SECTION 5

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5 Existing Environment and Interactions

5.1 Introduction

This section of the Environmental Assessment Report provides an overview of the existing environment associated with the project, the identification and analysis of impacts with the proposed mitigation measures.

The majority of topics discussed in this section rely on specialist studies focused on specific issues such as air quality, noise, soils, ecology and transportation/ traffic. These specialist studies are provided in Volume 2.

5.2 Climate

5.2.1 Weather Stations

Two weather stations have measured local weather elements within the Cessnock locality for a total of 125 years. Cessnock Post Office data records span the longest recording timeframe for precipitation, with records covering an 87 year period from 1903 to 1992. Maximum/ minimum temperature, precipitation and wind measurements have been reliably recorded at Nulkaba for a 38 year period between 1966 and 2004. The combination of these two weather stations provides sufficient information on the climatic conditions of the Cessnock locality. These weather stations and the remaining monitoring network are shown in **Figure 5.1**.

5.2.2 Rainfall

Mean rainfall figures for Cessnock Post Office indicate a ‘wet’ summer ‘dry’ winter cycle, with February being the wettest month of the year (i.e. mean = 88 mm) and August being the driest (i.e. mean = 44.3 mm). Records over an 87 year period indicate the potential for completely dry months (i.e. 0 mm monthly total rainfall) having occurred in seven separate months of the year, this being February and June – November. At Cessnock Post Office the annual mean precipitation for the past 87 years is 748 mm, which is comparatively similar to the annual mean at Nulkaba (i.e. 751 mm over a 38 year recording period).

The number of rain days is relatively consistent for each month of the year, which ranges between 6 and 8 rain days. The wettest month on record is February with 420.2 mm being recorded, with the wettest rain day in June where 191.3 mm of rain fell within a 24hr period.

5.2.3 Temperature

According to the Bureau of Meteorology (2002), the highest recorded temperature for Nulkaba stands at 44.4^{0}C, which was recorded in February 2006. The hottest month is January, where the average temperature exceeds 30^{0}C, followed closely by December and February at 29.4^{0}C. The coldest month of the year is July with an average monthly minimum temperature

Figure 5.1: Baseline monitoring network

of 4.5^0C. The lowest recorded temperature also falls in July where -4.2^0C has been recorded. The average number of frost days ranges between 10 and 17 per year, a range based on the number of days where the minimum temperature falls below 0^0C and 2^0C respectively.

5.2.4 Winds

South and south-easterly winds predominate over the summer months whilst winter months are characterised by north and north westerlies. Mean monthly wind speeds range between 9.4km/hr at 9am in the morning (April) to 17.8 km/hr at 3pm in the afternoon (September). September is on average the windiest month of the year.

5.2.5 Sunshine and Evapotranspiration

The Cessnock locality enjoys on average 72 clear, cloudless days every year, with the maximum number of clear days occurring in August (10 days). Conversely, August has the least number of cloudy days with an average 7 cloudy days recorded for this month. The cloudiest days occur over the summer period. Similarly, evapotranspiration is greatest during spring and summer with a daily 5mm average evaporation rate.

5.2.6 Humidity

Monthly average 9am and 3pm humidity levels fluctuate within a maximum 20% range throughout the year. The highest humidity levels are recorded in the morning the average range between 60 and 81%. Afternoon or 3pm humidity levels average between 43 and 56%.

5.3 Air Quality

Presented in the following sections is a description of the local air quality, impacts and proposed mitigation, including the estimated greenhouse gas emissions from the project. The specialist report prepared by Holmes Air Sciences Pty Limited is presented in **Appendix 3**.

5.3.1 Existing Air Quality

Air quality standards and goals refer to pollutant levels which include the project and existing sources. To fully assess impacts against all the relevant air quality standards and goals it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the project is likely to contribute to these levels.

Local air quality will be adversely affected periodically due to bushfires but otherwise there are no significant local sources of particulate matter.

The closest monitoring station is located at Kurri Kurri Hospital, which is in the vicinity of all three sites. PM_{10} concentrations are measured using a GRIMM monitor.

The annual average PM_{10} concentration measured at Kurri Kurri over the twelve month period 1 May 2005 to 30 April 2006 was $4.9\mu g/m^3$. The maximum measured 24-hour average PM_{10}

concentration over the same period was 16.9μg/m^3. Recent data for the months May and June 2006 have measured a maximum 24-hour average PM_{10} concentration of 28.7μg/m^3.

Based on our experience of the lower Hunter Valley, it is noted that the annual average concentration appears to be low. This could be due to the technology used and the actual annual average could be as high as 15μg/m^3.

5.3.2 Statutory Guidelines and Goals

In its modelling and assessment guidelines, New South Wales Department of Environment and Conservation (NSW DEC) specifies air quality assessment criteria relevant for assessing impacts from dust generating activities. The assessment criteria are summarised in **Table 5.1** and **Table 5.2**.

These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPMs (see NEPC, 1998)). However, the NSW DEC's criteria include averaging periods, which are not included in the Air-NEPMs and also includes references to other measures of air quality, namely dust deposition and total suspended particulate matter (TSP).

Table 5.1: NSW DEC impact assessment criteria for pollutants

Pollutant	Averaging period	Concentration	
		Parts per hundred million (pphm)	μg/m^3
PM_{10}	1-day	-	50
	annual	-	30
TSP	Annual		90

Table 5.2: NSW DEC amenity based criteria for dust fallout.

Pollutant	Averaging period	Maximum increase in deposited dust	Maximum total dust deposition
Deposited dust (insoluble)	Annual	2 g/m2/month	4 g/m2/month

In May 2003, NEPC set an advisory reporting standard for $PM_{2.5}$ as a variation to the NEPM (NEPC, 2003).The advisory reporting standards for $PM_{2.5}$ are a 24-hour average of 25μg/m^3 and an annual average of 8μg/m^3. The goal was to gather sufficient data nationally to facilitate the review of the Air Quality NEPM which commenced in 2005 and is due to be completed during 2006. The variation includes a protocol setting out monitoring and reporting requirements for particles as $PM_{2.5}$.

At this stage, the advisory reporting $PM_{2.5}$ standards are not part of the NSW DEC assessment criteria for projects and therefore have not been considered further in this assessment.

The focus of the air quality assessment is on the potential effects of PM_{10} emissions. PM_{10} has the capacity to affect human health and to cause nuisance effects.

5.3.3 Air Quality Modelling

The model used was the US EPA ISCST3 model. The modelling has been based on the use of three particle-size categories (0 to 2.5 μm - referred to as $PM_{2.5}$, 2.5 to 10 μm - referred to as CM (coarse matter) and 10 to 30 μm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors developed both within NSW and by the US EPA.

For modelling purposes it was assumed that the an extraction rate of 4000 tonnes per day could be all chitter, all tailings or any combination up to 100%. Given the higher moisture content of the tailings it was calculated that if the extraction from the tailings dams was 100% chitter, this would result in the highest total dust emissions, therefore this worst-case, was the scenario modelled.

It is important to note that the modelled extraction rate represents approximately a 25% higher extraction rate than that adopted due to traffic and noise considerations.

Modelling at Aberdare East was based on haulage using either Route A1 or A2, with extraction from Area C in the centre, Area E (the closest resource to receptors) and the Chitter Resource area to the west of the Tailings Dam.

Modelling at Neath was based on the extraction of chitter from the South Tailings Dam (starting location) or the Washery (closest to the receptors), with haulage going south along David Street as per route N2 and N3.

Modelling at Richmond Main East was undertaken assuming extraction from west to east of a single resource and haulage along the assigned route.

All modelling and predicted impacts assume safeguards and mitigations measures detailed in **Section 5.3.7** are implemented.

5.3.4 Air Quality Impacts

Air quality impacts are described below for each of the sites; Aberdare East, Neath, and Richmond Main East. The majority of impacts are associated with wheel generated dust as a result of haulage, with extraction activities having comparably lesser impacts. Discussion of the impacts is presented below.

5.3.4.1 Aberdare East

Table 5.3 summarises the highest 100 model predictions at each of the residential receptors due to dust emissions from operations at Area E of the Tailings Dams using Haulage Route A2. Results of modelling for other scenarios are included within Appendix 3.

Table 5.3: Summary of dispersion model predictions due to Aberdare East operations – Tailings Dam Area E and Haulage Route A2.

Property ID (refer Appendix 1)	PM_{10} (μg/m^3)		TSP (μg/m^3)	Dust deposition (g/m^2/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
A17	6.7	0.8	1.2	0.2
A18	6.9	0.8	1.2	0.2

Property ID (refer Appendix 1)	PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust deposition (g/m^2/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
A19	7.1	0.8	1.3	0.2
A20	7.3	0.8	1.3	0.2
A21	7.5	0.8	1.3	0.2
A22	7.6	0.8	1.3	0.2
A23	7.8	0.9	1.3	0.2
A24	7.9	0.9	1.4	0.2
A25	7.7	0.9	1.4	0.2
A26	7.6	0.9	1.4	0.2
A27	7.4	0.9	1.4	0.2
A60	6.9	0.9	1.4	0.2
A61	7.1	0.9	1.5	0.2
A62	7.3	1.0	1.5	0.2
A621	6.5	0.9	1.4	0.2
A622	6.7	0.9	1.5	0.3
A628	7.2	1.0	1.7	0.3
A63	7.5	1.0	1.6	0.3
A64	7.7	1.0	1.6	0.3
A65	8.1	1.0	1.7	0.3
A66	8.4	1.1	1.7	0.3
A67	8.7	1.1	1.8	0.3
A68	8.9	1.1	1.8	0.3
A69	9.2	1.1	1.8	0.3
A70	9.4	1.2	1.9	0.3
A71	9.4	1.2	1.9	0.3
A72	9.2	1.2	1.9	0.3
A73	9.1	1.2	1.9	0.3
A74	9.0	1.2	2.0	0.3
A75	8.9	1.2	1.9	0.3
A76	8.8	1.2	1.9	0.3
A77	8.6	1.2	1.9	0.3
A78	8.4	1.2	1.9	0.3
A375	7.1	0.8	1.2	0.2
A454	6.7	1.0	1.6	0.2
A460	7.1	1.1	1.8	0.2
A463	7.7	1.2	1.9	0.3
A464	8.4	1.3	2.2	0.3
A630	7.3	1.1	1.8	0.3
A633	7.4	1.1	1.8	0.3
A636	7.7	1.2	1.9	0.3
A650	8.0	1.2	2.0	0.3
A659	8.4	1.2	2.1	0.3
A662	8.8	1.3	2.1	0.3
A664	9.2	1.3	2.2	0.4
A672	9.7	1.4	2.3	0.4
A674	10.0	1.4	2.3	0.4
A676	10.6	1.5	2.5	0.4
A678	10.7	1.5	2.6	0.4
A680	10.8	1.5	2.6	0.4

Property ID (refer Appendix 1)	PM10 (µg/m³)		TSP (µg/m³)	Dust deposition (g/m²/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
A682	10.8	1.6	2.6	0.4
A683	10.7	1.6	2.6	0.4
A684	10.7	1.6	2.6	0.4
A686	10.6	1.6	2.6	0.4
A687	10.5	1.5	2.6	0.4
A688	10.3	1.5	2.5	0.4
A691	9.9	1.5	2.4	0.3
A694	6.9	1.1	1.8	0.2
A839	6.5	0.7	1.1	0.2
A840	6.7	0.7	1.1	0.2
A841	6.8	0.7	1.1	0.2
A842	6.9	0.7	1.1	0.2
A843	6.9	0.7	1.1	0.2
A844	6.9	0.7	1.1	0.2
A845	6.6	0.7	1.1	0.1
A846	6.6	0.7	1.1	0.1
A847	6.5	0.7	1.1	0.1
A896	7.7	1.2	2.0	0.3
A1140	9.8	1.4	2.4	0.5
A1141	12.0	1.9	3.3	0.7
A1142	7.1	0.8	1.2	0.2
A1146	15.3	2.7	4.8	1.0
A1147	11.6	1.8	3.0	0.6
A1148	9.6	1.4	2.3	0.5
A1149	7.0	0.7	1.2	0.2
A1151	8.1	1.4	2.2	0.5
A1172	6.6	0.7	1.1	0.2
A1178	6.5	0.8	1.2	0.2
A1193	7.7	0.9	1.4	0.2
A1215	6.4	0.9	1.4	0.2
A1216	7.4	0.9	1.5	0.2
A1218	16.9	3.3	5.8	1.2
A1237	7.8	1.1	1.7	0.2
A1238	8.6	1.2	2.0	0.3
A1260	6.5	0.7	1.1	0.2
A1261	6.5	0.7	1.0	0.1
A1262	6.6	0.7	1.1	0.2
A1263	6.7	0.7	1.1	0.2
A1264	6.8	0.7	1.1	0.2
A1270	6.4	0.8	1.3	0.2
A1271	6.7	0.9	1.4	0.2
A1303	6.5	1.1	1.7	0.2
A1340	7.7	0.9	1.3	0.2
A1341	7.5	0.8	1.3	0.2
A1342	8.1	0.9	1.4	0.2
A1343	8.1	0.9	1.4	0.2
A1353	6.5	0.9	1.4	0.2
A1357	8.0	0.9	1.6	0.3

Property ID (refer Appendix 1)	PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust deposition (g/m^2/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
A1358	7.7	0.9	1.5	0.3
A1359	8.1	0.9	1.6	0.3

Figure 5.2 shows the maximum predicted 24-hour average PM_{10} concentrations. Haulage Route A1 results in predicted concentrations at several residences potentially exceeding the DEC 24-hour average goal of 50 µg/m^3. Therefore on the basis of air quality haulage route A2 is preferred.

The maximum predicted concentration for Haulage Route A2 at the closest residences is 16.9 µg/m^3 (A1218). Therefore with this route it is unlikely that the DEC 24-hour average goal of 50 µg/m^3 would be exceeded due to the proposed operations even with existing maximum 24-hour average PM_{10} concentration of 28.7 µg/m^3.

A simple summing of the maximum measured and maximum predicted concentrations is likely to result in a conservative assessment of the cumulative impacts.

Annual average PM_{10} concentrations are predicted to be a maximum of 3.3 µg/m^3 (A1218) for Haulage Route A2. It is unlikely that the DEC annual average goal of 30 µg/m^3 would be exceeded due to the proposed operations with existing annual average PM_{10} concentrations which have been measured to be approximately 4.9 µg/m^3. Even if the annual average concentration were as high as 15 µg/m^3 the goal would be met.

It is unlikely that the 90 µg/m^3 NHMRC TSP goal would be exceeded.

Predicted annual average dust deposition levels at the nearest residence are predicted to be a maximum of 1.2 g/m^2/month (A1218) for Haulage Route A2. The predicted deposition level for Haulage Route A2 is below the goal. This can be further controlled by monitoring the prevailing meteorological conditions and ensuring the exposed areas are kept watered at all times.

5.3.4.2 Neath

Table 5.4 summarise the top 100 model predictions at the residential receptors due to dust emissions from the project for extraction from the Washery area.

Figure 5.3 show the maximum predicted 24-hour average PM_{10} concentrations. There are a number of residences that may result in an exceedence of the goal when combined the maximum measured 24-hour average PM_{10} concentrations at Kurri Kurri hospital of 28.7 µg/m^3. For extraction from the Washery Area the residences are N17 to N30, N33 to N43, N86 to N106, N113 to N119, N146 and N161.

However, as noted above, a simple summing of the maximum measured and maximum predicted concentrations is likely to result in a conservative assessment of the cumulative impacts.

Figure 5.2: Aberdare East – Tailings Dam E - Predicted maximum 24-hour average PM_{10} concentration due to emissions from the site ($\mu g/m^3$)

Annual average PM_{10} concentrations are predicted to be a maximum of 9.5 $\mu g/m^3$ (N154) from extraction in the Washery Area. It is unlikely that the DEC annual average goal of 30 $\mu g/m^3$ would be exceeded due to the proposed operations even with existing annual average PM_{10} concentrations which have been measured to be approximately 4.9 $\mu g/m^3$. Even if the annual average concentration were as high as 15 $\mu g/m^3$ the goal would be met.

