in the southeastern part of the Mine Area. The Overland Conveyor Corridor and Rail Load-out Facility area include small remnants of riparian vegetation and the pine plantation (see **Figure 5.8**).

Much larger areas of intact natural vegetation have been retained in the steeper elevated land to the east of the proposed Mine Area on and adjacent to Rocky Hill. However, cattle grazing occurs in these areas, and parts of the lower slopes have been partially cleared, burnt or under-scrubbed. Full clearing of the native vegetation and conversion to open pasture has previously been carried out up to and over the ridge-top in some areas.

Noxious and environmental weeds are scattered throughout the Site at a low to moderate density.

Fauna

Eight fauna habitat types are present within the study area. The first four habitat types correspond with Vegetation Communities 1 to 4 whilst habitat types 5 to 8 represent localised areas typically within or adjacent to cleared open paddocks (Community 1).

1. Cleared Open Paddocks

The cleared open paddocks typically comprise native and introduced grasses and forbs and provide an important foraging area for many species of bird and larger terrestrial mammal species such as the eastern grey kangaroo.

2. Ironbark/Grey Gum/Spotted Gum/White Mahogany Open Forest/Woodland

The main remnant patches occur near and adjacent to McKinleys Lane. This habitat provides refuge for woodland birds and arboreal mammal species and shelter for macropods currently frequenting the cleared areas within the proposed Mine Area. Some patches of this vegetation have been grazed, harvested for timber or burned.

3. River Oak/Cabbage Gum/Broad-leaved Apple Riparian Forest

The riparian habitat extends the length of most of the Avon River, Waukivory Creek and Oaky Creek while small isolated patches of this community are located within the small ephemeral drainage lines in the proposed Rail Load-out Facility area. This habitat type may support a range of species that use the vegetation adjacent to rivers and small streams for foraging, refuge and roosting.

4. Giant Stinging Tree/Fig Rainforest Gullies

The rainforest habitat is generally restricted to the upper slope wet gullies and drainage lines although there are some small remnant patches on the lower slopes of Rocky Hill. The rainforest habitat is dark and moist and may support a range of species that typically use rainforest areas for foraging and refuge. Within some parts of this habitat, rock crevices and tree hollows were present (ranging in size) and may provide potential refuges for arboreal mammals, ground dwelling mammals and micro bats. This habitat type has been affected by fragmentation through years of burning and grazing and there is some edge impact from pioneer weed species, particularly in the isolated remnants.

5. Farm Dams

Most farm dams are vegetated around the perimeter with cumbungi and phragmites and provide good habitat for some amphibians and foraging habitat for micro bats and water birds.

6. Rivers and Creeks

The small to large pondages with stream riffles, some with an abundance of debris such as logs, may support a range of species such as platypus, aquatic reptiles such as turtles and water dragons.

7. Bridges/Culverts

The bridges and culverts within the study area range from concrete to composite, i.e. timber and concrete, to timber structures. These bridges provide roosting habitats for micro bats, and refuge for reptiles such as pythons and small lizards.

8. Paddock Trees/Dead Stags

Paddock trees provide roosting habitat for micro bats, birds and arboreal mammals. The majority of the dead stags are in a reasonable state of decay and provide an abundance of hollows and fissures.

A total of 73 species of vertebrate fauna were positively identified during the field survey, including seven species of frogs, five reptiles, 18 mammals and 43 species of birds. Of these species, eight are listed as vulnerable under the TSC Act. One of the species recorded (Cattle Egret) is listed under the EPBC Act as migratory. Targeted surveys for the Giant Barred Frog within the study area have been unsuccessful. Further details on threatened fauna species are provided in Section 5.7.2.

5.7.2 Issues of Conservation Significance

Flora

One vegetation community, the Giant Stinging Tree/Fig Rainforest Gullies, which occurs within the gullies on the eastern side of the Mine Area and largely beyond the proposed area of disturbance, corresponds with the Vulnerable Ecological Community, Lower Hunter Valley Dry Rainforest listed within the *NSW Threatened Species Conservation Act 1995*.

No threatened flora species or endangered populations were recorded within the study area and no Threatened Ecological Communities listed within the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* are considered to occur in the study area.

Fauna

The field surveys identified eight threatened fauna species which are listed within the NSW TSC Act. In addition, the Cattle Egret (although not a threatened species) is listed as migratory under the EPBC Act and was observed in open pasture within the study area, albeit removed from the proposed area of disturbance (**Figure 5.8**). Potential habitat for many of the threatened species recorded was identified within the study area.

The vegetation corridor adjacent to the northern section of McKinleys Lane provides known habitat for five threatened fauna species namely, the Squirrel Glider, the Grey-crowned Babbler, the Eastern Bentwing-bat, the Little Bentwing-bat and the Large-footed Myotis. This section of vegetation would not be directly disturbed north of the office and amenities during the life of the Proposal as the Applicant intends to construct the mine access road to the east to avoid clearance of this habitat area.

The rainforest gullies and surrounding open forest/woodland on the slopes to the east of the proposed Mine Area provide potential habitat for a range of threatened species such as the Wompoo Fruit-Dove and the Spotted-tailed Quoll. In addition, the Yellow-bellied Sheath-tail-bat was identified as a “probable” species in this locality from ultrasonic call analysis.

The riparian areas of Waukivory and Oaky Creeks and the Avon River are likely to provide a corridor function in the landscape for many fauna species.

5.7.3 Key Ecological Issues and Preliminary Assessment

The majority of the disturbance throughout the mine life would occur within the cleared open pasture with paddock trees. The Proposal would, however, result in the removal of approximately 25ha of native vegetation comprising 19ha of an open forest/woodland (Community 2), 3ha of a rainforest community (Community 4) and 3ha of a riparian forest

(Community 3). Habitats adjacent to the area of proposed mining and related operations may also be subject to disturbance attributed to noise, dust and movement of machinery and people, and may become unsuitable for sensitive fauna species during the life of the operations.

Offsets would be provided for the native vegetation cleared or modified and are available in the forested areas on the steeper land to the east of the Mine Area and along riparian creek line areas mainly in the western, northern and southern parts of the Mine Area.

The preliminary assessment of the Proposal upon the ecological values of the Site identifies that minimal impact would occur principally because:

- of the planned avoidance of direct impacts on known fauna habitat along McKinleys Lane;
- <25ha of remnant native vegetation would be removed; and
- an offset in perpetuity would be established.