It is unlikely that the 90 $\mu g/m^3$ NHMRC goal would be exceeded.

Predicted annual average dust deposition levels at the nearest residence are predicted to be a maximum of 2.7 g/m^2/month (N24) for extraction from the Washery Area. This exceeds the DEC goals of less than 2 g/m^2/month increment. The predicted levels at N95, N96 and N154 are also above the DEC increment goal of less than 2 g/m^2/month increment. Deposition levels can be controlled by monitoring the prevailing meteorological conditions and ensuring the exposed areas are kept watered at all times.

Table 5.4: Summary of dispersion model predictions due to Neath operations – Washery Area.

Property ID (refer Appendix 1)	PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
N8	11.7	0.8	1.3	0.1
N9	12.2	0.8	1.3	0.1
N10	13	0.9	1.5	0.2
N11	13.9	1	1.6	0.2
N12	15	1.1	1.9	0.2
N13	16	1.2	2.1	0.2
N14	16.9	1.3	2.3	0.3
N15	17.9	1.5	2.6	0.3
N16	19.7	1.8	3.2	0.4
N17	24.4	3.3	6.3	0.8
N18	26.2	4	7.7	1
N19	27.8	4.6	8.9	1.2
N20	29.5	5.3	10.4	1.5
N21	30.7	5.7	11.3	1.6
N22	31.6	6	12	1.7
N23	31.3	5.7	11.6	1.7
N24	40.5	8.8	17	**2.7**
N25	29.3	6.1	11.1	1.7
N26	26.9	5.5	9.8	1.5
N27	24.7	5	8.7	1.3
N28	23.1	4.5	7.6	1.1
N29	22.6	4.4	7.2	1
N30	22.3	4.3	6.9	1
N31	21.8	4.1	6.6	0.9
N32	21.8	4	6.2	0.8
N33	22.2	4	6.1	0.8
N34	22	3.9	5.9	0.8
N35	22.7	4	5.9	0.7
N36	23	4	5.8	0.7
N37	23.4	3.9	5.6	0.7

Property ID (refer Appendix 1)	PM10 (µg/m³)		TSP (µg/m³)	Dust deposition (g/m²/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
N38	23.9	3.9	5.5	0.7
N39	23.7	3.8	5.3	0.7
N40	24	3.8	5.3	0.7
N41	23.8	3.7	5.1	0.6
N42	23.3	3.6	5	0.6
N43	22.6	3.5	4.8	0.6
N44	21.6	3.4	4.6	0.6
N45	20.2	3.2	4.3	0.5
N46	18	2.9	4	0.5
N47	17.1	2.9	3.9	0.5
N48	15.7	2.7	3.7	0.5
N49	14.7	2.5	3.5	0.5
N50	13.9	2.4	3.3	0.4
N51	13.1	2.2	3.1	0.4
N52	12.2	2	2.8	0.4
N53	11.6	1.9	2.7	0.4
N54	11.2	1.8	2.5	0.4
N80	13.7	1.1	1.9	0.2
N81	14.6	1.2	2.1	0.2
N82	15.6	1.4	2.3	0.3
N83	16.7	1.5	2.5	0.3
N84	17.7	1.7	2.9	0.3
N85	21.6	2.4	4.2	0.5
N86	22.9	2.8	5	0.7
N87	23.9	3.1	5.6	0.7
N88	25.1	3.7	6.8	0.9
N89	27.1	4.6	8.6	1.2
N90	28.5	5.2	10	1.4
N91	30.2	6	11.5	1.6
N92	31.8	6.7	13	1.9
N93	32.9	6.9	13.5	1.9
N94	33.7	6.7	13.2	1.9
N95	41	8.4	15.8	**2.4**
N96	37.4	7.5	13.9	**2.1**
N97	33.2	6.6	11.9	1.7
N98	29.3	5.9	10.2	1.5
N99	28.1	5.6	9.7	1.4
N100	27.2	5.4	9.2	1.3
N101	32.1	6.2	9.9	1.3
N102	25.2	4.8	7.5	1
N103	25.6	4.8	7.4	1
N104	25.2	4.7	7	0.9
N105	26	4.7	6.9	0.9
N106	26.4	4.7	6.7	0.8
N107	11.8	0.6	1	0.2
N112	17.2	1.9	3.3	0.4
N113	30.1	5.7	10.6	1.5

Property ID (refer Appendix 1)	PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust deposition (g/m^2/month)
	Averaging period		Averaging period	
	24-hour	Annual	Annual	Annual
	Air quality impact assessment criteria			
	50	*30*	*90*	*2*
N114	31.2	6.3	11.9	1.7
N115	33.7	6.9	13.1	1.8
N116	34.5	6.9	13.2	1.8
N117	32.7	4.6	9.7	1.3
N118	24.9	4.9	8.8	1.3
N119	23.3	4.6	8	1.2
N120	19	2.9	4	0.5
N121	18.5	2.8	3.9	0.5
N122	17.9	2.7	3.8	0.5
N123	16.3	2.5	3.5	0.5
N124	15.4	2.4	3.4	0.4
N125	14.5	2.3	3.2	0.4
N126	13.6	2.2	3.1	0.4
N127	12.8	2.1	2.9	0.4
N128	12	2	2.8	0.4
N129	11.3	1.9	2.7	0.4
N146	23.4	4.7	8	1.2
N154	44.6	9.5	17.1	2.6
N156	12.0	0.6	1.1	0.2
N158	11.1	0.9	1.5	0.2
N159	11.9	1.0	1.6	0.2
N160	12.9	1.1	1.7	0.2
N161	33.0	5.6	7.4	0.9

Figure 5.3: Neath – Washery - Predicted maximum 24-hour average PM_{10} concentration due to emissions from the site ($\mu g/m^3$)

5.3.4.3 Richmond Main East

Table 5.5 summarises the model predictions at each of the residential receptors due to dust emissions from the project.

Figure 5.4 shows the maximum predicted 24-hour average PM_{10} concentrations. The closest residences are predicted to experience a maximum of 14.4 $\mu g/m^3$. It is unlikely that the DEC 24-hour average goal of 50 $\mu g/m^3$ would be exceeded due to the proposed operations even with existing PM_{10} concentrations.

Annual average PM_{10} concentrations are predicted to be a maximum of 1.8 $\mu g/m^3$. It is unlikely that the DEC annual average goal of 30 $\mu g/m^3$ would be exceeded due to the proposed operations even with existing annual average PM_{10} concentrations which have been measured to be approximately 4.9 $\mu g/m^3$.

It is unlikely that the 90 $\mu g/m^3$ NHMRC goal would be exceeded due to the existing operations even with existing annual average TSP concentrations.

The predicted annual average dust deposition levels at the nearest residence are predicted to be a maximum of 0.3 g/m^2/month. Compliance with the DEC goals of less than 2 g/m^2/month increment and a total of 4 g/m^2/month would therefore be anticipated.

Table 5.5: Summary of dispersion model predictions due to Richmond Main East operations

Property ID (refer Appendix 1)	PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)
	24-hour	Annual	Annual	Annual
	Air Quality Impact Assessment Criteria			
	50	*30*	*90*	*2*
R1	14.4	1.8	2.9	0.3
R2	3.8	0.4	0.5	0.0
R3	10.6	1.1	1.7	0.2
R4	3.8	0.3	0.4	0.0
R5	3.1	0.2	0.3	0.0
R7	11.5	1.8	2.9	0.3
R8	6.0	0.9	1.4	0.1
R9	4.5	0.3	0.4	0.0
R10	8.4	0.3	0.5	0.1
R11	14.2	1.0	1.5	0.2
R12	5.5	0.7	0.9	0.1
R15	7.3	0.3	0.4	0.0

5.3.5 Greenhouse Assessment

This section examines the scientific principles that relate Greenhouse Gases (GHGs) to the global warming effect and estimates emissions of GHGs associated with the HEM project. It is demonstrated that when all categories demonstrated that when all categories (that is, Scopes 1, 2 and 3) of GHG emissions from the HEM project are taken into account the project will comply with the principals of ESD.

Figure 5.4: Richmond Main East - Predicted maximum 24-hour average PM_{10} concentration due to emissions from the site ($\mu g/m^3$)

The protocol nominates the following greenhouse gases:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

From the point of view of the HEM project only CO_2, CH_4 and N_2O are relevant.

5.3.5.1 HEM's Emissions

CO_2 emissions from the project would result from the following sources:

- The extraction of chitter and tailings from the three extraction sites due to the combustion of diesel fuel (used in diesel-powered equipment);
- The transport of the product coal to the Hebburn No .3 processing plant from the extraction site, from the processing plant to the coal loader located in Mayfield, Newcastle (Port Waratah Coal Services), and the transport of the product coal overseas;
- The use of electrical energy at Hebburn No. 3 to process the chitter and tailings into product coal, in conjunction with the combustion of diesel fuel in diesel-powered equipment; and
- The combustion of the product coal in power generating facilities.

Spontaneous combustion is fully accounted for as it is taken into account in the burning of the coal.

5.3.5.2 Summary of Total CO_2 Emissions

The total annual emission of CO_2-equivalent assuming 4000 t/y of chitter and tailings are extracted and 975,684 t/y of product coal is then exported and burnt in a power station, is approximately 2.038 Mtpa. **Table 5.6** summarises the total emissions from all sources.

Table 5.6: Summary of total estimated CO2 emissions (t/y)

Activity	**CO_2-e/y (t/y)**
Extraction of chitter and tailings	1,631
Transport of chitter and tailings (alternative route)	3,127
Processing at Hebburn No.3	4,786
Transport of product coal	3,785
Burning of product coal in a power station	2,023,939
TOTAL	**2,037,267**

Since the locations of the customers is not know it is not possible to provide a realistic estimate of the emissions associated with the delivery of the coal by sea, but a small additional emission will be associated with this activity.

5.3.5.3 Contribution to Global Warming

It is useful to consider the contribution that the estimated quantum of GHGs generated by HEM product coal might make to global warming. Because the relationship between global warming and greenhouse gas concentrations is not linear there is no accepted method to determine the contribution that a given emission of greenhouse gases might make to global warming.

At any point in time, it would be reasonable simply to compare the estimated emission of CO_2-equivalent from the various activities with the estimated equivalent global emission from fuel burning of 26,583.3 Mtpa. On this basis, the emissions from the mining and burning coal from HEM is estimated to be 0.00001% of global CO_2-equivalent annual emissions. Thus, the HEM project could be considered to 0.00001% to the increase in global temperatures caused by the increase in greenhouse gas emissions as they are currently.

It can be estimated that the emissions from the HEM (including mining, transporting the coal to Newcastle and burning the coal) would lead to an increase in global temperature of 0.0000019 ^oC [$(2.038 \times 10^6/2{,}750 \times 10^9) \times 2.5\ ^oC$].

There will clearly be no measurable environmental effect due to the emissions of greenhouse gases from HEM even when the customer's use of the coal is taken into account. Any environmental assessment would conclude that the effects of the emissions from HEM are unmeasurable. Given this it is clear that HEM would comply with the principles of ESD.

In practice, of course the effects of global warming and associated climate change are the cumulative effect of many thousands of such sources and it is the cumulative effects that pose a threat to ESD principles.

This analysis highlights the problem of dealing with climate change on a mine-by-mine, or project-by-project basis. Indeed if this approach is adopted it is likely to be ineffective since the coal will simply be sourced from some other place.

Ultimately, the control of greenhouse gas emissions is likely to occur via economic instruments such as carbon taxes set as suggested in the recently released Stern Review and elsewhere (Stern, 2006). These taxes, set appropriate levels, would encourage increases in efficiencies in the way that carbon-based fuels (including coal) are used, encourage the development of carbon capture and sequestration and encourage the development of renewable forms of energy generation, and improve the efficiency with which electricity is used.

5.3.6 Spontaneous combustion

Coal reacts with atmospheric oxygen even at ambient temperatures and this reaction is exothermic. If the heat liberated during that process is allowed to accumulate, the rate of the above reaction increases exponentially and there is a further rise in temperature. When this temperature reaches the ignition temperature of coal, the coal starts to burn and the phenomena is described as spontaneous combustion.

Spontaneous combustion has been known to occur at both Richmond Main East and Neath resources, while there is no knowledge of it occurring at Aberdare East. Typically spontaneous combustion is managed by excavating the material, spreading it out on the ground and tracking over it using a excavator or dozer and dampened using a water cart.

5.3.7 Air Quality Safeguards and Mitigation

The modelling results presented above are the maximum predicted levels and are based on the assumption that basic control measures to minimise dust emissions are implemented. It does not assume that operations will cease during unfavourable climatic conditions. This section outlines procedures proposed for the management and control of dust emissions.

The installation of a wind vane and a dust tracker will be investigated to allow HEM operations to operate without adversely impacting the surrounding residences, in addition the following controls are proposed:

- Review of meteorological conditions for each day to minimise the short-term impact on the residences at each site;
- Vegetation stripping should be undertaken during damp conditions or when prevailing winds are not in the direction of the residences;
- Maintain stockpiles in a moist condition to minimise wind blown and traffic generated dust;
- The use of the preferred haulage routes utilising the Werakata National Park amounts to a significant reduction (more then 400%) in greenhouse gas emissions due to the reduced haulage distance required;
- Water all roads and trafficked areas to minimise the generation of dust;
- Selection and maintenance of machinery to minimise fuel usage and subsequent emissions; and
- Commit to progressive extraction and rehabilitation to minimise the total area of exposure.

5.3.8 Conclusion

It is concluded that there may be some residences at both the Aberdare East and Neath sites that may be affected by dust levels exceeding the 24-hour average PM_{10} assessment criterion of 50 $\mu g/m^3$ and may be impacted by dust levels exceeding the annual average 2 g/m^2/month (insoluble solids) deposition level assessment criteria.

These impacts will be managed by monitoring the PM_{10} concentrations in the vicinity of these residences, together with the development of a management plan that utilises an onsite wind vane to effectively coordinate operations with prevailing climatic conditions.

There are no impacts predicted at residences close to the Richmond Main East site.

5.4 Acoustic Environment

Presented in the following sections is a description of the acoustical environment, impacts and proposed mitigation. The specialist report prepared by Spectrum Acoustics Pty Limited is presented in **Appendix 4**.

5.4.1 Existing Acoustical Environment

Unattended noise logging was carried out in Aberdare East (i.e. 15 and 20 May 2006), whilst noise levels at Neath were measured as part of previous studies for associated projects in the area (i.e. 27 March and 3 April 2003) to determine background levels. Noise logging was not completed in the vicinity of the Richmond Main East deposit due to its relatively isolated, rural character that has a known low background noise level. Noise logging locations are shown in Figure 5.1.

Noise levels were recorded for 15 minute statistical intervals over the entire measurement period using an Acoustic Research Laboratories EL-215 Environmental Noise Logger in accordance with the relevant EPA guidelines and AS 1055-1997 "Acoustic Description and Measurements of environmental noise". Periods of adverse weather conditions were excluded from the data as per the procedures outlined in Appendix B of the Industrial Noise Policy (INP).

Background noise levels were calculated from the measured data using the tenth percentile method as specified in the INP. Results for Aberdare East and Neath are summarised in **Table 5.7** for the period of proposed operations (i.e. day time Monday to Friday) as per procedures outline in the INP.

Table 5.7: Measured ambient noise levels

Location	Day i.e. hours of operation between 7am-6pm	
	Background L90 dB(A)	Leq dB(A)
21 Cessnock Street, Aberdare	33	53
125 Maitland Road, Neath	39	57

The acoustic environment in the vicinity of Cessnock Street is characterised by domestic and natural sounds such as insects (as evidenced by a marked decrease in L_{eq} during the night time measurement period), birds etc. (note that night time noise levels are not reported above). Traffic noise from nearby major roads was also a feature of the area. Similarly, the acoustic environment at Neath is characterised by sounds from domestic, traffic sources (i.e. Maitland Road) and natural sources.

The Richmond Main East deposit is relatively remote and natural noises dominate the acoustic environment at this location, with a nominal background noise level set at 30 dB. While receiver types in the vicinity of the Richmond Main East deposit are rural, those in Aberdare East and Neath are classified as suburban. There are few existing industrial noise sources in the area near the Richmond Main East or Neath deposits. However, an area south of the Aberdare East deposit that is within the HPOTS lands is used for the training of plant machinery operators, which may be considered a source of intermittent industrial noise.

5.4.2 Statutory Guidelines and Goals

5.4.2.1 Operational Noise

The INP specifies two noise criteria, an "intrusiveness" criterion that limits Leq noise levels from the industrial sources to a value of "background plus 5 dB", and an "amenity" criterion that aims to protect against excessive noise levels where an area is becoming increasingly developed. In determining the amenity criterion only existing industrial noise is considered.

Amenity criteria are dependant upon the nature of the receiver area and the existing level of industrial noise. As described above receivers in the vicinity of Richmond Main East are considered rural, whilst those near Aberdare East and Neath are suburban. In relation to the other two deposits, as current industrial noise is insignificant, the adopted amenity criterion is equal to the recommended amenity limit for a suburban area. **Table 5.8** below specifies the applicable base noise objectives for the each area being assessed.

Table 5.8: Base noise level objectives

Period	Intrusiveness Criterion* Leq (15 min) dB(A)	Amenity Criterion Leq (Period) dB(A)
Cessnock Street, (Aberdare)	38	55**
Maitland Rd. (Neath)	44	55**
Richmond Main East	35	50***

* Rating Background Level (RBL) + 5dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L_{90} of the $L_{90's}$" for each separate day of the monitoring period.

** Suburban zone Table 2.1 of INP.

*** Rural zone Table 2.1 of INP.

The project specific noise level criteria for each site are as follows:

- Aberdare East 38 dB(A) L_{eq} (15 min)
- Neath 44 dB(A) L_{eq} (15 min)
- Richmond Main East 35 dB(A) L_{eq} (15 min)

The INP also lists recommended Leq noise levels from industrial sources for various specific receiver types. In the case of a school, the criteria are 35 dB(A) Leq (1hr), internal, for the noisiest 1 hour period (when in use) and 45 dB(A) Leq when in use for a playground. At its closest point the Aberdare East deposit is approximately 350m from parts of Cessnock High School.

5.4.2.2 Traffic Noise

Heavy vehicles travelling on a public road are subject to noise restrictions specified in the EPA *Environmental Criteria for Road Traffic Noise, 1999* (ECRTN). The ECRTN recommends the criteria shown below in **Table 5.9**, with night time criteria not considered as the project will be restricted to daytime operations.

The various transport routes considered join the public road system at different points for each site being worked. Most of the transport routes will be on collector roads, but at times the trucks will also travel on local, collector and arterial roads. Proposed transport routes also include selected power line and fire trail easements within and adjacent to Werakata National Park. Noise from vehicles travelling on these parts of the transport routes was assessed against the project specific noise levels for the relevant sites and has considered the intermittent nature of the operations.

Table 5.9: Road traffic noise criteria (extract from ECRTN).

Situation	Recommended Criteria Day (7a.m. – 10p.m.)
7. Landuse developments with potential to create additional traffic on existing freeways/arterial road.	60dB(A)L_{eq} (15 hr)
8. Landuse developments with potential to create additional traffic on collector road.	60dB(A)L_{eq} (1 hr)
13. Landuse developments with potential to create additional traffic on local roads.	55dB(A)L_{eq} (1 hr)

5.4.3 Acoustical Modelling

Noise guidelines used for this project relate to the potential operational and traffic sources. The noise sources have been analysed and assessed in accordance with the relevant INP and *Environmental Criteria for Road Traffic Noise, 1999* (ECRTN) criteria. A discussion of the noise goals is presented as follows:

5.4.3.1 Operational Noise

Chitter and tailings extraction works will be undertaken using a front end loader for each site (or possibly small excavator). The extracted material will then be loaded into semi trailers and transported to the processing facility or directly to the power stations.

As the deposit is several metres thick the removal of carbonaceous materials will be carried out behind (relative to the residential receivers) a working face that will generally be between 2 and 4 m high. This working face represents an effective acoustic barrier, which has been an important consideration in the development of an extraction process that minimizes the impacts on residential receivers.

At Richmond Main East the deposit consists only of chitter. The removal of chitter will commence at the western end of the deposit (again at the location furthest from any residential receivers) where thickness is zero. Operations will progress to the east so that the face in front of the loader will progressively increase in height until a typical working height of 3 to 4 m is reached.

Due to the mobile nature of the operations, noise exposure in the direction of individual residences will be variable. That is, for example, site machinery will move about throughout the course of any 15 minute period, with the noisier parts of the plant (i.e. engine, exhaust) sometimes facing a residence and at other times be facing away. Similarly, the machinery is not likely to be operating at full power for the entire 15 minutes, depending upon whether it is loading, travelling, excavating material or idling.

The calculation of the sound power level for machinery used in the proposed operation has considered the variable nature of site operations. For instance, the sound power level for a loader was calculated using full power operation in the direction of the receivers for 5 minutes of a 15 minute period. A similar approach has been used to derive the sound power level for other machinery such as the elevated scrapper and truck movements within each site. Base sound power levels and frequency spectra used to calculate site specific levels has been derived from the Spectrum Acoustics technical database.

These values were used to model the extent of noise emanating from the extraction operation (i.e. RTA Technologies Environmental Noise Model (ENM) v 3.06 computer software). Assumptions used in the model included the consideration of prevailing winds (i.e. southeast in summer and northwest in winter) and wind speed (3m/s from each of these directions). Operational and atmospheric scenarios were also considered for each of the deposits to encompass worst case scenarios.

Modelling was undertaken for operational and atmospheric scenarios described below in **Table 5.10**. A front end loader was used in the scenarios rather than an excavator, given its higher sound output. It is only occasionally that both a front end loader and an excavator would be working concurrently.

Table 5.10: Acoustical modelling scenarios for proposed operations.

Scenario	Site	Description
1	Aberdare East	Dozer on topsoil (at ground level) north west wind,
2	Aberdare East	Dozer on topsoil (at ground level) south east wind
3	Aberdare East	Front end loader in pit and a truck in pit and truck at access point on route A1 north west wind
4	Aberdare East	Front end loader in pit and a truck in pit and truck at access point on route A1 south east wind
5	Aberdare East	Front end loader in pit and a truck in pit and truck at access point on route A2 north west wind
6	Aberdare East	Front end loader in pit and a truck in pit and truck at access point on route A2 south east wind
7	Neath	Dozer on topsoil (at ground level) north west wind
8	Neath	Dozer on topsoil (at ground level) south east wind
9	Neath	Front end loader in pit and a truck in pit (Washery Area) and truck at access point on route N1 north west wind
10	Neath	Front end loader in pit and a truck in pit (Washery Area) and truck at access point on route N1 south east wind
11	Neath	Front end loader in pit and a truck in pit (South Tailings Dam Area) and truck at access point on route N1 north west wind
12	Neath	Front end loader in pit and a truck in pit (South Tailings Dam) and truck at access point on route N1 south east wind
13	Richmond Main East	Dozer on topsoil (at ground level) north west wind
14	Richmond Main East	Dozer on topsoil (at ground level) south east wind
15	Richmond Main East	Front end loader in pit and a truck in pit and truck at access point on route R1 north west wind
16	Richmond Main East	Front end loader in pit and a truck in pit and truck at access point on route R1 south east wind.

5.4.4 Acoustical Impacts

5.4.4.1 Operational Noise

Each site will have a climatic trigger employed to minimise impacts to the surrounding receptors. The proposed triggers at the three sites are:

- Aberdare East – Limited operations during a south east wind;
- Neath – Limited operations during a north west wind; and
- Richmond Main East – No significant meteorological limitations, limited project duration.

The potential modelled exceedances during operations (i.e. when the climatic conditions are not triggered and operations not limited) at the three sites are shown in **Table 5.11**. The modelled noise predictions do not take into the account the significant buffering potential of obstacles, such as houses that may be located between the noise source and the receiver.

Table 5.11: Predicted impacted landowners from noise modelling at the three sites, (note the A prefix in the site ID is for Aberdare East, while N is for Neath and R for Richmond Main East.

Site_ID (refer Appendix 1)	Land Status	Noise Goal	Predicted Potential noise level / impact
A463		38	38-40/ 0-2dBA
A686	no house	38	38-40/ 0-2dBA
A687	no house	38	38-40/ 0-2dBA
A690		38	38-40 0-2dBA
A1147		38	38-40/ 0-2dBA
A1150		38	40-45/ 2-7dBA
N92		44	44-45/ 0-1dBA
N93		44	45-50/ 1-6dBA
N94		44	45-50/ 1-6dBA
N95	no house	44	44-45/ 0-1dBA
N113		44	44-45/ 0-1dBA
N114		44	45-50/ 1-6dBA
N115		44	45-50/ 1-6dBA
N116	no house	44	50-55/ 6-11dBA
N154		44	44-45/ 0-1dBA
R11		35	35-40/ 0-5dBA

The following sections detail the potential exceedances under all modelled scenarios, however, all scenarios may not be applicable as climatic triggers will be employed to maximise the prevailing meteorological conditions and limit impacts to receivers.

Aberdare East

Noise levels predicted for potential sensitive receptors in the Aberdare East area during a north west wind (Scenario 1) indicate a minimal adverse impact on surrounding receptors.

While elevated noise levels throughout several streets in the Aberdare area were identified during south east winds (Scenario 2), with noise levels at Cessnock High School remaining within the acceptable limits.

While the model accounts for topographical variation, it should be noted that modelled levels could be lower if the model was capable of incorporating the beneficial buffering potential of intermediately buildings (residences) such as those located along Cessnock Street.

Under south east winds, noise levels of up to 45 dB(A) Leq may be experienced at the houses closest to the dozer (i.e in Cessnock Street). An analysis of the unattended noise data logger located in Cessnock Street shows existing day time Leq noise levels average 53 dB(A), with a range from 52 to 55. Acceptable day time noise level from industrial noise sources in a suburban area is 55 dB(A) Leq which is significantly below the predicted level for scenario 2.

Noise contour modelling for the typical operating scenario of a front end loader and truck working in the extraction area and another truck leaving the site via the northern entrance (proposed route A1) represents scenarios 3 and 4. The results show that there will be an exceedance of the noise criterion at houses near the haulage route under each of the assessed conditions, with the greatest exceedance experienced during a south east wind.

Modelling for scenarios 5 (**Figure 5.5**) and 6, which have considered the same operating conditions described for scenarios 3 and 4 with the exception of a truck at the southern entrance (proposed route A2), show that there will be an exceedance of the noise criterion under each of the assessed conditions. The exceedance will be greatest during a south east wind, and operations would therefore be limited during these periods.

The results for each of scenarios 3, 4, 5 and 6 show that the worst case noise levels at the closest residences in Aberdare (around Cessnock Street) will be in the low 40’s dB(A) (in all cases less than 45 dB(A)). As detailed above this is less than the measured existing Leq noise level in the area.

Under each of scenarios 1 to 6 the worst case noise level at Cessnock High school will be 40 dB(A) at the closest point to the extraction site. This is significantly below the acceptable outdoor noise level for a school (45 dB(A)). The façade of a typical building will attenuate at least 10 dB(A) with windows open. This would equate to a worst case interior level of less than 30 dB(A) in the school rooms, which is below the acceptable level.

Neath

Scenarios 7 and 8 show the modelled impacts of a dozer pushing topsoil on the South Tailings Dam, with no noise criterion exceedance expected during a south east wind. Under the assessed conditions there will be an exceedance of up to 1 dB(A) at houses along the northern side of Maitland Road in Neath under a north west wind, with the maximum predicted noise level of approximately 50 dB(A) at the old colliery house.

Scenarios 9 and 10 (**Figure 5.6**) show the predicted noise contours for typical extraction operations being carried out in the southern parts of the Washery area of the proposal with a truck at the entrance to the site. The results show that there will be a minor exceedance (approximately 1 dB(A)) at some houses on Neath Road under a north west wind from the combined operations and trucking activities. Under a south east wind there will a minor exceedance at the houses closest to the entrance to the site as a result of noise from trucks.

Figure 5.5: Predicted noise levels at Aberdare East under Scenario 5.

Figure 5.6: Predicted noise levels at Neath under Scenario 10.

Scenarios 11 and 12 show the predicted noise contours for typical mining operations being carried out in the southern parts of the South Tailings Dam with a truck at the entrance to the site. The results show that, under the modelled atmospheric conditions, there will be no adverse noise emissions from the extraction operations but there will be a minor exceedance as a result of noise emissions from trucks entering and leaving the site. The truck impacts are predicted to affect houses closest to the sites entrance in David Street.

Richmond Main East

The results show that there will be no adverse impacts at the residence near the transport route as a result of the modelled truck movements on the site. However, site works using a bull dozer will have an impact on local residences.

Scenarios 13 and 14 show the modelled impacts of a dozer pushing topsoil, with an exceedance of approximately 3 dB(A) expected at both residences to the north and east of the site under a southeast wind, while under a north west wind there will be approximately 5 dB(A) exceedance at the residence to the east of the site. Modelled scenario 15 (**Figure 5.7**) indicates a south east wind will result in received noise for the residence to the north that exceeds the adopted criterion by approximately 3 or 4 dB(A). Under the modelled scenario 16 during a north west wind there will be a small exceedance (approximately 2 dB(A)) at the residence to the east of the site.

Conclusion

In relation to all of the deposits it is recognised that the extraction process will be of a relatively short term nature, during the day from Monday to Friday. For each of the sites the maximum exceedances will not occur at all residences for the full duration of the extraction. As discussed earlier, the extraction process will move around, as the resource is progressively depleted, thus received noise at individual residences will vary depending upon their proximity to the extraction site at any time.

5.4.4.2 Traffic Noise

Transport haulage routes on public roads will pass through areas that are variously uninhabited, semi rural or suburban in nature, thereby passing along local, collector and arterial roads, as defined in the ECRTN. Accordingly, the strictest noise level criterion applies to vehicles travelling on local roads. Government Road at Aberdare East (routes A1 and A2), David Street at Neath (routes N1, N2 and N3) were modelled under this criteria. For all other sites, access will be directly to collector or arterial roads and the transport route will remain on such roads to the processing site.

Traffic modelling results indicate that under the proposed transport schedule of up to a maximum 20 vehicle trips per hour (i.e. empty truck in and laden truck out), the criterion for a local road will not be exceeded at residences 15m from the centre of any of the local roads on the transport routes.

5.4.5 Acoustical Safeguards and Mitigation

5.4.5.1 General Safeguards

The maintenance of noise emissions to levels at or below those calculated by the model will require the following mitigation measures to be implemented:

Figure 5.7: Predicted noise levels at Neath under Scenario 15.