5.8 AQUATIC ECOLOGY

Cardno Ecology Lab Pty Ltd commenced their initial desk-based studies and site reconnaissance within the Site and wider study area in October 2010, with a detailed field assessment conducted in mid-November 2010. Existing habitats, water quality characteristics and the aquatic flora and fauna of the study area were identified during the course of the field work. Cardno Ecology Lab Pty Ltd has also coordinated a study of the occurrence of stygofauna within the groundwater in the Mine Area.

5.8.1 Existing Environment

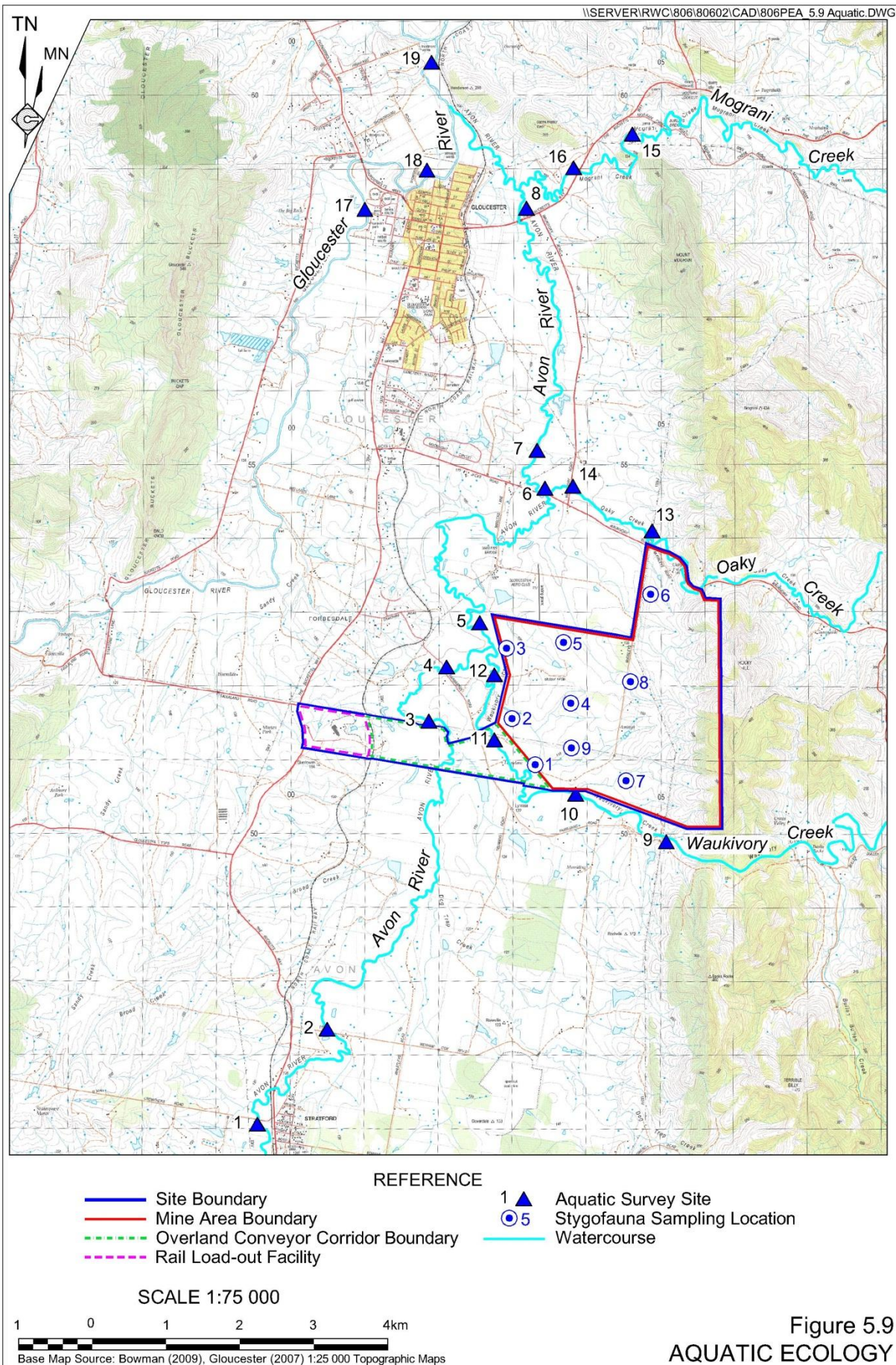
The aquatic ecology study area includes reaches of the following watercourses.

- Avon River upstream of its confluence with the Gloucester River.
- Waukivory Creek upstream of its confluence with the Avon River.
- Mograni Creek upstream of its confluence with the Avon River.
- Oaky Creek upstream of its confluence with the Avon River.
- Gloucester River immediately upstream and downstream of its confluence with the Avon River.

The study area also incorporated several small un-named drainage lines flowing westwards into and across the Mine Area from the hills to the east. Some farm dams were also inspected.

Figure 5.9 presents the location of the aquatic survey sites, stygofauna sampling sites, the extent of the wider study area and the Site.

Riparian and in-stream habitats across the study area were noted to be substantially degraded by historical and ongoing agricultural land use practices. Aquatic plants and macroinvertebrate assemblages within the study area were impaired and dominated by pollution-tolerant taxa.



Database and literature searches for threatened species indicated that no threatened species of fish or aquatic macroinvertebrates are likely to occur in the area.

The aquatic ecology of the three permanent watercourses within and adjacent to the Site is discussed below in terms of aquatic habitats, macroinvertebrates and fish. Sites at several other watercourses within the surrounding area were sampled concurrently to provide a reference of data for those sites that could potentially be affected by the Proposal.

Avon River

Macrophyte communities are present on the edges of all watercourses or submerged in pools. The macroinvertebrate assemblages observed were moderately to significantly impaired, reflecting existing pollution and/or local habitat degradation and were dominated by pollution-tolerant taxa, again indicating degraded conditions.

The Avon River contained moderate fish habitat. Seven species of fish and two crustaceans (freshwater shrimp and prawns) were recorded, with most sites yielding four or five species.