- All personnel working on the job including contractors and their employees should be made aware of their obligations and responsibilities with regard to minimising noise emissions;

- Contractors should familiarise themselves with methods of controlling noisy machines and alternative construction procedures. These are explained in AS2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites";

- Activities that are known or have the potential to create excessive noise should, where possible, be scheduled to occur at times to cause least annoyance to the community. Carrying out such work during early morning should be avoided. This includes start up and idling and excessive walking etc. of heavy machinery prior to commencement of work;

- Dozers to be used on topsoil removal should only be used in first gear when travelling in reverse;

- Regular and effective maintenance of all equipment including vehicles moving on and off the site should be conducted. Prompt attention must be given to repair of loose or rattling parts and broken equipment by qualified persons;

- Mechanical plant should be silenced using best available control technology. Noise suppression devices should be maintained to manufacturer's specifications. Internal combustion engines should be fitted with appropriate, well maintained, high efficiency mufflers;

- When selecting contractors and/or equipment for the job, preference must be given to those with capacities best suited to the task at hand. That is the use of larger machines with excess capacity should be avoided unless these can be shown to be quieter than smaller capacity machines;

- If possible, machines, which are used intermittently, should either be shut down in the intervening periods between work or throttled down to a minimum;

- Consider alternatives to reverse alarms such as manually adjustable or ambient noise sensitive types ("smart" reversing alarms). Alternative site management strategies can be developed, in accordance with a site OH & S Plan, with the concurrence of the appropriate OH & S Officer;

- Any portable equipment with the potential to create high levels of noise eg compressors, generators etc should only be selected for use if it incorporates effective noise control. This equipment should be located where practical so that natural ground barriers or site sheds etc are between it and the nearest potentially affected receivers;

- All unsealed or private access roads must be maintained in good condition and free of potholes;

- All vehicles on site roads must limit their speed to minimise noise emissions. A maximum speed limit of 20 kph must be set for all site roads.

- Where practicable, access roads and loading points should be sited a maximum distance from residences. Loading activities should be carried out on the opposite side of trucks in relation to houses and should make use of natural or other existing barriers, where available, as acoustic shielding;

- Any trucks forced to queue before loading should be shut down: and
- The proposed plan of operations should involve commencing works in parts of the deposits furthest removed from nearby residences. Working faces in the pit should be kept at the maximum safe working heights, with working faces maintained between the noise source and the residential receivers for the maximum practical time.

5.4.5.2 Consultation

As part of the initial stages of the project HEM, has contacted potentially affected receivers in the vicinity of each deposit. Upon approval of the project further liaison with all of the potentially affected receivers, particularly those at Aberdare for residents in Cessnock, Greta and Rawson Streets, Aberdare Road and cross streets, Government Circuit and Jeffries Street, the resident south of the railway line (near the HPOTS entrance, adjacent to the Cessnock High School) and Cessnock High School.

Once reacquainted with the project description and aims, the community should be given progress updates at regular intervals or at particular milestones. A contact name and phone number of a responsible person will be provided to residents for the efficient handling of complaints, which are to be constantly reviewed by the proponent.

5.4.5.3 Climatic Triggers

The modelling indicates received noise levels will be significantly affected by atmospheric conditions. If practical, works on exposed areas (i.e. without the barrier effects of the extractive face) should be avoided at Aberdare East under a light south easterly wind, and at Neath under a light north west wind.

Where this cannot be avoided, it is recommended that a noise management program initiated to monitor actual noise levels at potentially affected receivers to assess any complaints and, if required, operations should be modified or ceased where noise goals are substantially exceeded.

5.5 Groundwater

Presented in the following sections is a description of the groundwater environment, impacts and proposed mitigation. The specialist advice prepared by Coffey Geotechnics Pty Limited is presented in **Appendix 5**.

5.5.1 Existing Environment

Groundwater at the three sites are summarised as follows:

- Aberdare East – deep groundwater within underground workings and shallow “artificial” groundwater within the Tailings Dams;
- Neath - deep groundwater within underground workings and shallow “artificial” groundwater within the Tailings Dams; and

- Richmond Main East – No groundwater is expected to be encountered at this resource, shallow or deep.

The Aberdare East tailings dams have been constructed in a valley effectively blocking the free drainage of an existing unnamed creek. As a result of this restriction, surface waters have leached through the tailings dams generating effectively an "artificial" or man made groundwater table. This "artificial" groundwater re-emerges from the down gradient side of the resource as a acidic iron rich leachate. Similarly, Neath has been constructed in a similar manner, however it is thought that the water within the Neath resource is less then that found at Aberdare East due its location within its respective catchment.

Beneath Neath and Aberdare East there is a vast network of underground mine workings, connectivity between collieries is possible but unknown. It is expected that based on the Hebburn No.3 standing water levels the Aberdare workings are likely to be filled with water, while the Neath workings are predominantly dry.

Existing water quality is thought to be consistent with water extracted at the Hebburn No.2 mine workings for Hebburn No.3 and at the Austar Mine near Bellbird south of Cessnock. This water typically contains high iron, sulphate, sodium, chloride, is highly saline, highly reducing and typically has a pH of approximately 6.5 until the water oxidises to a pH less then 5.

Rehabilitation at Neath in the 1980's and again in the late 1990's involved the drilling of boreholes into the underground workings to allow the discharge of acidic seepages.

5.5.2 Groundwater Users

Given the groundwater types (shallow "artificial" groundwater and deep groundwater in the underground workings) users of these groundwaters are limited.

The "artificial" groundwater at Aberdare East and Neath is not believed to significantly interact with the local natural groundwater, as groundwater comes to the surface in the form of acidic leachate. The removal of the resources will enhance water qualities in the area.

The Austar Underground Coal mine is located approximately 8km south west of Aberdare East resource and the Hebburn No.3 processing plant are the only known users of the deep groundwater in the area. The discharge of excess or poor quality captured waters into these shafts is not expected to cause any impact to these operations.

5.5.3 Impacts

Potential impacts to the groundwater include:

- Removal of the "artificial" groundwater table within the tailings dams and consequential improvement in surface water qualities within the Black Creek and Swamp Creek catchments through the removal of the acid source and establishment of original creek line and drainage; and

- Discharge of acidic seepages and excess surface waters from disturbed areas onsite to a drilled bore hole into the underground workings at Aberdare East and Neath, impacts associated with this practice are thought to be minimal given the highly reducing environment and existing poor water quality within the underground workings.

Impacts associated with the extraction of groundwater and disposal of slimes to the underground workings at Hebburn No.2 for the Hebburn No.3 project are covered under an existing approved consent.

5.5.4 Monitoring

The potential impacts above are minimal, and regular monitoring will be undertaken to monitor changes in water quality being discharged underground and of the downstream surface water catchment.

Should the monitoring identify significant changes to existing water qualities, site practice will be reviewed and amended as required. This may involve the addition of ameliorants such as lime to raise low pH levels, or restriction of water discharges until it can be diluted with relatively uncontaminated surface water runoff captured within the disturbance area.

5.6 Surface Water

Presented in the following sections is a description of the surface water environment, impacts and proposed mitigation prepared by Wells Environmental Services in association with Peter Sullivan & Associates.

5.6.1 Existing Catchment Hydrology

5.6.1.1 Aberdare East – Black Creek Catchment

Aberdare East is located within the catchment of a small unnamed tributary of the Black Creek.

The higher areas of the catchment are characterised by bushland including a portion of the Werakata National Park. A now derelict quarry is also located in the upper portion of the catchment. Downstream of the site the unnamed tributary flows into a wetland that controls the discharge of acidic waters from flowing further down the catchment.

Downstream of the wetland the tributary flows into a highly disturbed environment as it is formalised in concrete drains, where it joins with Black Creek and flows north through Cessnock and Pokolbin before meeting the Hunter River.

Within the site boundary the unnamed tributary has been diverted south around the tailings emplacement in a drainage channel that is up to 4 meters deep on the south western side of the emplacement. The drainage line continues north-west along a formalised drainage following the south western side of both the tailings dams and the chitter resource area to a dam known as the “Acid Dam”. From this dam water flows into a wetland before leaving the site.

Several acidic and iron rich seepages emanate from the base of the tailings dam area in Area A, these intersect with the diverted drainage line approximately 140m to the west.

5.6.1.2 Neath – Swamp Creek Catchment

Neath is located in the upper reaches of the catchment of a small unnamed tributary of Swamp Creek.

Down gradient of the site two drainage lines join and flow east toward Maitland Road intersecting Swamp Creek south of Abermain. Swamp Creek flows north through Abermain and Weston before joining Fishery Creek that joins Wallis Creek and enters the Hunter River at Maitland.

Within the site there has been numerous drainage works constructed in past rehabilitation activities. In 2001 due to increasing community concern the DPI-MR built a diversion drain around the north and western sides of the tailings dams, draining waters to a clean water dam south west of the site. The drain was constructed to prevent water leaching into the tailings from the upgradient catchment. Effectively the site has no catchment external to the bounds of the resource.

Down gradient of the South Tailings Dams and within the Washery area there are significant acid and salt scalds, these drain to concrete and limestone channels that are directed to boreholes that discharge the water to the underground workings. Downstream of the boreholes the creek is severally degraded with steep eroding banks and scattered chitter spread along the banks.

5.6.1.3 Richmond Main East – Wallis Creek Catchment

Richmond Main East is located within the Wallis Creek Catchment approximately 500m downstream of Colliery Dam.

The site is located immediately adjacent to Wallis Creek, above the western bank. The edge of the resource and the banks of Wallis Creek has significant weed infestation, with the adjacent section of Wallis Creek consisting of shallow vegetated sandbar on the western side of the creek. The main drainage channel is located on the eastern side of the Creek. **Figure 5.8** was taken from the top of the resource looking east over the Creek, illustrating the weed infestation in the foreground, vegetated sand flats behind (the brown reeds) and the main channel in the background.

The Richmond Main East resource has no catchment outside the bounds of the resource as it is effectively a knoll emplaced west of Wallis Creek and south of an unnamed tributary of Wallis Creek, therefore the only contributing water from the area is from rainfall within the site. Drainage from the site currently flows to the south, east and north.

An abandoned railway embankment is located along the northern edge of the resource effectively capturing any water that may drain north, this water is then conveyed east to a flood plain on the eastern bank of Wallis Creek. Water draining east or south is effectively unrestricted.

5.6.2 Water Quality

Water qualities in the catchments vary, Aberdare East and Neath are both responsible for the considerable degradation of water qualities in their respective catchments while Richmond Main East does not appear to have any appreciable impact on the water quality within Wallis Creek. A more detailed discussion is presented in the sections below.

Figure 5.8: Looking east over Wallis Creek from the edge of the Richmond Main East resource.

5.6.2.1 Aberdare East

Water quality draining from the Aberdare East tailings dam is typified by high acidity, salinity and iron. Sampling has been undertaken at the site in 1993 and 1999 by the Department of Mineral Resources (now DPI-MR) and in 2002 as part of an honours thesis titled "The Geochemistry and Remediation of Greta Coal Measure Washery Waste Seepage at Aberdare NSW", prepared by J. P. Berry). Key sampling locations are illustrated in Figure 5.1 and the analysis is presented in **Table 5.12**.

Table 5.12: Water quality monitoring at Aberdare East

Parameter	ANZECC 2000 Trigger Values for 80% Protection of Aquatic Ecosystems)	Up gradient of Tailings Dams (2002)	Tailings Dam Leachate (2002)	Dam south of Chitter Resource Area (1999) #
pH	6.5-8.5	6.99	**2.61**	**2.95**
EC (mS/cm)	00.5-1.5	1.27	**3.85**	**2.7**
CO_3^{-2} Alkalinity mg/L	~	0	0	0
HCO_3^- Alkalinity mg/L	~	35	0	0
Aluminum (mg/L)	0.15	0.006	**36.949**	-
Iron (mg/L)		0.745	168.255	35
Manganese (mg/L)	3.6	0.171	**9.249**	**5.25**
Nickel (mg/L)	0.017	0.002	**0.653**	-
Zinc (mg/L)	0.031	0.006	**0.679**	**0.57**

Parameter	ANZECC 2000 Trigger Values for 80% Protection of Aquatic Ecosystems)	Up gradient of Tailings Dams (2002)	Tailings Dam Leachate (2002)	Dam south of Chitter Resource Area (1999) #
Chloride (mg/L)		87	201.3	129
Sodium (mg/L)		154	278	228
Potassium (mg/L)		11.1	1.65	2
Calcium (mg/L)	1000	39.6	273.6	104
Magnesium (mg/L)		42.85	237	101
Sulfur (mg/L)	1000	288.5	**2772**	**1360**
# This sample was taken in 1999 prior to the rehabilitation of the Chitter Resource Area by the DPI-MR, water quality in this location may have improved, however no considerable rehabilitation work has been undertaken on the tailings dam area, as such drainage continues to leach from this area to this location.				
Values highlighted in bold illustrate an exceedance of the ANZECC 2000 trigger value for 80% protection of aquatic environments. The 80% trigger values are generally adopted for highly disturbed catchments such as this one.				

From Table 5.12 it can be see that water up gradient of the tailings dams is relatively good quality meeting the ANZECC trigger values for 80% protection of the aquatic environment. However as water passes through the site the water quality significantly declines.

The acidic seepage draining the tailings area has been the subject of numerous proposals for remediation including the use of lime and seawater neutralised bauxite refinery residues applied in various methods including direct addition, batch treatment and permeable reactive barriers (refer URS study).

Sampling undertaken in 1999 indicated that the wetland west of the Acid Dam appeared to substantially improve the water quality prior to its discharge from the site.

5.6.2.2 Neath

Water quality emanating from Neath appears to be similar to Aberdare East. An honours thesis titled “A Study of Acid Mine Drainage: Neath Washery a Case in Point” prepared by V. Garling in 2002 sampled several locations around the site, an additional sample was also taken form the creek draining beneath Maitland Road in 2006. Sampling locations are illustrated in Figure 5.1 and the analysis is presented in **Table 5.13**.

Table 5.13: Water quality monitoring at Neath

Parameter	ANZECC 2000 Trigger Values for 80% Protection of Aquatic Ecosystems)	Confluence of Creeks east of Washery Area (2001)#	Creek draining site at Maitland Road (2001)#	Creek draining site at Maitland Road (2006)
pH	6.5-8.5	2.90	3.10	5.07
EC (mS/cm)	00.5-1.5	0.434	0.224	0.185
CO3-2 Alkalinity mg/L	~	<1	<1	<1
HCO3- Alkalinity mg/L	~	<1	<1	4
Iron (mg/L)	~	53	18	1.3
Aluminum (mg/L)	0.15			
Manganese (mg/L)	3.6	7.4		
Nickel (mg/L)	0.017			
Zinc (mg/L)	0.031	1.5		

Parameter	ANZECC 2000 Trigger Values for 80% Protection of Aquatic Ecosystems)	Confluence of Creeks east of Washery Area (2001)#	Creek draining site at Maitland Road (2001)#	Creek draining site at Maitland Road (2006)
Chloride (mg/L)	~	328	179	10.4
Sodium (mg/L)	~	416	196	21
Potassium (mg/L)	~	16	6	3
Calcium (mg/L)	1000	143	54	11
Magnesium (mg/L)	~	189	80	3
Sulphate (mg/L)	1000	2020	855	64
# Sourced from URS Report Prepared for DPI-MR 2003				

Table 5.13, illustrates the poor water qualities that are found at Neath. The latest sample taken in 2006, was during a dry period after a short rainfall event and is therefore likely to be substantially diluted, showing minimal evidence of the upstream acid source.

Neath has a ongoing history of saline acidic leachate emanating from the chitter and tailings emplacements as indicated by the analysis above. The Neath site has been subject to water treatment works by the Kurri Kurri Landcare group in 2005, the water treatment was by way of a small lime dosing plant.

5.6.2.3 Richmond Main East

Water sampling was undertaken in 2006 in Wallis Creek immediately upstream and downstream of the site as illustrated in Figure 5.1. Results of the analysis is shown in **Table 5.14**.

Table 5.14: Water quality monitoring at Richmond Main East

Parameter	ANZECC 2000 Trigger Values for 80% Protection of Aquatic Ecosystems)	Wallis Creek Upstream of Richmond Main East (2006)	Wallis Creek Downstream of Richmond Main East (2006)
pH	6.5-8.5	6.82	6.79
EC (mS/cm)	00.5-1.5	665	659
CO_3^{-2} Alkalinity mg/L	~	<1	<1
HCO_3^- Alkalinity mg/L	~	61	62
Iron (mg/L)	~	1.02	0.67
Chloride (mg/L)	~	127	123
Sodium (mg/L)	~	75	73
Potassium (mg/L)	~	4	4
Calcium (mg/L)	1000	16	16
Magnesium (mg/L)	~	12	12
Sulfur (mg/L)	1000	34	32

It is apparent that from the results in Table 5.14 that there is no appreciable impact to water qualities from the resource at the time of sampling. The nil impact is probably due to the high flows within Wallis Creek relative to the potential contribution from the resource as there is no permanent or ephemeral drainage lines leaching through the resource.

5.6.3 Surface Water Users

For the entire Black Creek catchment there are 129 surface water licences which can take approximately 5,206 megalitres of water per year for numerous purposes of which irrigation demand is highest in summer and has a high value of production as a result of the irrigation. Black Creek is considered to have a high level of economic significance to the local community (Water sharing in the Black Creek water source, DNR 2006).

For the entire Wallis Creek (including Swamp Creek) catchment there are 17 surface licenses which can take approximately 500 megalitres of water per year. Irrigation demand is highest in summer when the peak demand for water may be as high as 8 megalitres per day. The demand for water during summer often exceeds flow. Wallis Creek is considered to have a low level of economic significance to the local community (Water sharing in the Black Creek water source, DNR 2006).

Notwithstanding the above, the main user of surface waters in close proximity to the sites is the environment. Water emanating form the Aberdare East and Neath resources are likely to be detrimental to downstream environmental users in its current form, given the low pH and high salinity.

5.6.4 Conceptual Water Management System

The conceptual water management system (WMS) for the Aberdare East and Neath sites is illustrated in **Figure 5.9**, and the WMS at the Richmond Main East resource is illustrated in **Figure 5.10**, the key components of these are described in the sections below.

5.6.4.1 Water Usage and Supply

Onsite water use is limited primarily to dust suppression and potentially rehabilitation if required. Water required for dust suppression will be initially sourced from sedimentation ponds providing the water quality is acceptable. This water would be distributed around the site by a small mobile pump and pipe network and distributed via small static sprays. Water required for dust suppression outside the disturbed working area on each site would be sourced from the Hunter Water Corporation public mains system by registered contractors at nearby filling locations, the water will be distributed via water trucks.

5.6.4.2 Clean Water Management

Clean water diversion swales are already present at each of the sites diverting surface water flows around the resource areas in various conditions.

Internally within the resource area, diversion swales will be constructed where required to minimise the volume of water that is inadvertently captured from within the disturbance area. These swales will continually change as the extraction of the resource continues to ensure their effectiveness.

5.6.4.3 Dirty Water Management

Dirty water contaminated through the exposure of surface waters to operation areas at each of the resources will be captured by appropriately sized drainage swales and directed to one or a series of sedimentation basins.

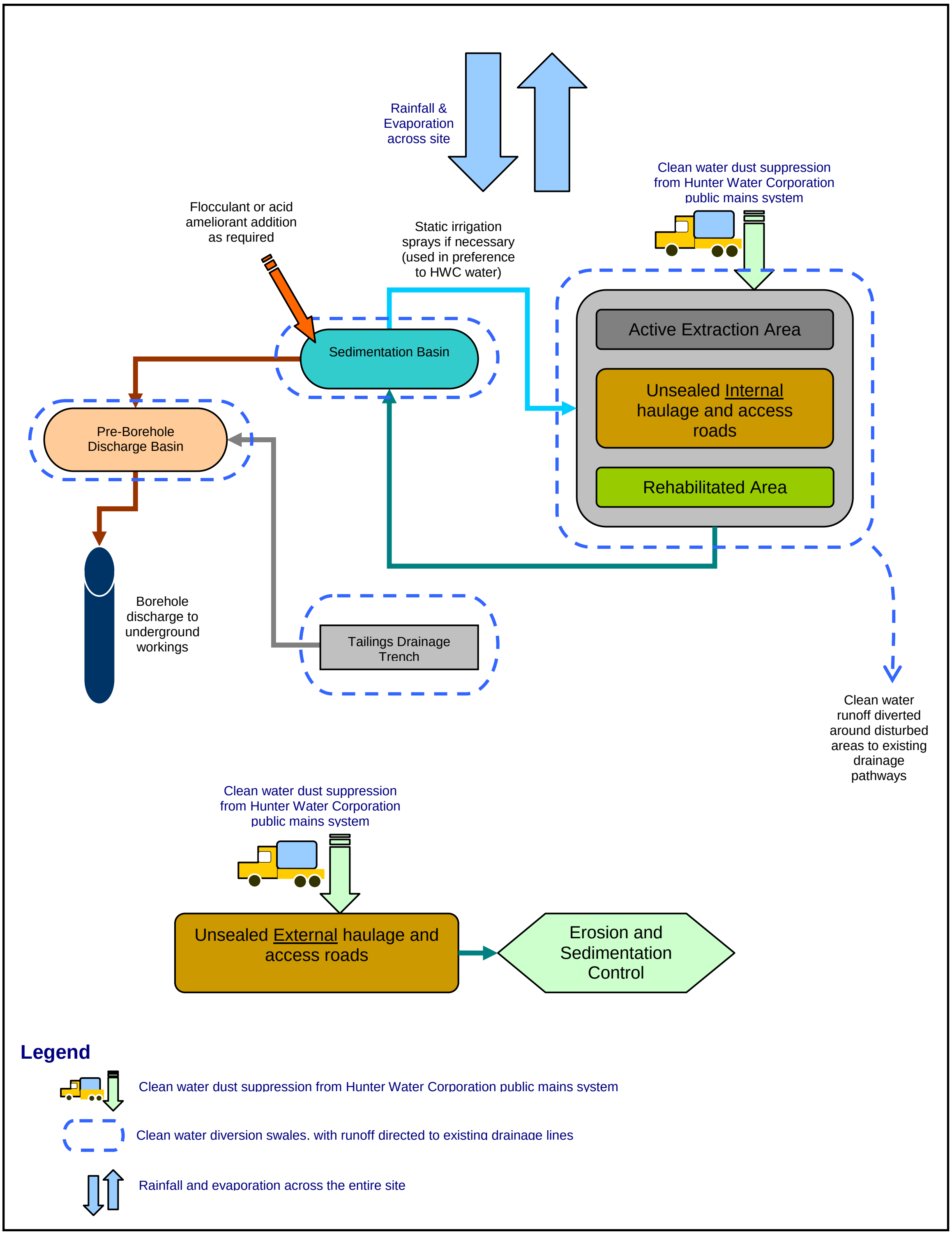

Figure 5.9: Conceptual water management and use for the Aberdare East and Neath rehabilitation sites.

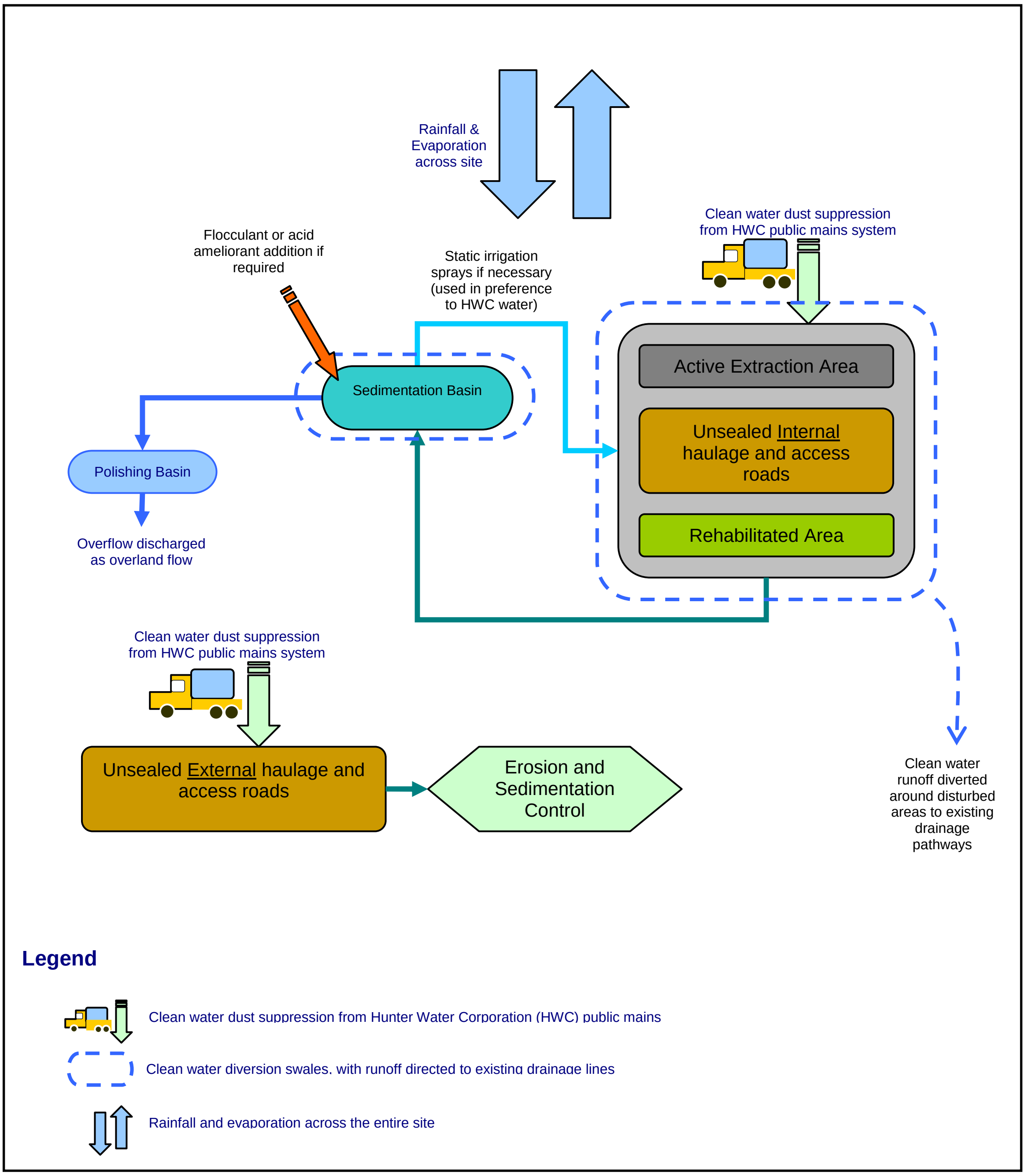

Figure 5.10: Conceptual water management and use for the Richmond Main East rehabilitation sites.

In the event that additional water is required onsite for use in dust suppression, water may be pumped from the sedimentation basins to feed static sprays, in the event this water is of poor quality it may be treated using an additive such as lime (to correct the pH) or a flocculent (to settle sediments).

From the sedimentation basins excess or poor quality waters will be conveyed by pump and pipe or gravity depending on the stage of the resource extraction to a pre-borehole discharge basin at Aberdare East and Neath and by gravity to a polishing basin at Richmond Main East.

The Pre-borehole discharge basin will discharge preferably by gravity to a borehole intersecting the underground workings down gradient of the basin. The construction of a specific borehole to enable gravity feed requires significant confidence in the orientation and accuracy of the mapped underground workings to enable the bore to intersect underground voids, if there is limited confidence, water will be pumped and discharged to holes drilled into the respective colliery shafts caps at Aberdare East or Aberdare Shaft and Neath.

The polishing basin at Richmond Main East will be provided to ensure that in the unexpected event that an additive such as lime (to correct the pH) or a flocculent (to settle sediments) is required in the sediment basin, the water can be effectively discharged to overland flow with negligible impact to Wallis Creek.

5.6.4.4 Sizing of Structures

Prior to the commencement of operations a water management plan will be developed as a component of the MOP that will detail the sizing and location of sediment dams, notwithstanding, preliminary calculations have been undertaken by the Department of Lands (Soil Conservation Service) and is included within **Appendix 6** in an erosion and sediment control plan.

Preliminary sizing of the main sedimentation dams and drainage structures has identified that using a conservative 1 in 20 year average recurrence interval (ARI) the following dams would be required at the three sites:

Aberdare East – two dams totalling approximately 9ML (7ML and 2ML)

Neath – two dams totalling approximately 3.6ML (2.6ML and 1ML)

Richmond Main East – one basin totalling 1.7ML.

5.6.5 Surface Water Impacts

Potential impacts to surface water as a result of the rehabilitation process at the three sites are outlined below:

- Sedimentation of surface waters as a result of runoff from disturbed areas and access roads;

- Export of contaminated runoff and contamination of surface waters as a result of the increased leaching and oxidation from the exposure of potentially acidic and saline carbonaceous materials, in the case of Aberdare East and Neath, there are already an existing problems;

- Hydrocarbon contamination of surface waters from onsite refuelling, leakages or spills from machinery;

- A net positive impact through the realignment of past diversion works around the Aberdare East tailings dams, and remediation of the currently eroding diversion channel; and

- A net positive impact to the Wallis, Fishery and Black Creek Catchment through the removal of carbonaceous materials, that for Aberdare East and Neath are known to leach acid and salt laden waters to the surrounding environment.

5.6.6 Surface Water Mitigation

Mitigation measures to address potential impacts to receiving surface waters include:

- Construction and regular maintenance of catch drains, silt fences and sedimentation ponds to contain sediment downslope of disturbed areas;
- Seeding and, where required, controlled fertilising of all disturbed areas to provide for rapid grass cover;
- Clear identification and delineation of areas that will be disturbed as part of the extraction process so that disturbance is limited to those areas;
- Minimising the clearing of vegetation to allow the works to proceed and to minimise machinery disturbance outside of these areas;
- Limiting the number of roads and tracks established;
- Construction of drains upslope of areas to be disturbed to convey clean runoff away from disturbed areas;
- Constructing access road and earthworks cut and fill batters at slopes (of 1V:3H or less, where possible), to maximise long term stability;
- Reshaping, topsoiling and vegetating as soon as practical;
- Progressively stripping and stockpiling topsoil for later use in rehabilitation;
- Regular maintenance of erosion control works and rehabilitated areas;
- Progressive stabilisation and revegetation of disturbed areas;
- Addition of flocculants or ameliorants to settle or correct the pH of waters captured on site;
- Placement of appropriate spill containment kits on each site/vehicle (as appropriate) to provide a quick response in the event of fuel or hydraulic spills;
- Discharge of excess and poor quality waters to underground mine workings;
- Prior to the commencement of works at Richmond Main East undertake detailed survey of the resource highlighting its proximity to Wallis Creek and submit to the Department of Natural Resources and the Catchment Management Authority to develop detailed procedures for the resource extraction in the vicinity of Wallis Creek; and
- Development of an appropriate inspection and maintenance system to ensure the above mitigation measures are effective and managed appropriately.

The discharge of acidic seepage from the Neath washery site was evaluated in 2003 by URS on behalf of DPI-MR, it was concluded that the discharge of acidic seepage to the underground mine workings was an acceptable short term practice, qualifying that the destination of the seepage was ultimately not understood. HEM are proposing to use this practice for the discharge of acidic seepage, that will progressively improve in quality as the project proceeds.

5.6.7 Monitoring and Contingency Strategy

To effectively manage the listed potential impacts and proposed mitigation measures it is necessary to develop an effective monitoring strategy (using visual and chemical indicators) to ensure that downstream water users and the environment are not adversely impacted as a result of the removal of these resources.

Visual monitoring includes the inspection of all operational practices, rehabilitation sedimentation structures and clean water diversions at the three sites. The respective site water management strategy will be reviewed regularly to ensure that the adopted practices/ structures in place are achieving the relevant objectives. The reviews will happen on a regular basis, more frequent in times of wet weather and immediately following storm events to assess their effectiveness, should it be identified that the structure is ineffective or could be improved, observations will be recorded photographically, and improvements made immediately.

The following monitoring of surface water will be undertaken:

- Monthly sampling and analysis of water discharging to underground workings at Aberdare East and Neath for pH, conductivity, iron, sodium, chloride, and sulphur;
- Monthly sampling and analysis downstream of the Neath resource pH, conductivity, iron, sodium, chloride, sulphur and alkalinity;
- Monthly sampling and analysis at Aberdare East of water up gradient of the Tailing Dam and down gradient of the Chitter resource area for pH, conductivity, iron, sodium, chloride, sulphur and alkalinity; and
- Sampling of waters in the polishing basin at Richmond Main East prior to discharge to overland flow for pH, conductivity, iron, sodium, chloride, sulphur and alkalinity.