Waukivory Creek

Waukivory Creek supported approximately one half of the macrophytes observed in the Avon River. The assemblage of macroinvertebrates was moderately to significantly impaired, suggesting pollution and/or local habitat degradation. Waukivory Creek contained moderate fish habitat. The creek contained deep pools, undercut banks, some submerged woody debris and riffle habitat in upstream sections. Six species of fish were recorded. As in the Avon River, the fish assemblage was dominated by longfinned eels, gudgeons and mosquito fish. Freshwater shrimp and prawns were also common in Waukivory Creek.

Oaky Creek

Two sites were surveyed in Oaky Creek.

Aquatic habitat in Oaky Creek was highly to moderately degraded and observations indicated that the creek provided minimal fish habitat.

Stygofauna

Stygofauna comprise highly specialised aquatic macroinvertebrates and some fish that are adapted to living in groundwater habitats. They may exhibit high levels of endemism (i.e. species restricted to particular localities) and may function in the breakdown of organic material and assist in the transfer of water by burrowing. Previous studies have indicated stygofauna in alluvial aquifers tend to be present in greater diversity and abundance than in coal seam aquifers. The frequently high electrical conductivity (EC) of waters in the latter has been suggested as a cause of the lower proportion of stygofauna while waters with EC values exceeding 3000µS/cm are thought to be unsuitable for stygofauna.

Stygofauna were sampled advantageously within bore holes drilled throughout the Mine Area for monitoring groundwater levels and chemistry. In total, 37 samples were collected from groundwater within three types of aquifers (coal seam, interburden and alluvial) on three occasions. Stygofauna were sampled by pumping water from bores through a fine mesh and examining the material retained on the mesh under a microscope.

At the times of sampling, groundwater samples from all aquifers had high ECs, ranging from 1 240 μ S/cm to 7 047 μ S/cm. There was a large variability among boreholes and within the three types of groundwater, but variability through time was generally small. With the exception of one sample, all the coal seam samples had ECs in excess of 3 000 μ S/cm and in some samples ECs exceeded 6000 μ S/cm. In total, 432 invertebrates from nine taxa were collected in the three types of groundwater. Only four individuals were collected from the coal seam groundwater, representing less than 1% of total abundance. All of the taxa collected were either terrestrial or soil/water dwelling taxa that are not obligate stygofauna.

5.8.2 Key Aquatic Ecological Issues and Preliminary Assessment

Flora and Fauna of Surface Waters

Watercourses within and adjacent to the Site were assessed as having minimal value as habitat for native fish, with mosquito fish (an introduced pest species) observed in the main watercourses and one farm dam.

There are no known impediments to fish passage within the Avon/Waukivory system that would be crossed by the proposed Overland Conveyor Corridor. Moreover, there are no significant barriers to fish movement (e.g. weirs) occurring between these watercourses and the Pacific Ocean, suggesting that the Avon/Waukivory system could support a relatively diverse fish fauna, including migratory species, such as eels (which were observed by Cardno Ecology Lab staff) and Australian bass. However, fish habitat within the Avon/Waukivory system was considered to be of low to moderate value, which may reduce the diversity of native fishes in that area. Moreover, mosquito fish also occur in these rivers, which would also further impact on the native fish fauna there.

The review of threatened species indicated that no threatened species of fish or aquatic macroinvertebrates are likely to occur in the area, but that the distribution of tall knotweed (a threatened aquatic plant), encompasses the study area. This species was not observed during the targeted field searches and the nearest records are 85km to the south in a different catchment. Therefore, tall knotweed does not appear to present a constraint to the Proposal.

A range of conventional controls and safeguards would be adopted to protect aquatic ecosystems within and adjacent to the Site and throughout the study area. These controls and safeguards relate to:

- avoiding substantial changes to natural watercourse flow regimes;
- maintaining water quality in surface waters, principally through sediment controls;
- protecting riparian vegetation; and
- managing pest species.

Based on the outcomes of the stygofauna survey completed for this Proposal, it would appear that these fauna would not have significant environmental implications for the Proposal.

The safeguards required to manage surface water quality would equally assist in the management of the aquatic and riparian flora and fauna in surrounding watercourses. With the adoption of the various safeguards, impacts on the aquatic ecosystem within and surrounding the Site would be acceptable.

5.9 SOIL RESOURCES AND LAND CAPABILITY/AGRICULTURAL SUITABILITY/AGRICULTURAL PRODUCTIVITY

A review of published literature has been conducted by Geoff Cunningham Natural Resource Consultants (GCNRC) to identify the soil types present within the Site. Key information was obtained from Henderson (2000a) and (2000b). GSS Environmental mapped the boundaries of the alluvial sediments principally within the Mine Area. A comprehensive site investigation of the soils within the Mine Area, Overland Conveyor Corridor and Rail Load-out Facility has commenced with the outcomes to be included in the Environmental Impact Statement.

5.9.1 Existing Environment

Six soil landscapes occur within the Site (see **Figure 5.10**), namely:

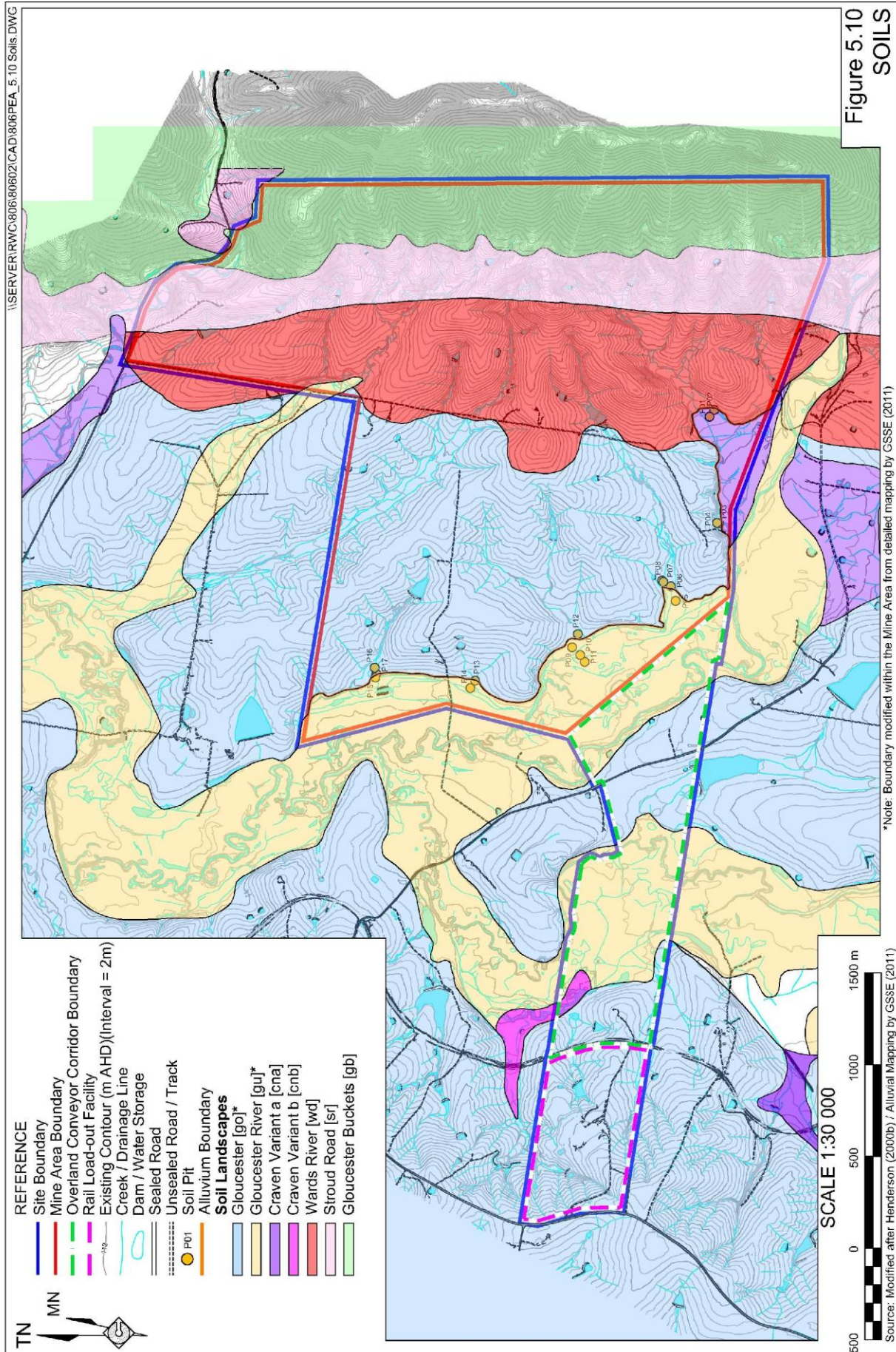
- Gloucester [go] Soil Landscape;
- Gloucester River [gu] Soil Landscape;
- Wards River [wd] Soil Landscape;
- Stroud Road [sr] Soil Landscape;
- Craven [cn] Soil Landscape [variant a]; and
- Gloucester Buckets [gb] Soil Landscape.

The Gloucester [go] Soil Landscape comprises undulating low hills on sedimentary rocks with generally absent rocky outcrops and is the most common soil type on the Site. These soils are classified as Sodosols, Kurosols and Tenosols within the Australian Soils Classification.

The Gloucester River [gu] Soil Landscape occurs in the western part of the Mine Area and occupies broad level alluvial plains with occasional small swamps and swampy oxbows associated with Waukivory Creek and the Avon River. These soils are classified as Chromosols within the Australian Soils Classification.

The Wards River [wd] Soil Landscape comprises areas where sediments of the Gloucester Coal Measures create low rolling hills. These are classified as Kurosols and Tenosols within the Australian Soils Classification.

The Stroud Road [sr] Soil Landscape is present in the eastern section of the Site and is characterized by rolling and undulating hills on volcanics. Landforms include moderately broad crests with some rock outcrop, convex upper slopes, lower ridges and moderately broad drainage plains. Within the Australian Soils Classification, the soils of the crests, outcrops and upper slopes are classified as Tenosols and Dermosols, whilst those of the lower ridges are classified as Ferrosols and those of the drainage plains are classified as Vertosols.



The Craven [cn] Soil Landscapes Variants a and b occur within low and wide drainage depressions with deep eroded gullies and long swamps. These soil landscapes occur in areas associated with drainage lines and therefore occupy relatively small areas to the north and in the south of the Mine Area and within and adjacent to the Rail Load-out Facility. The soils are classified as Kurosols within the Australian Soil Classification.

The Gloucester Buckets [gb] Soil Landscape comprises rolling to very steep hills on volcanics and sediments and occurs in the far eastern section of the Site. Relief varies between 60m and 350m with slopes typically 25% to >50%. Terracetting and hummocky terrain are present along with small [30m-50m] scarps. Rock outcrop and surface boulders are common. The soils are classified as Rudisols and Tenosols within the Australian Soil Classification.

The detailed soils investigation undertaken for the Proposal would assist in establishing the land capability, agricultural suitability and agricultural productivity. Each of these aspects will be comprehensively addressed in the *Environmental Impact Statement*.

5.9.2 Key Soil and Land Capability Issues and Preliminary Assessment

The proposed mining operations would involve the removal and transfer/storage of all topsoil and selected subsoil in operational areas. Progressive and final rehabilitation would also be undertaken using the previously stripped topsoil and subsoil. As the majority of the Site is currently used for cattle grazing, further studies have commenced to quantify the impact the Proposal would have on the agricultural suitability and productivity of the areas to be disturbed. These studies will also provide recommendations on soil stripping, stockpiling, erosion control and rehabilitation methods.

5.10 HERITAGE

Kayandel Archaeological Services coordinated the initial desk-top studies, review of databases, Aboriginal stakeholder consultation and the survey of the study area defined in June 2011. These studies have been continued and extended and are being finalised by Archaeological Surveys and Reports Pty Ltd. A further survey of an enlarged study area that incorporates all project components is planned for February/March 2012. The outcomes from these surveys will supplement the results of surveys and consultation undertaken during the exploration phase within the Mine Area. Registered Aboriginal stakeholder Do Waa Kee Cultural and Heritage Surveys has contributed to the ethnohistorical and current Aboriginal context of the area within and surrounding the Site.

5.10.1 Ethnohistory

At the time of European settlement (1830 – 1840), the Gloucester – Stroud area was inhabited by the Kattang speaking peoples of the Kabook tribe. This tribe was divided into a number of local groups, each with a degree of autonomous identity and rights associated with a specific geographical estate. The Kabook tribe enjoyed a healthy and abundant lifestyle prior to European settlement, with some local groups having up to 500 members. In addition to the Kabook tribe, the Gringai, Worimi and Biripi tribes also inhabited areas within the Gloucester – Stroud area prior to European settlement. By 1850, the majority of coastal ranges and plains

had been settled and modified by Europeans and traditional Aboriginal social and land-use systems were noticeably affected. With reduced or refused access to their traditional lands, the remaining Kattang speakers became dependant on food and supplies provided by European settlers, many residing on the periphery of European settlements with a number of campsites used by such “fringe-dwellers” having been reported in the Copeland and Barrington areas.

5.10.2 Current Aboriginal Context

In the Gloucester – Stroud area today, most of the Aboriginal population are direct descendants of the region’s traditional tribal groups with most descendants still observing their cultural connections with the lands and waters of the Gloucester – Stroud area. Each tribe has significant areas and items that remain integral to the continuing of customary lore such as:

- the Booken Booken Mountains (known today as “The Bucketts”)
 - A significant spiritual place for the Kabook people.
- Gloucester Primary School
 - Once a ceremonial, “Bora” or “Boombit” place.
- Dark Point, Seal Rocks
 - A culturally significant place for the Worimi people.

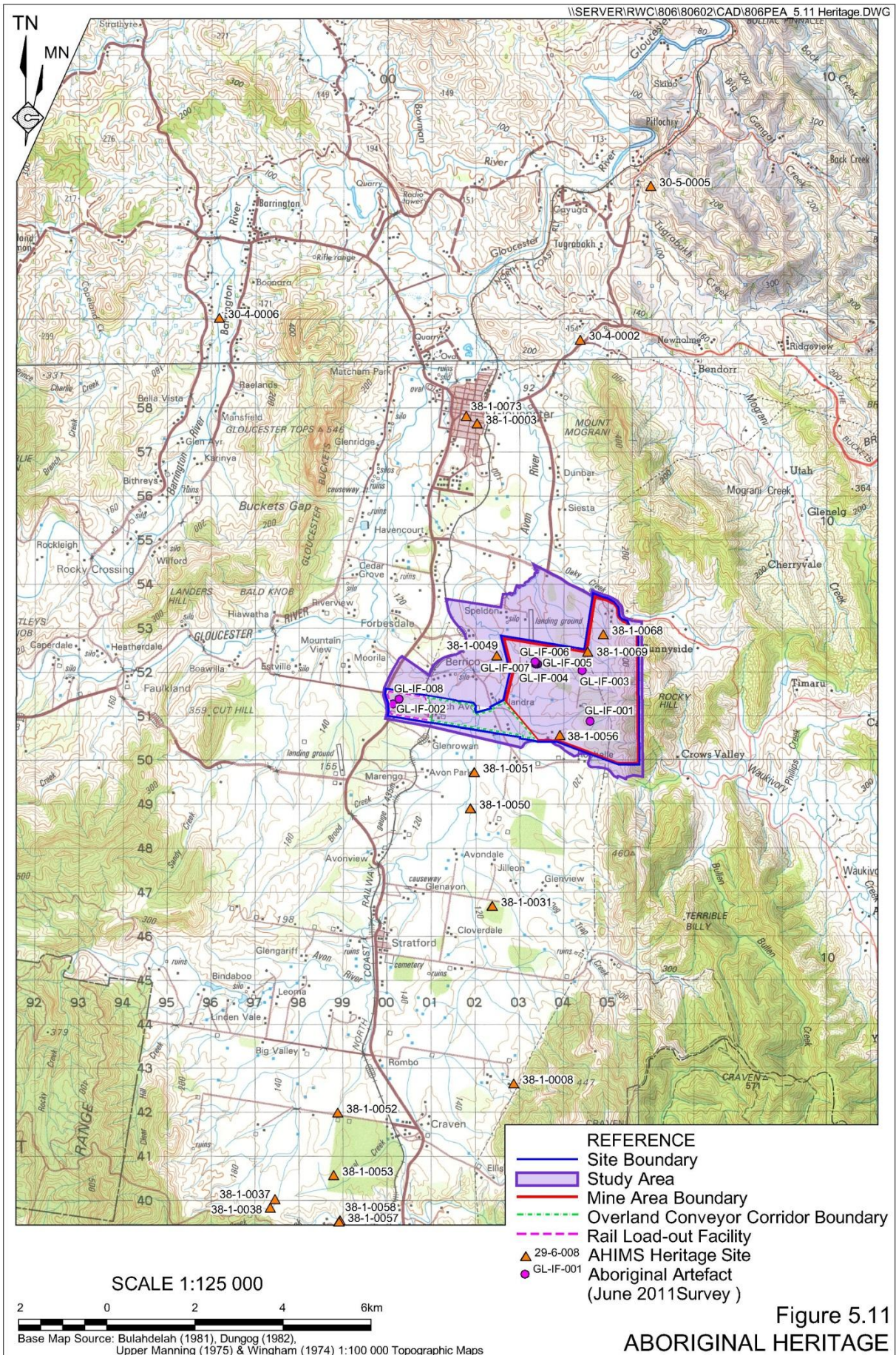
5.10.3 Stakeholder Consultation

Stakeholder consultation has and will be conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Applicants 2010 (DECCW 2010)*.

5.10.4 Existing Environment

Aboriginal Heritage

Desk-based and field investigations relating to Aboriginal heritage on the Site commenced in June 2010. An initial AHIMS search conducted in June 2010 identified one Potential Aboriginal Deposit (PAD) near the southern boundary of the Mine Area (Site 38-1-0056 – **Figure 5.11**). In August 2010, and prior to exploration activities commencing within the area now referred to as the Mine Area, Mr Robert Yettica of Cultural Consulting Services conducted a survey of the planned exploration areas at the recommendation of Forster Local Aboriginal Land Council. The survey identified two isolated artefacts in the northern part of the exploration area. These newly discovered sites (38-1-0068 and 38-1-0069 as shown on **Figure 5.11**) were subsequently entered onto the AHIMS database.



Other registered sites identified in the AHIMS search and identified on **Figure 5.11** include the following.