If monitoring identifies adverse changes in the water quality a detailed review of operating practices and the water management system will be undertaken to determine areas that require improvement.

5.7 Soils

Presented in the following sections is a description of the local soils, impacts and proposed mitigation. The specialist report prepared by the Department of Lands (Soil Conservation Service), is presented as **Appendix 6**.

5.7.1 Soil Sampling and Analysis

Soil samples were collected from each of the sites, including reject material from the Hebburn No. 3 processing plant, to identify the value of site soils for rehabilitation works. Soil analyses included electrical conductivity, pH, particle size, dispersion percentage and the Emerson aggregate test. Additional tests for soils generated by the Hebburn No. 3 processing plant, which are proposed for use in rehabilitation works, were performed to assess the constraints of this potential growth medium. Tests included cation exchange capacity; exchangeable sodium, potassium, calcium, magnesium and aluminum; available water exchange capacity; field capacity and wilting point.

5.7.2 Soil Conditions

Due to the extent of past disturbance, soil profiling has been conducted using land use histories in association with analytical results.

5.7.2.1 Aberdare East

The A horizon of the natural soils within the Aberdare East location are typically dark to yellow brown loamy sands with sandy fabric, moderately moist and few roots. This significantly contrasts with the disturbed soils of the resource, which range from acidic saline silty clay scalds to very dark greyish brown loams. Localised saline and acidic soils appear to be associated with silty clays and heavy clays.

The soil analysis for samples collected from surface materials of the Aberdare East deposit (i.e. nine analysed samples) have identified soil conditions with acidity ranging from moderate to extreme (5.6 – 3.5 pH), with one soil sample identifying the presence of alkaline soils (pH 8.3), and salinity ranging from low to high (i.e. 0.4 – 22 dS/m). These results are consistent with recent and historical visual observations, with salt scalds and iron precipitation within drainage lines common throughout the immediate catchment. Acid mine drainage is known from this site.

Dispersion testing indicated that all soil samples were characterised by low dispersion, with potential for dispersion after disturbance. The Emerson aggregate test indicates that the soils are prone to slacking, which may be indicative of the low organic matter content.

5.7.2.2 Neath

The A horizon (0.00 – 0.34 m) of the natural soils that adjoin the disturbed terrain of the Neath deposit are characterized by brown to very dark greyish brown clay loams. There is an abrupt boundary with the B horizon (i.e. 0.34 – 0.80 m), which is characterised by a reddish brown clay, with gradual integration with siltstone and sandstone in the C horizon. This significantly contrasts with the disturbed soils of the resource, which range from acidic saline silty clay scalds to very dark grey/ yellow brown loams/ light clays. Localised saline and acidic soils appear to be associated with silty clays and heavy clays.

The soil analysis for samples collected from surface materials of the Neath deposit has identified soil conditions with acidity ranging from neutral to extreme (7.0 – 2.8 pH) and salinity ranging from low to high (i.e. 1.7 – 21 dS/m). These results are consistent with recent and historical visual observations, with salt scalds and iron precipitation within drainage lines common throughout the immediate catchment. Acid mine drainage is known from this site.

Dispersion testing indicated differences between the two soil samples with neutral acidity and low salinity, with one sample indicating spontaneous dispersion while the other having slight dispersion quality after being reworked. The soil sample with high salinity and extreme acidity was aggregated, hence not prone to dispersion. The Emerson aggregate test indicates that all the soils are prone to slacking, which may be indicative of the low organic matter content.

5.7.2.3 Richmond Main East

The natural soils adjoining the Richmond Main East resource are mostly black (A1 horizon) to dark reddish brown (B horizon) clays, with the intermediate A2 horizon consisting of dark greyish brown light clays. The soil pH is moderately acidic (5.5 – 6) and is consistent with natural soil conditions of the district.

The soil analysis for samples collected from surface materials of the Richmond Main East deposit (i.e. two analysed samples) have identified soil conditions with acidity ranging from high to extreme (5.1 – 4.3 pH) and low salinity (i.e. < 1.7 dS/m). Dispersion testing indicated differences between the two soil samples, with the extremely acidic sample demonstrating moderate to spontaneous dispersion while the highly acidic soil having slight dispersion qualities after reworking. The Emerson aggregate test indicates that both soil samples are prone to slacking, which may be indicative of the low organic matter content.

5.7.2.4 Hebburn No. 3 Soil Medium

The processing of chitter and tailings at the Hebburn No.3 plant generates a significant volume of sandy material that would otherwise be disposed of to the underground workings with the remaining slimes. The soil analysis for samples collected from Hebburn No. 3 (i.e. one sample) has identified loamy sand that is both extremely acidic and saline. Predictably, the sodium exchangeability is high (i.e. 35%), which is indicative of a sodic soil (i.e. poor physical condition). Both exchangeable potassium and calcium were low, while exchangeable magnesium was high. The soil samples sandy texture (i.e. large particle size) predictably resulted in low water availability capacity. The Emerson aggregate test indicates that the soil sample is prone to slacking, which may be indicative of the low organic matter content. No dispersive qualities were identified within the soil sample.

While this material exhibits some negative traits, additional leaching of the material by rainfall and amelioration using lime or similar may prove the material suitable to embellish soils for the rehabilitation at the three sites.

5.7.3 Rural Land Capability and Agricultural Suitability

5.7.3.1 Rural Land Capability

Rural land classification mapping for the Cessnock and Newcastle 1: 100 000 map sheets identifies Aberdare East and Neath as containing Class IV and VI lands. The majority of Richmond Main East is classed as IV, with isolated areas of Class VIII located adjacent to Wallis Creek. These rural capability classifications for these sites indicate the land is suitable for grazing, with Class VIII indicative of lands that are unsuitable for rural activities.

5.7.3.2 Agricultural Suitability

Agricultural suitability is a classification system that considers land arability for crops, pasture and livestock using climate, topography and soil characteristics. The biophysical characteristics of Aberdare East and Neath indicate a Class 5 agricultural suitability, meaning that these sites are generally unsuitable for agriculture. The majority of Richmond Main East is considered Class 4, meaning that this site is suitable only for grazing purposes.

No areas suitable for cropping activity are to be adversely impacted by the proposal. To the contrary, it is considered that the rehabilitation of these sites will have an indirect net benefit for productive agricultural landscapes within the Black Creek and Wallis Creek catchments by removing salinity and/ or acid generating point sources that contribute to poor water quality.

5.7.4 Impacts to Soils

The soil assessment identified the following potential impacts for soils contained within the development area:

- Poor plant growth due to existing extremely acidic and saline soils;
- Increased erosion risk for soils with dispersive capabilities; and
- Low organic matter content implying poor soil condition and potential soil slacking.

The loamy sand soil materials sourced from the Hebburn No. 3 processing plant, which are proposed for use in the rehabilitation of these sites, has been identified as having extreme salinity and acidity levels. Hence, additional processing and amelioration will be required to prevent localised impacts of plant growth and water quality, should this material be required as a soil medium.

5.7.5 Safeguards, Mitigation and Management of Soils

5.7.5.1 Safeguards

Topsoil resources contained within the disturbance areas will form a major component of the rehabilitation phase. Hence, the management and conservation of this resource is considered important to the overall performance of the operation. Accordingly, HEM will undertake specific soil management and conservation strategies to ensure there is a sufficient supply of materials aiding the progressive rehabilitation of each site. Strategies include the following:

- Identification and quantification of suitable soil resources;
- Optimise the recovery of suitable soil resources;
- Provide clear guidance on stripping and stockpiling procedures;
- Separate and treat unsuitable soil resources;
- Manage suitable and unsuitable topsoil stockpiles so as to not degrade the resource; and
- Establish effective methods for utilising available soil reserves in rehabilitation including potential soil reserves acquired from the Hebburn No. 3 processing plant.

5.7.5.2 Strategies for Improving Soil Health as a Plant Growth Medium

All the soils throughout the project area were of an acid pH trend, elevated salinity and low in organic matter. These factors reduce the availability of nutrients and create and unfavourable microclimate for germination of plant seeds. The key management practices to rectify these issues are:

- Application of the appropriate amount of soil ameliorant and fertiliser;
- The establishment of a rapid growing cover crop on stockpiles and rehabilitation sites to initially protect the soil's physical and chemical properties and subsequently improve organic matter content; and
- Increased processing of the soil resource produced by the Hebburn No. 3 processing plant by leaching with rain water to reduce the saline characteristics of the soil. The addition of fertilisers to the soil will be considered to improve exchangeable potassium and calcium. Lime will be applied to all soils containing elevated acidity levels (i.e. <5.5

pH) to neutralise this detrimental chemical property. Gypsum will be applied to improve calcium content in the soils and help improve soil structure.

5.7.5.3 Mitigation

The removal of surface carbonaceous materials form the site will require the stripping and stockpiling of existing soil capping (i.e. potential topsoil), where available, to enable machinery access to the resource. Following the removal of the carbonaceous materials, suitable topsoil identified for rehabilitation purposes will be redistributed throughout the final landform. Soil management issues arising during this process will include soil salinity, acidity, dispersion and organic matter content.

The analysis of soil samples from each of the sites has identified soils unsuitable for rehabilitation activities, due primarily to high to extreme salinity levels. Accordingly, it is recommended that these soils be separately stockpiled from those with lower salinity levels to minimise the transfer of contained salts to the final landform. Treatment of these saline soils may include leaching and/or controlled blending with soils of lower salinity levels.

While acidic soils also represent a constraint for the use of these soils in rehabilitation works, it is considered that using lime to neutralise acidity is a simple process that will suitably improve soil conditions for use in rehabilitation works.

5.7.5.4 Management

The following soil stockpile management practices will maintain the viability of the soil resources:

- Keep vehicular traffic to a minimum on the soils to be stripped. Exclude all traffic from soils that are sensitive to structural degradation;
- Construction of stockpiles with a “rough” surface condition to reduce erosion hazard, improve drainage and promote revegetation;
- Soil stockpiles will be no more then 60 cm high to maintain the soil microflora and macroflora biology. Where site constraints do not allow this, stockpiles will be no deeper then 3 meters in order to minimise problems with anaerobic conditions;
- Fertilise and seed stockpiles which are to be inactive for extended periods to maintain soil structure, organic matter and microbial activity;
- Installation of silt fences around stockpiles to control potential loss of stockpiled soil through erosion prior to vegetative stabilisation;
- Stockpiles to be deep-ripped to establish aerobic conditions, prior to reapplication of stockpiled soil for rehabilitation;
- The appropriate soil ameliorant be applied at an appropriate rate to dispersive soil stockpiles where necessary;
- Implement appropriate weed control strategies particularly for any noxious weeds; and
- Immediate revegetation will provide vegetative competition to assist with control of undesirable plant species.

5.8 Land Use

5.8.1 Existing Land Use

Each of the sites is located within rural zoned lands that have, to various degrees, been subject to coal mining activity. The general usage of rural zoned lands within the Cessnock local government area is low intensity agriculture, such as low density cattle or equine grazing, which is primarily due to the localities low soil fertility, extent of native vegetation cover and low average annual rainfall. Viticulture and intensive agriculture such as poultry farming are more common agricultural activities north and northeast of Cessnock where there are larger expanses of cleared lands and/or more suitable soils.

Local land uses are generally passive low intensity activities, a land use history that is consistent with the capabilities of these sites. Both Aberdare East and Neath are owned by the Crown and are in various stages of rehabilitation, with no evidence of any other land use occurring within these areas. Public access to Aberdare East is prohibited unless authorized by the current leasee (HPOTS). Neath is freely open to the public, however the site is not conducive to public use given the irregular topography of the current landforms and its degraded state. Conversely, Richmond Main East is privately owned and is used for cattle grazing.

Current landforms consist of flat benches adjoining steep batters, with natural soil and vegetation cover generally sparse and interrupted by exposed chitter and tailings. Substantial erosion, salt scalds and acid mine drainage issues occur throughout Neath and down slope of Aberdare East resulting in landscapes unsuitable for rural purposes.

5.8.2 Land Use Impacts

The removal of carbonaceous materials from each site will inevitably result in the modification of existing landforms to a form moderately consistent with the pre-mining environment. The restoration of landforms to a pre-mining state will improve the function of local watersheds both in terms of flow and water quality (i.e. removal of contaminants). Further, removing surface salts contained within the carbonaceous resource together with topsoil emplacement and revegetation works will arrest sediment and erosion issues.

5.8.3 Future Land Use

The impact of the proposed works represent a positive influence on currently disturbed landscapes, particularly when considering the increased potential for undertaking permissible land uses listed under a 1(a) Rural “A” zone. At Aberdare East, the proposed works will restore the previous natural landforms and also significantly reduce the extent of surface contaminants that directly contribute to salinity within Black Creek. Land will also be liberated for other potential future uses. Similar benefits will be achieved for Neath, with final landforms potentially consisting of native vegetation cover to embellish the extent of local endangered vegetation and threatened species habitats.

Richmond Main East is currently used for cattle grazing given the low soil fertility of the limited topsoil and exposed carbonaceous materials. Chitter removal and topsoil emplacement, together with revegetation using various grass species, will enhance the agricultural potential of this landscape and potentially increase the grazing value of this area. The proposed outcomes are consistent with the local rural land usage and are considered positive improvements to local rural lands.

5.9 Ecology

The ecological character (flora, fauna and aquatic environments) of the site and wider locality is described in the following sections together with an evaluation of the likely impacts and mitigation measures. The specialist report supporting this section, prepared by Ecovision Consulting, is presented in **Appendix 7**.

5.9.1 Introduction

The study area is located near the northern boundary of the Sydney Basin Bioregion, with the corresponding boundary with the adjoining North Coast Bioregion generally defined as the Hunter River. The majority of the study area is characterised as gently undulating hills and broad drainage corridors with substantial native vegetation cover, which is a characteristic trait of the Lower Hunter sub-region. Cleared lands are prominent within local residential settlements, along road corridors and throughout areas that have experienced mining activities.

The study area is located within a broad transitional zone between the Sydney Basin and North Coast Bioregions, meaning that many plant species and vegetation communities reach their limits of distribution within this area. Similarly, the relative abundance of many fauna species changes across this transition zone, which is likely to correspond with a relative increase in soil fertility and water resources north of the Hunter River (e.g. carboniferous geological formations).

In general, the native vegetation of the broad drainage corridors and low-lying alluviums is characterised by Redgum Forests dominated by either Forest Redgum (*Eucalyptus tereticornis*) or Parramatta Redgum (*Eucalyptus parramattensis spp. decadens*). Spotted Gum (*Corymbia maculata*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*) typically dominate elevated well-drained slopes and ridgelines. Canopy associates throughout the locality may include Rough-barked Apple (*Angophora floribunda*), Grey Gum (*Eucalyptus punctata*), Grey Box (*Eucalyptus moluccana*), Scribbly Gum (*Eucalyptus haemastoma*) or Narrow-leaved Ironbark (*Eucalyptus crebra*).

5.9.2 Survey Methodology

The survey and assessment methods used to prepare the *Ecological Impact Assessment* were acquired from the '*Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*' (DEC 2004) - working draft guidelines. Surveys were stratified according to landscape features that traditionally define ecological systems (e.g. topography, slope, aspect, spoils), with replication also incorporated into the survey design to strengthen the validity of survey results. Base survey units used to define survey stratification and replication are referred to as Ecological Stratification Units (ESUs), which were derived principally from regional vegetation mapping (i.e. Lower Hunter Central Coast Regional Environmental Strategy vegetation mapping – NPWS (2003)).

Field surveys were conducted primarily within the subject site on areas that are identified as experiencing the greatest project impact. However, proximal areas located outside the subject site (i.e. in the study area this being a 10 km radius of the subject site) were also surveyed to assist the classification of ESUs, vegetation types and Endangered Ecological Communities (EECs). Survey methods employed reflect only a selected range of those discussed in the '*Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*' (DEC 2004) - working draft guidelines, with deviation from these guidelines reflective of the impact extant and vegetation characteristics contained within the impact envelope.

5.9.3 Existing Ecological Environment

Presented in the following sections are details of ecological values that are characteristic of the locality. This information has been derived from various local reports and database searches.

5.9.3.1 Vegetation Communities of the Locality

Vegetation of the study area comprises a range of differing vegetation types, which is reflective of the diverse topographical features observed within the area. **Table 5.15** identifies those vegetation communities that occur within the study area (i.e. 10 km radius of the sites) as mapped by the Lower Hunter Central Coast Regional Environmental Strategy (NPWS, 2003).

Table 5.15: Vegetation Extent within the Study Area (NPWS, 2003)

Map Unit (NPWS, 2003)	Vegetation Name	Extent within Study Area (Ha)	Extent within Subject Site (Ha)
1	Coastal Wet Gully Forest	58.9	N/A
1a	Coastal Warm Temperate- Subtropical Rainforest	23.3	N/A
3	Hunter Valley Dry Rainforest	6.6	N/A
5	Alluvial Tall Moist Forest	1,889	N/A
6	Coastal Narrabeen Moist Forest	251	N/A
7	Sheltered Rough Barked Apple Forest	1	N/A
9	Coastal Ranges Open Forest	7	N/A
12	Hunter Valley Moist Forest	211	N/A
13	Central Hunter Riparian Forest	434	N/A
15	Coastal Foothills Spotted Gum - Ironbark Forest	2,671	N/A
17	**Lower Hunter Spotted Gum - Ironbark Forest**	**20,657**	**59.5**
19	**Hunter Lowland Redgum Forest**	**3,598**	**7.4**
21	Hunter Range Grey Gum Forest	83.5	N/A
30	Coastal Plains Smooth-barked Apple Woodland	3,806	N/A
35	**Kurri Sand Swamp Woodland**	**2,448**	**10.0**
37	Swamp Mahogany - Paperbark Forest	0.5	N/A
40	Swamp Oak Rushland Forest	14	N/A
42	Riparian Melaleuca Swamp Woodland	2	N/A
46	Freshwater Wetland Complex	99	N/A

Native vegetation of the locality is classifiable into at least three flora communities with vegetation communities bolded in Table 5.15 representing those that have been mapped within the site or are immediately adjacent to the proposed development (NPWS, 2003). Kurri Sand Swamp Woodland, Hunter Lowlands Red Gum Forest, Lower Hunter Spotted Gum

Ironbark Forest and Quorrobolong Scribbly Gum Woodland are EEC's with known occurrences within the general locality (DEC, 2006).

These plant communities are predominantly restricted to the Lower Hunter, where they form a mosaic of small, medium and large sized remnants amidst rural residential developments, agricultural land and coal mining leases. Connectivity between remnants varies in accordance with the intensity of these land uses, with local connectivity being high as a consequence of the Werakata National Park and its proximity to the project.

5.9.3.2 Significant Flora Values of the Locality

Databases were reviewed to identify the flora species of the study area, (DEC, 2006; DEH, 2006). In summary, the DEC (2006) wildlife atlas database search identified 591 flora species records within the study area comprising of 478 natives and 113 exotics. Seven of these flora species are listed as threatened biodiversity, present within the area, with some of these species known to be present nearby the site. **Table 5.16** identifies the threatened flora species of the locality, with those in bold representing species known to be located nearby the site. Those that are considered 'Subject Species' for this assessment are also identified.

Table 5.16: Potential Subject Species within the Locality

Common Name Flora	Scientific Name	Legal Status	Records in Study Area	Subject Species
Bynoe's Wattle	Acacia bynoeana	E1	5	Yes
	Callistemon linearifolius	V	21	Yes
Slaty Red Gum	Eucalyptus glaucina	V	5	No
	Eucalyptus parramattensis ssp. decadens	V	62	Yes
	Grevillea parviflora subsp. parviflora	V	94	Yes
	Rutidosis heterogama	V	45	Yes
	Tetratheca juncea	V	28	No

Details of the habitats for these species are provided in the specialist report.

5.9.3.3 Significant Fauna Values of the Locality

The DEC (2006) wildlife atlas database identified 137 fauna species records within the study area, which consists of 135 natives and 2 exotics. Thirty-four of these fauna species are listed as threatened biodiversity. **Table 5.17** identifies the threatened species of the locality, with those in bold representing species known to be located nearby the site. Those species that are considered 'Subject Species' for this assessment are also identified.

Table 5.17: Threatened species of the locality

Common Name	Scientific Name	Legal Status	Records in Study Area	Subject Species
Green and Golden Bell Frog	Litoria aurea	E1	2	No
Green-thighed Frog	Litoria brevipalmata	V	2	No
Speckled Warbler	Pyrrholaemus sagittatus	V	10	Yes
Black-breasted Buzzard	Hamirostra melanosternon	V	3	No
Magpie Goose	Anseranas semipalmata	V	4	No
Gang-gang Cockatoo	Callocephalon fimbriatum	V	12	Yes
Glossy Black-Cockatoo	Calyptorhynchus lathami	V	15	Yes
Black-necked Stork	Ephippiorhynchus asiaticus	E1	2	No
Brown Treecreeper	Climacteris picumnus	V	50	Yes

Wompoo Fruit-Dove	Ptilinopus magnificus	V	1	No
Diamond Firetail	Stagonopleura guttata	V	1	No
Pied Oystercatcher	Haematopus longirostris	V	1	No
Comb-crested Jacana	Irediparra gallinacea	V	13	No
Little Tern	Sterna albifrons	E1	1	No
Black-chinned Honeyeater	Melithreptus gularis gularis	V	53	Yes
Regent Honeyeater	Xanthomyza phrygia	E1	17	Yes
Hooded Robin	Melanodryas cucullata	V	2	No
Grey-crowned Babbler	Pomatostomus temporalis	V	30	Yes
Swift Parrot	Lathamus discolor	E1	56	Yes
Turquoise Parrot	Neophema pulchella	V	8	No
Painted Snipe	Rostratula benghalensis	E1	1	No
Barking Owl	Ninox connivens	V	2	Yes
Powerful Owl	Ninox strenua	V	10	Yes
Masked Owl	Tyto novaehollandiae	V	7	Yes
Sooty Owl	Tyto tenebricosa	V	1	No
Eastern Freetail-bat	Mormopterus norfolkensis	V	11	Yes
Yellow-bellied Glider	Petaurus australis	V	23	Yes
Squirrel Glider	Petaurus norfolcensis	V	24	Yes
Koala	Phascolarctos cinereus	V	5	Yes
Grey-headed Flying-fox	Pteropus poliocephalus	V	35	Yes
Eastern False Pipistrelle	Falsistrellus tasmaniensis	V	3	Yes
Little Bentwing-bat	Miniopterus australis	V	8	Yes
Eastern Bentwing-bat	Miniopterus schreibersii	V	12	Yes
Greater Broad-nosed Bat	Scoteanax rueppellii	V	3	Yes

5.9.4 Ecology of the Impact Area

5.9.4.1 Vegetation Cover and Plant Species

The flora survey identified 193 species, consisting of 143 natives and 50 exotics, within three vegetation communities (ESUs) dominated by various combinations of the following canopy species: Parramatta Redgum (*Eucalyptus parramattensis spp. decadens*); *Eucalyptus capitellata*, Spotted Gum (*Corymbia maculata*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). A summary description of the sites vegetation is provided in the following section, Field verified vegetation mapping is presented in **Figure 5.11**.

General Observations

Tree Canopy

Tree cover of elevated dry positions within the landscape is mostly characterised by an open forest structure dominated by Spotted Gum (*Corymbia maculata*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Shrubby woodlands occur throughout lower lying lands and are dominated by species such as Parramatta Redgum (*Eucalyptus parramattensis ssp. decadens*) and Narrow-leaved Rough-barked Apple (*Angophora bakeri*). These vegetated landscapes are particularly common throughout lands adjacent to the proposed transport routes.

Figure 5.11: Field verified vegetation mapping of the study area.

An interrupted tree canopy occurs throughout the interface between the disturbed terrain containin the emplaced carbonaceous materials and adjoining tracts of native vegetation, with tree heights and maturity reflective of this disturbed environment (i.e. mainly young trees and samplings containing no hollows).

Shrub Canopy

A shrub stratum is common throughout selected parts of the disturbed terrain within Aberdare East and Neath, with the prevalence of this vegetation primarily due to past rehabilitation works. Common natives such as Wattle (*Acacia parvipinnula*), Blackthorn (*Bursaria spinosa*), Gorse Bitter Pea (*Daviesia ulicifolia*) and *Melaleuca nodosa* are characteristic of this stratum. Few shrubs were noted at Richmond Main East due to the extent of grazing activity and absence of clay capping. The shrub understorey of the adjoining open forests and woodlands is typically dense, with less dense shrub understorey associated with areas exposed to recent fires (i.e. transport route between Richmond Main East and Leggetts Drive).

Groundcover Stratum

Native grasses and herbs dominate the majority of the subject sites ground strata vegetation cover. The most regularly observed native grasses throughout the subject site were Threeawn Grass (*Aristida vagans*), Wire Grass (*Entolasia stricta*), Lovegrasses (*Eragrostis brownii*) and Kangaroo Grass (*Themeda australis*). The groundcover density decreased with increased shrub canopy. Commonly observed herbs throughout the subject site include White Root (*Pratia purpurascens*), Rock Fern (*C. sieberi*), Mat Rush (*Lomandra filiformis*), *Goodenia hederacea* and *Dianella revoluta.*

Exotic Species

Exotic species were infrequently observed throughout the subject sites, with the majority of observations restricted to weeds such as Lantana (*Lantana camara*) at Richmond Main East and Pampass Grass at Aberdare East. These two species were generally restricted to previously disturbed landscapes, with occurrences in adjoining native vegetation limited to absent. Other infrequently observed exotic species in disturbed areas include Paspalum (*Paspalum dilatatum*), Fleabane (*Conyza bonariensis*), Ribwort (*Plantago lanceolata*) and Fireweed (*Senecio madagascariensis*).

5.9.4.2 Fauna and their Habitats

The fauna survey identified 51 avian species, with 12 mammal, 8 reptile and 5 amphibian species within the subject site, representing approximately 55% of observed fauna diversity within the study area (DEC, 2006).

The field survey also identified five fauna habitat categories that provide opportunity for a range of fauna activity such as foraging and breeding. These habitat categories are as follows:

- Grasses and herbs of the grassland and shrubland environs;
- Moderately dense shrub cover throughout shrublands, woodlands and open forest vegetation;
- A nectar producing tree canopy dominated by the winter flowering Spotted Gum;
- Scattered fallen timber and leaf litter; and

- Aquatic environs in areas adjoining the eastern boundary of the Aberdare East resource.

Commentary on these observations is provided as follows for the impact area (i.e. carbonaceous emplacements).

Avifauna

The absence of trees and shrubs substantially limits the availability of foraging resources such as nectar, thereby disadvantaging species reliant on this foraging resource such as honeyeaters and insectivores. Other common open woodland and woodland species such as the Noisy Miner (*M. melanocephala*), Magpie-Lark (*Grallina cyanoleuca*) and Galah (*E. roseicapilla*) will only infrequently forage throughout this vegetation due to the limited presence of suitable foraging values. Conversely avian species such as the Pied Butcherbird (*Cracticus nigrogularis*) and Magpie (*Gymnorhyna tibicen*) will frequently be observed within the wide-open grassland environments such as those within the resource areas.

Breeding activity will be restricted to ground dwelling species such as the Masked Lapwing (*Vanellus miles*) and Quail (*Coturnix pectoralis*). However, species such as the Speckled Warbler (*Chthonicola sagittata*), which is also a ground-nesting species, will not occur within the impact area due to the absence of a shrub canopy and diverse range of foraging habitats. The Diamond Firetail (*Stagonopleura guttata*), a tree nesting species, is unlikely to be found throughout the grassy disturbed terrain due to the limited diversity of native grasses and lack of tree roost sites.

Mammals

The absence of a tree canopy throughout the grassland and shrubland formations substantially limits the potential for arboreal species such as possums to occur within this area. These mammals only infrequently use these treeless areas for movement purposes. However, microchiropteran bats may forage over the disturbed terrain, particularly during the onset of the warmer months where insect activity is at its peak.

The grassland environments enhances foraging habitat for exotic fauna such as the European Fox (*Vulpes vulpes*) and Rabbit (*Oryctolagus cuniculus*). Small native ground fauna reliant on habitat features such as fallen timber and rocky outcrops are likely to be absent from this vegetation due to the influence of past land clearing activities and predation. However, the larger mobile species such as the Eastern Grey Kangaroo (*Macropus gigantea*) are likely foraging occupants of this area, particularly during nocturnal periods.

Reptiles

The vegetation communities of the sites are unsuitable for small sedentary reptilian species of limited home ranges due to the absence of a rocky outcrops, fallen timber and leaf litter, tree canopy and shrubs for shelter, foraging and breeding. Species such as the Sun Skink (*L. delicata*), Barred-side Skink (*Eulamprus tenuis*), Wall Skink (*Cryptoblephurus virgatus*) are likely to be absent from this area.

Larger more mobile reptiles such as the Lace Monitor (*Varanus varius*) and Bearded Dragon (*Pogona barbata*) are also unlikely to occur within this vegetation community due to the limited occurrence of suitable foraging and breeding habitats. However, these species may infrequently use this area for movement, particularly where there is adjoining areas of native vegetation.

Amphibians

Vegetation located above the carbonaceous emplacements is characterised by dry terrestrial environs that is not conducive to amphibian activity. No typical breeding activity occurs within the vegetation communities.

5.9.4.3 Threatened Biodiversity

Two threatened plant species (i.e. *Grevillea parviflora* spp. *parviflora* and Parramatta Redgum (*Eucalyptus parramattensis* ssp. *decadens*)) and two endangered ecological communities (i.e. Lower Hunter Spotted Gum Ironbark Forest and Kurri Sand Swamp Woodland) have been identified within or adjacent to the area affected by the proposed development. **Figure 5.12** identifies the location of field verified threatened biodiversity.

5.9.4.4 Groundwater Dependant Ecosystems

The identification of Groundwater Dependant Ecosystems (GDEs) was completed using the eight-step rapid assessment (DLWC, 2002). According to the DLWC (2002) there are five potential Groundwater Dependant Ecosystem types to consider, these being either terrestrial, base flow, aquifer and cave, wetland or terrestrial fauna ecosystems. The discussion provided in the following sections identifies the relevance of these Groundwater Dependant Ecosystem types to the project area.

Terrestrial

No mappable terrestrial Groundwater Dependant Ecosystem was identified within the impact zone or immediate surrounding landscape. Terrestrial vegetation cover of the locality is typically characterised by dry sclerophyll forests and woodlands of widespread occurrence with no exclusive or significant interaction with groundwater.

Base flow

Shallow groundwater in close proximity to the Richmond Main East site is likely to be a contributing factor in the formation of any hyporheic zones within the sandy basement of Wallis Creek. Riparian and aquatic ecosystems within Wallis Creek may therefore be considered a groundwater dependent ecosystem on this basis. The significance of this potential groundwater dependent ecosystem would be judged by its current biological composition and the environmental values of the lower catchment and surrounding lands.

At this location, riparian vegetation has been modified by past and present agricultural activities, with remnant plant composition restricted to scattered trees, shrubs and cosmopolitan disturbance tolerant grasses and herbs. This vegetation cover is now scattered along the Wallis Creek corridor (i.e. gallery open woodland) in contrast with likely past conditions such as gallery forests and woodlands. Aside from the influence of hoofed animals on the creek bank morphology, the elevated weed cover introduced by land clearing and agriculture has substantially diminished the ecological character of this environment.