- 38-1-0053 – Artefact
- 38-1-0038 – Artefact
- 38-1-0057 – Potential Archaeological Deposit.
- 30-5-0005 – Ceremonial Ring (stone or earth)
- 38-1-0073 – Aboriginal Ceremony and dreaming, ceremonial ring (stone or earth) Potential Archaeological Deposit.
- 38-1-0049 – Scarred Trees
- 38-1-0051 – Artefact Scatter
- 38-1-0050 – Artefact Scatter
- 38-1-0037 – Artefact
- 38-1-0058 – Artefact
- 30-4-0006 – Burial/s (Barrington Burial Site)
- 38-1-0008 – Open Camp Site
- 38-1-0052 – Artefact
- 30-4-0002 – Stone arrangement site
- 38-1-0031 – Artefact
- 38-1-0003 – Bora ceremonial site

A further survey of the study area encompassing components of the Site was conducted in June 2011 by Kayandel Archaeological Services, in consultation with registered Aboriginal stakeholders. During that survey, a total of eight sites were identified, each comprising isolate artefacts. All artefacts were located within 10m of unnamed ephemeral watercourses. No artefact scatters or scarred or culturally modified trees were identified during the survey. **Figure 5.11** presents the location of the Aboriginal heritage sites identified through the June 2011 the survey as well as those sites identified through a further AHIMS search of an area of approximately 530km² centred on the Site undertaken in May 2011.

In total, eleven Aboriginal heritage sites are recorded within the Site.

European Heritage

Searches were undertaken of the Gloucester Shire Council State and Federal registers that included publicly available records covering the Site with no evidence of any recorded European heritage sites being identified. The European history of the Stroud – Gloucester Valley has been recognised since the grant of the 250 000ha of land to the Australian Agricultural Company in the early 1800s.

5.10.5 Key Heritage Issues and Preliminary Assessment

Recorded sites within the Gloucester area suggests that the greatest evidence of occupation occurs in association with suitable topography and reliable water, i.e. Waukivory Creek and Avon Rivers.

The survey results to date suggest a low level of occupation/use. The management of the artefacts that occur within the Site would be addressed in a Cultural Heritage Management Plan prepared in consultation with the local Aboriginal stakeholders.

5.11 SOCIO-ECONOMIC SETTING

Key Insights Pty Ltd, a consultancy specialising in social and economic impact assessment, has provided the following summary of the existing socio-economic setting and their proposed approach to the socio-economic assessment of the Rocky Hill Coal Project.

5.11.1 Existing Environment

The Gloucester Local Government Area (LGA) is located within the Hunter Region of Councils (see **Figure 5.12**). The town of Gloucester is the major commercial and urban centre of the area and is located 310km north of Sydney, 125km north of Newcastle and 78km west of Taree.



Figure 5.12 Hunter Region LGAs

A summary of available census data collected by the Australian Bureau of Statistics is presented as follows.

Population

In recent years, Gloucester Shire has seen steady growth in its total population. Between the 2001 Census and 30 June 2010 the population for the Gloucester Statistical Local Area increased from 4 682 to 5 181. This 9% growth has been attributed to the area being selected as the ideal place for business re-location, “tree changers” and retirees. Census data also confirmed a trend towards an aging of the population with the percentage of children and young people trending down.

Labour Force

Unemployment figures were relatively stable during the period from 1991 to 2006. The labour market recorded at the 2006 Census showed that there were 3909 persons 15 years of age and over in the Gloucester district. A total of 2003 persons were recorded to be in the labour force with approximately one third of the workforce being employed part time.

Income

Analysis of household income levels in the Gloucester Shire in 2006 compared to the Hunter Region shows that there was a smaller proportion of high income households (those earning \$1 700 per week or more) and a larger proportion of low income households (those earning less than \$500 per week). Overall, 9.9% of the households earned a high income, and 29.7% were low income households, compared with 17.7% and 24.3% respectively for the Hunter Region.

Industry Employment Profile

In 2006, the main employment sector in the Gloucester Shire was Agriculture, Forestry, Fishing (366 people or 19.5%) followed by Health Care and Social Assistance (195 people or 10.4%) and Retail Trade (187 people or 10.0%). In 2006, the Mining industry sector employed 78 people or 4.2% of the total employed population throughout Gloucester Shire.

Housing

The total number of occupied dwellings at the time of the 2006 census was 2005, an increase of 128 from the 2001 Census. Of these dwellings, 982 were reported as owned, 463 as being purchased and 440 were as being rented.

Education

At the time of the 2006 Census, the Gloucester Shire had a total of seven schools with 850 students recorded as in attendance. The majority of students (over 410) attended Gloucester High School while 269 students attended Gloucester Public School.

The closest TAFE colleges are at Taree and Tuncurry. Hunter TAFE also conducts courses through flexible delivery. The closest university is in Newcastle.

Tourism

There is a range of accommodation in the Gloucester region ranging from camping, B&Bs, farm stays and self-contained units through to luxury retreats. Between 2007 and 2009, the Australian Bureau of Statistics reports there has been a steady decline in the small number of Hotels, Motels and Serviced Apartments.

The major attractor to the area is the World Heritage listed Barrington Tops National Park.

5.11.2 Approach to Socio-economic Assessment

The approach to the socio-economic assessment will involve an analysis of the available socio-economic data together with the results of qualitative research undertaken with local people to capture the full range of potential issues and opportunities within the community. The assessment will include the following.

1. A review of all available socio-economic related studies/data for the local and regional communities surrounding the Site.
2. Use of Australian Bureau of Statistics and Council data to profile the local and regional communities including information relating to education, housing, industry and employment, community services and facilities.

3. Identification of all land uses and community infrastructure/services surrounding the Site and identification of the potential social contribution/impact on those land uses and community infrastructure/services.
4. Consultation with various stakeholders to scope socio-economic issues and refine the research methodology. Consultation will be undertaken with reference to Gloucester Shire Council's "*Consideration of Exploration and Mining Applications – A New Approach*" and may include:
 - structured interviews with near neighbours;
 - structured interviews with key community organisations including local peak groups for business, training organisations, real estate agencies/housing bodies, health organisations, farming organisations, environment groups and local tourism groups;
 - a focus group meeting with Community Consultative Committee (CCC) members; and
 - requests for input from key people/organisations recommended by the CCC such as Council and other groups or individuals.
5. An assessment of the potential impact on the local and regional communities including the following.
 - Social impact with respect to potential noise, air quality, visibility and transport impacts.
 - Impacts upon services and social infrastructure.
 - Social impact associated with the proposed preferred final land use(s).
 - Economic impacts on the local community (e.g. employment market, tourism and land values) and broader area of influence (i.e. contribution to the regional and NSW economies).
 - Community perceptions.
 - Cumulative impacts and mitigation strategies.
 - Ongoing consultation mechanisms for the life of the mine (e.g. CCC, company website, 1800 number, community newsletter, etc.).

5.11.3 Preliminary Scoping of Socio-economic Impacts

A preliminary review of media, political statements, Council policy and the minutes of the community consultative committee meetings indicates that there are a range of issues to be addressed through the community engagement process. These issues relate to both the perceived specific impacts associated with the Proposal and the broader community polarisation in relation to coal mining generally.

Both Council policy and community comment suggest that there is open acknowledgement of the wider regional and state employment and economic benefits of new coal mines. However, a more micro analysis indicates the negative impacts on land and property values, tourist visitation and spend and the effect of “reduced ambience” on tourism investment and the process of attracting Tree Changers’ is perceived to be subtle, long term and real. Given such perceptions, the scope of socio-economic issues is broad and diverse. Potential socio-economic impacts associated with the Rocky Hill Coal Project to be further explored through the community engagement process are as follows.

Contribution to the wider Regional and State Economy

Through its market research, the Applicant has established that the coal products from the Rocky Hill Coal Project would be in considerable demand throughout South East Asia and China. The Site is strategically located close to the Port of Newcastle with transportation via rail. Therefore, the Rocky Hill Coal Project would contribute to Australian coal exports and deliver a return to the State Government and regional economy.

Employment Impacts and Population Growth

The Proposal would deliver an estimated peak of 100 FTE³ positions during the 9 to 12 month construction period and up to 150 FTE positions in management and operations once mining has commenced. Some construction activity will be short term. The current predicted life of mine is up to 21 years. Once operational, the Proposal would result in up to three times as many people directly employed in the mining industry within the region than reported in the 2006 Census. Once construction and mining multipliers are applied, the Proposal represents a significant increase in local employment opportunities.

The Rocky Hill Coal Project will employ local people as well as attracting new residents to the Gloucester area. Although some employees will commute from other centres such as Newcastle and may at times require the services of local accommodation and other local business, it is recognised that they are unlikely to contribute to the local community to the extent of those who move to the area.

The injection of employment activity arising directly or indirectly as a consequence of the Rocky Hill Coal Project would stimulate local investment in the rental market as well as apply pressure to local vacancy rates. However, in the longer term it will stimulate housing construction and possibly increase the average price of local housing stock.

Employment in the well paid mining sector can also be a challenge to other areas, particularly agriculture where competition for workers based on level of pay is not viable.

Growth in population can enhance the viability of local services and social infrastructure as the increased population stimulates demand. The micro-economy will be stimulated with local businesses benefiting from increased disposable incomes.

Key strategies to be developed through the process of community and stakeholder engagement and ongoing planning by the Applicant will include ways of maximising local employment, encouraging relocation to the area, encouraging the provision of training for vulnerable groups in the employment market (such as young people) and establishing company policies that

³ FTE – Full Time Equivalent

support employee engagement and contribution to the local community. GRL envisages committing to a production-based contribution for a range of local and district community programs.

Environmental Impacts

There is a social dimension to environmental impacts which is identified both in Council policy documents and minutes from the community consultative committee. Community engagement will explore the priorities of the community and provide information on environmental issues and mitigation strategies in relation to specific likely concerns such as:

- vegetation clearing (loss of local habitat and rehabilitation plans);
- dust and dust monitoring related to stockpiles, ROM pad, loading onto rail and general operations (perceived health impacts);
- water management and impacts;
- visual impact during operational phase and proposed visual barriers (perceived impacts on ambience, sense of place and secondary impacts on local tourism trade);
- traffic impacts;
- noise and blasting impacts; and
- final landform and possible return to agricultural use.

It is acknowledged that some members of the Gloucester community and wider community hold a view that there can be no net benefit associated with coal mining because of the significant risk of climate change. This is a policy issue at every level of government and the current position supports coal mining as a necessary part of the economy to be implemented under strict regulation.

Cumulative Impacts

The Rocky Hill Coal Project is one of a few mining operations either underway or planned in the Gloucester area. It will be important to analyse the potential impacts of the Rocky Hill Coal Project in relation to, and in combination with, both the positive and negative impacts of other resource based operations in the Stroud – Gloucester Valley and the Hunter Region.

6. CUMULATIVE IMPACTS

6.1 INTRODUCTION

The development and operation of the Rocky Hill Coal Project is proposed in an area south-southeast of Gloucester where an extension to an existing coal mine (east of Stratford) is proposed and coal seam gas activities are approved. This section reviews each of these proposals/projects and profiles the information known and likely issues that would need to be addressed in an assessment of cumulative impacts.

Given the evolving and transient nature of the activities associated with the two above ventures and the Rocky Hill Coal Project, the cumulative impact assessment would involve the selection of practical scenarios for each project that are likely to occur simultaneously or in a similar timeframe. All scenarios to be assessed in a cumulative manner would be discussed with the respective applicants or operators.

6.2 STRATFORD EXTENSION PROJECT

Preliminary discussions held with Gloucester Coal Ltd have established that the Company proposes to extend its open cut mining activities within and adjacent to its existing mining leases on its Stratford Coal Mine Area. The Stratford Extension Project would involve the following activities.

- Extensions to the Roseville West Open Pit and two additional open pits.
- Construction and use of new waste and coal stockpile areas.
- Continued backfilling of open pit voids.
- Production of 2.6 million tonnes of ROM Coal.
- A range of other related operational and infrastructure activities.

If approved, the extension would add an additional 11 years to the mine's operational life.

The *Environmental Impact Statement* for the Rocky Hill Coal Project would address the cumulative impacts with the Stratford Extension Project based upon information provided by Gloucester Coal Ltd at the time of the preparation of the *Environmental Impact Statement*.

The main impacts of the Stratford Extension Project that would need to be assessed in a cumulative sense would relate to activities that are similar to those proposed by the Applicant and involve impacts upon noise, air quality, groundwater, surface water, traffic, agricultural productivity and socio-economic issues.

6.3 COAL SEAM GAS ACTIVITIES

In February 2011, AGL Upstream Infrastructure Investments Pty Ltd (AGL) was granted approval by the Planning Assessment Commission for the activities required to develop the Coal Seam Gas resources within a 210km² area of the Gloucester Basin. Development of the Proposal would be staged, with Project Approval 08_0154 enabling the establishment of 110 gas wells and associated or supporting infrastructure within the Stage 1 Gas Field Development Area (GFDA) (see **Figure 1.4**). AGL is also in the process of installing four exploration wells and deep monitoring piezometers immediately west of GRL's Site as also shown on **Figure 1.4**.

Works within the GFDA will involve the construction and operation of a well field, a Central Processing Facility (CPF) and associated infrastructure including a power generation plant, gas transmission pipeline and delivery station. The range of activities for which approval was granted can be broadly described within the following elements.

- Gas well and associated gas and water pipeline installation activities within the Stage 1 GFDA, directly south of and extending into the Rocky Hill Mine Area.
- Construction and operation of the CPF with an average capacity of 80 TJ per day at either CPF Site 1 or CPF Site 7 within the Stage 1 GFDA. It is understood CPF Site 7 is the preferred site for the facility.
- Construction and operation of a gas transmission pipeline within an overall 100m wide assessment corridor to transport the gas from the CPF to Hexham.
- Construction and operation of the Hexham Delivery Station (HDS).

Cumulative impacts could potentially occur between the Rocky Hill Coal Project and the AGL Project depending largely upon AGL's development timetable and the sequence of activities with the Rocky Hill Coal Project. The main potential impacts and the likely AGL activities contributing to those components are as follows.

Noise – noise and vibration from:

- drilling of wells;
- completion of wells – permeation and fracking;
- construction of hardstand, infrastructure at the wellhead and access roads;
- operation of pumps and associated machinery at the wellhead, including generators;
- construction of water and gas gathering system;
- vehicle movements related to the transportation of equipment and water required for fracking to each of the 110 wells in Stage 1;
- construction of a temporary workforce camp; and
- construction and operation of the CPF.

Air Quality – dust from:

- construction of hardstand, infrastructure at the wellhead and access roads;
- construction of water and gas gathering system;
- vehicle movements related to the transportation of equipment and water required for fracking to each of the 110 wells in Stage 1;
- construction of a temporary workforce camp; and
- construction and operation of the CPF.

Surface water – risks posed from the potential for:

- increased turbidity/sedimentation from various earthworks, watercourse crossings, installation of gas and water gathering lines and other activities;
- contamination of surface waters from fuels, oils, or chemicals;
- increased salinity of surface waters and detrimental impacts to surrounding vegetation as a result of accidental release of saline drill, frac and/or produced waters during drilling and well development activities; and
- diversion/alteration of natural drainage patterns through the construction of access roads and grading/development of areas.

Groundwater – risks posed from the potential for:

- dewatering of shallow aquifers;
- increased aquifer permeability as a result of the fracking and removal of groundwater;
- reduction in stream (base) flow if dewatering of the alluvial and shallow aquifers occurs as a result of fracking and gas extraction; and
- surface storage leakage of saline groundwater.

GRL has established a constructive dialogue with AGL to ensure that potential cumulative impacts arising from the two ventures are well understood and specific mitigation measures are adopted beyond those intended for each individual Project and any other projects/activities that are approved for each Company. This could include AGL's installation of the four exploration wells immediately west of the GRL's proposed Mine Area. Relevant specialist studies commissioned by GRL will consider each of the above risks.

It is noted that the project approval for the AGL Project is currently the subject of a judicial appeal in the NSW Land and Environment Court.

7. CONCLUSION

Based upon the investigations undertaken to date and the information assembled for this document, it is assessed that the Rocky Hill Coal Project is practical and feasible and can be designed and operated in a manner which reflects the environmental and other constraints, while at the same time optimising resource recovery and the benefits to the State, region and local area. As such, it is concluded that the information currently available and presented in this document is sufficient for the Department of Planning and Infrastructure and both State and local government agencies to issue their requirements for an *Environmental Impact Statement* for the Proposal. Likewise, it is also concluded that it would be possible for an appropriately designed Project to be assembled for determination.

8. REFERENCES

- Australian Bureau of Statistics (2006). Census data by location, <http://www.censusdata.abs.gov.au/ABSNavigation/prenav/LocationSearch>.
- Australian Rail Track Corporation (2011),
Master Train Plan – Freight and Country Passenger Services,
http://www.artc.com.au/library/MTP_2012-01-15_NSWQLD%201.pdf,
http://www.artc.com.au/library/MTP_2012-01-15_NSWQLD%20200.pdf.
- Australian Standards HB 203:2006 and AS/NZS 4360:2004
- Bureau of Meteorology (2011). Climatic Averages Australia, www.bom.gov.au.
- Department of Environment, Climate Change and Water (2010) Aboriginal Cultural Heritage Consultation Requirements for Applicants 2010, www.environment.nsw.gov.au/licences/consultation.htm.
- Department of Natural Resources (2009), Avon River Water Source Report Card – August 2009, www.dnr.nsw.gov.au/water/pdf/wsp_reportcard_avon_draft.pdf.
- Department of Planning (2008). Applying SEPP 33, http://www.planning.nsw.gov.au/plansforaction/pdf/hazards/haz_applying_sepp33_consulation_draft_2008.pdf,
- Gloucester Coal Ltd (2011), Stratford Extension Project – Project Description and Preliminary Environmental Assessment
- Gloucester Shire Council (2010). Gloucester Local Environmental Plan, www.gloucester.nsw.gov.au/planning/1710/1828.html.
- GSS Environmental (2011). Alluvial Soil Assessment *Gloucester Resources Limited*.
- Henderson, L.E. (2000a). Soil Landscapes of the Dungog 1: 100 000 Sheet Report. (Department of Land and Water Conservation, Sydney.
- Henderson, L.E. (2000b). Soil Landscapes of the Dungog 1: 100 000 Sheet Map. (Department of Land and Water Conservation, Sydney.
- Roads and Traffic Authority (2004). Annual Average Daily Traffic, www.rta.nsw.gov.au/trafficinformation/downloads/aadtdata_dl1.html.
- Smith, G. (2011) The Stroud – Gloucester Valley and Vale of Gloucester (not published).