The surrounding landscape has been predominantly cleared of its historic vegetation cover and has subsequently had a history of agricultural use, this primarily being the grazing of cattle. Satellite coal mining operations also feature within the locality as surface and underground operations. Surface operations are mostly restricted to coal handling, with the construction of the Colliery Dam a consequence of power generation at Richmond Main East.

Figure 5.12: Location of field verified threatened biodiversity.

The lower reaches of Wallis Creek drain into the Hunter River at East Maitland, with numerous offline wetlands located throughout the Wallis Creek floodplain between Richmond Main East and the Hunter River.

The majority of this floodplain has been cleared of its native vegetation cover, with these wetlands being modified by the presence of agriculture and any associated reduction in water quality.

Aquifer and Caves

Based on a consideration of the project area's geomorphology there are no aquifer or cave GDEs expected in the subject site.

Wetlands

The Wallis Creek floodplain contains a large number of closed offline wetlands (i.e. not connected to the main creek flow path). The wetlands represent potential groundwater dependent ecosystems that perform important process that generally maintain improved water quality values. While the Richmond Main East site is not located within the catchment of an offline wetland, the downstream Wallis Creek floodplain does contain these features.

Terrestrial Fauna

Groundwater dependant ecosystems are known to contribute to the distribution of fauna species or communities within the landscape. An example of this is refuge habitat created by drought tolerant vegetation that has known interactions with groundwater resources. The study area does not contain any known examples of this type of groundwater dependant ecosystem.

Summary

Of the possible assessed groundwater dependent ecosystems considered above it is concluded that the hyporheic zone of Wallis Creek (i.e. base flow system) is the only groundwater dependant ecosystem within close proximity to the impact area. There are no clear examples of terrestrial, aquifer/ cave, wetland or terrestrial fauna groundwater dependency occurring within or adjacent to the sites.

5.9.5 Ecological Impacts

The proposed project is generally restricted to terrain already disturbed by former coal mining activity, which has resulted in the creation of a partially rehabilitated landscape overlying emplacements of carbonaceous materials containing polluting elements. Natural soils and intact native vegetation is generally restricted to lands surrounding the project area, with the exception of lands that directly adjoin bush land tracks (i.e. requirements for isolated track widening). Therefore, the majority of biodiversity losses will be associated with existing disturbed landscapes that are exposed to elevated levels of soil salinity and acidity.

At the PFM for this project, the DoP, DEC and DNR identified key issues for consideration in the Environmental Assessment Report, these being:

- Impacts on threatened biodiversity;

- Reduction of wildlife connectivity;
- Amenity of Werakata National Park;
- Impacts on watercourses; and
- Interactions with groundwater dependant ecosystems.

Impacts on threatened biodiversity may potentially occur during the removal of emplaced carbonaceous materials or as a consequence of vehicle movements along bush land tracks. More specifically, issues of concern include:

- Threatened plant removal along tracks and within carbonaceous emplacements;
- Increased road mortality of local fauna (e.g. arboreal fauna); and
- Reduced wildlife connectivity, hence increased propensity for predation.

Each of the above identified issues are discussed in the following sections to assist the development of mitigation strategies.

5.9.5.1 Threatened Plants

Two threatened plant species (i.e. *Grevillea parviflora* spp. *parviflora* and Parramatta Redgum (*Eucalyptus parramattensis* ssp. *decadens*)) and two endangered ecological communities (i.e. Lower Hunter Spotted Gum Ironbark Forest and Kurri Sand Swamp Woodland) have been identified as being directly impacted by the proposed development. The likely extent of this impact is estimated as follows:

- Forty-nine *Grevillea parviflora ssp. parviflora* from roadside environments;
- Ten Parramatta Redgum (*Eucalyptus parramattensis* ssp. *decadens*) at Aberdare East;
- Thirteen Parramatta Redgum (*Eucalyptus parramattensis* ssp. *decadens*) at Richmond Main East;
- 1.9 ha of Lower Hunter Spotted Gum Ironbark Forest EEC along the bushland tracks; and
- 1.0 ha of Kurri Sand Swamp Woodland EEC along the bushland tracks.

Lower Hunter Spotted Gum Ironbark Forest occurs around the perimeter of the Neath site, with no impacts expected on this EEC as a consequence of the project. Similarly, there is no expected loss of Hunter Lowlands Redgum Forest or Lower Hunter Spotted Gum Ironbark Forest from the Richmond Main East site or along the access pathway linking that site with Leggetts Drive.

5.9.5.2 Road Mortality

The transportation of carbonaceous materials from each of the sites to Hebburn No. 3 will involve the utilization of selected bush tracks, local and state roads. The increased utilisation of local and state roads is within expected traffic growth rates for the Cessnock area, with the resultant impacts on wildlife accepted as an unavoidable outcome (i.e. road kill). However, the intensification of vehicle movements along local bush land tracks, which do not form part of an identified transport corridor, represents an increased risk for local wildlife. Accordingly, the project may potentially have an increased impact on wildlife populations located along these tracks.

5.9.5.3 Wildlife Connectivity

The project impacts are generally limited to small isolated locations within a heavily vegetated landscape. The loss of vegetation from disturbed landscapes will therefore be of limited consequence when considering the extent and nature of existing local wildlife corridors. Only a negligible adjustment to local wildlife corridors is expected as a consequence of the development.

The removal of native vegetation as a direct consequence of extracting carbonaceous materials from Aberdare East and Neath will be restricted to existing disturbed terrain characterised by past rehabilitation works and natural regeneration. The biological values of these sites are limited and do not represent a significant component of any wildlife corridor to or from Werakata National Park. Therefore, works proposed within these areas will have no identifiable impact on local wildlife connectivity within and between parts of Werakata National Park.

However, during the construction and operation phases of the project there will be isolated direct impacts on track side native vegetation within Werakata National Park, with potential impacts on diurnal fauna species occurring as a consequence of track widening and haulage movements. Fauna and habitat at greatest risk of being impacted include:

- Riparian environments (i.e. amphibian habitat); and
- Reptiles, larger mammals and birds.

These matters represent important components of a conservation reserve, with the protection of this biodiversity important to the viability of local ecological processes. Minimal mitigation is required to minimise this impact given the isolated and limited impact of the proposed development.

5.9.5.4 Reduced Fire Frequencies

The project will remove carbonaceous material emplacements that are known to be prone to spontaneous combustion, and a potential ignition source for a bush fire event. Many local bush fires have been traced to spontaneous combustion sources, with the result of these unplanned fire events having a significant detrimental influence on local biodiversity values. The removal of this ignition source will potentially lead to a reduced incidence of fire, hence improved conditions for important ecological processes.

5.9.5.5 Reduced Illegal Rubbish Dumping

The project will potentially increase accessibility to bush land areas through the improvement to selected bush land tracks. While this may potentially increase public access for illegal rubbish dumping, it is considered that the presence of operational staff along this track during the haulage period will discourage access by individuals considering this activity. However, following the cessation of material haulage, the discouraging influence promoted by HEM staff will be removed from these tracks, hence potentially increasing the incidence of rubbish dumping activities.

Council has identifies illegal rubbish dumping as a major local issue requiring intervention to prevent the further deterioration of environmental amenity. Mitigation such as improved access control through the installation of gates is regarded as a potential solution that may reduce the incidence of this illegal activity.

5.9.5.6 Amenity of Werakata National Park

The Werakata National Park borders selected proposed transportation routes between Aberdare East/ Neath and Hebburn No. 3. Werakata National Park does not directly adjoin any of the carbonaceous emplacement sites.

In the absence of proactive management by HEM, the proposed project may potentially contribute to an increased frequency of existing impacts that affect Werakata National Park such as inappropriate fire regimes, road kill, introduction of weeds or feral animals. However, it is proposed to implement strict management policies and procedures to eliminate or significantly reduce the projects direct and indirect impacts on Werakata National Park. Conversely, it is anticipated that the project will actually decrease the frequency of existing pre-development impacts and potentially reduce the severity of these events (i.e. removal of bush fire ignition sources such as spontaneous combustion).

There would be no access impediments to NPWS staff during and/or after the project. Public access will be hindered by transportation activities, for safety reasons, which will be only short term. The project will result in the improvement of selected fire trails within the National Park, which if maintained by the NPWS, will result in a net positive impact such as fire management and erosion control within riparian environments. Fire trail improvements will increase the effectiveness of NPWS management works such as fire regimes, weed and feral animal control. These upgrades will also aid the suppression of unplanned bush fires.

5.9.5.7 Groundwater Dependant Ecosystems

The hyporheic zone within the Wallis Creek riparian corridor is considered a potential groundwater dependant ecosystem (i.e. groundwater baseflow) and represents the only likely groundwater dependant ecosystem adjacent to the impact area.

Wallis Creek and its floodplain is a modified environment with limited native vegetation cover. The vegetation cover located within and adjoining Richmond Main East is predominantly exotic and based on soils formed from carbonaceous materials (i.e. little to no soil capping). The proposed removal of carbonaceous materials will not adversely impact local vegetation coverage or riparian plant populations. Further, it is considered that any near surface groundwater located near or beneath the Richmond Main East deposit will not be adversely impacted by proposed operations.

The proposed removal of carbonaceous materials will permanently remove a source of acid generating materials that would otherwise have a negative impact on local groundwater resources. Current conditions potentially favour the gradual leaching of acid generating materials. Accordingly, it is considered that the proposed development represents a proactive environmentally responsible activity by removing a pollution source that may potentially have an adverse impact on Wallis Creek, Swamp Creek or Black Creek water qualities.

5.9.6 Impact Mitigation

The mitigation strategy has been developed to deliver a net positive benefit for local biodiversity, despite only a limited loss of locally important ecological elements from within the disturbance envelope. The key elements of the mitigation strategy are:

- Avoidance of locally important ecologically elements;
- Increasing the net native vegetation cover within the locality through proactive rehabilitation;
- Salvage and recycling of vegetation matter and fauna habitats within the rehabilitated landscape; and
- Access control and monitoring of traversed tracks within Werakata National Park and adjoining bushland.

A discussion of these mitigation works is provided in the following sections. The section titled ‘Ecological Management’ will discuss the strategies outlining management regimes and monitoring procedures for the mitigation measures.

5.9.6.1 Avoidance

Transport operations will involve the utilization of selected bush land tracks throughout the locality, with route selection and track maintenance having been refined primarily by the presence of threatened biodiversity. Track improvement will be limited in most cases to the existing width, particularly where Kurri Sands Swamp Woodland adjoins the transport route (i.e. Richmond Main East and Aberdare East).

Threatened plant species located on track margins will be located by survey and protected, where practicable, to limit biodiversity losses from the locality. Threatened species observed during the survey of these tracks includes *Grevillea parviflora* ssp. *parviflora* and Parramatta Redgum (*Eucalyptus parramattensis* ssp. *decadens*). While some isolated losses are expected, it is predicted that the majority individual specimens identified within close proximity to the impact area (i.e. 20 m buffer around the carbonaceous emplacements and bush land tracks) will be retained in the post development landscape in an unaffected state.

The conservation of threatened biodiversity occurrences within Werakata National Park will be prioritized above track construction/ maintenance works, with any conflict between the two matters being resolved by mitigation that is to achieve a net beneficial biodiversity outcome. Opportunities for beneficial outcomes include:

- Increasing the extent of native vegetation rehabilitation reflective of Kurri Sand Swamp Woodland within Aberdare East; and
- Planting of Parramatta Redgum (*Eucalyptus parramattensis* ssp. *decadens*) in rehabilitated landscapes.

Conversely, due to the absence of naturally occurring native vegetation types within the footprint of the carbonaceous emplacements, there will be no requirement for the consideration of avoidance strategies. Despite regional mapping identifying the presence of Lower Hunter Spotted Gum Ironbark Forest and Hunter Lowlands Redgum Forest EECs within the disturbance footprints, site surveys have established an absence of these vegetation types from resource areas.

Existing native vegetation cover within each of the sites is variable and consistent with past rehabilitation strategies. Proposed rehabilitation objectives aim to achieve improved biodiversity outcomes by promoting the growth of local plant species characteristic of significant vegetation types found within the Cessnock locality. These outcomes are considered achievable, with rehabilitation works observed within Area D of the Aberdare East deposit supportive of this rehabilitation approach.

5.9.6.2 Rehabilitation Works

According to NPWS (2003) vegetation mapping there will be a loss of approximately 14 ha of native vegetation cover from the disturbed terrain within Aberdare East and Neath. While vegetation mapping indicates the presence of Lower Hunter Spotted Gum Ironbark Forest and Hunter Lowlands Redgum Forest EECs at these locations, it has been demonstrated through field survey that the vegetation cover is not consistent with any locally occurring natural vegetation communities, particularly those described as listed EECs. The vegetation cover is consistent with past rehabilitation works using native seed from the locality, particularly wattles (*Acacia* spp.) and grasses (*Aristida vagans*).

As a consequence there is no requirement to instigate impact mitigation focusing on a ‘maintain and enhance’ outcome for locally occurring EECs. However, it is proposed to mitigate the vegetation loss primarily by rehabilitating final landforms with plant species consistent with vegetation types such as Lower Hunter Spotted Gum Ironbark Forest and Kurri Sand Swamp Woodland. This strategy represents a substantial contribution to an enhanced outcome.

Rehabilitation works involving the introduction of native vegetation at Neath is expected to cover the entire disturbance footprint, this approximately being 16 ha. Relative to the total loss of native vegetation cover from the three sites (i.e. past rehabilitation works), this represents a net increase of 16% native vegetation for the locality. The rehabilitation works will occur on soils that are influenced by the emplaced carbonaceous materials. Further, rehabilitation works will occur within an area that is enclosed by native vegetation, with the final landform resulting in a reduced edge impact on existing adjoining Hunter Lowlands Spotted Gum Ironbark Forest EEC. The reduction of edge impacts is considered an important beneficial outcome.

Rehabilitation works involving the placement of native vegetation cover is planned for the Aberdare East final landform within landscapes susceptible to erosion (i.e. drainage lines). The proposed rehabilitation focus at Aberdare East aims to create a grassland cover consistent with rural landscapes together with native vegetation along a proposed east-west trending drainage corridor. The biological content of this proposed vegetation cover would reflect the plant species associated with the regionally significant and endangered Kurri Sand Swamp Woodland. The area of proposed native vegetation cover may potentially be as much as 8 ha.

Rehabilitation works at Richmond Main East will be restricted primarily to grassland vegetation cover consistent with surrounding rural agricultural land cover type. However, some native revegetation works are proposed for lands that immediately adjoin Wallis Creek. Native revegetation works will focus on the introduction of a tree cover characteristic of riparian corridors within the locality, primarily tree of the Hunter Lowland Redgum Forest vegetation type. Species such as Rough-barked Apple (*Angophora floribunda*) and Forest Redgum (*Eucalyptus tereticornis*) will be introduced into this area together with various grass and shrub species. The area of proposed native vegetation cover may be as much as 2 ha.

5.9.6.3 Recycling

The retention of disturbed native vegetation that currently covers the emplaced carbonaceous materials (i.e. past rehabilitation of former coal mine sites) is not, in its current form, considered a valuable contribution to the conservation of local threatened biodiversity. Past rehabilitation works were focused on the reinstatement of vegetation cover to protect soils rather than the reinstatement of native vegetation cover consistent with surrounding landscapes. However, irrespective of the past rehabilitation objectives for these sites it is considered that the biological values contained within some of these rehabilitated areas contains a valuable recyclable resource that may potentially enhance future land form rehabilitation works (i.e. soil seed bank).

Flora survey data indicates that 'Area D' at Aberdare East represents the most valuable recyclable resource available to this proposed operation. A diverse array of native plant species (i.e. shrubs and grasses) forming a dense coverage of vegetation predominantly void of weed species was identified within this area. The type of species located in Area D are mostly 'pioneer species', which are species adapted to developing large soil seed bank in short periods that are amenable to mass germination response following disturbance (e.g. natural triggers such as fire). It is considered that the collection of this resource (i.e. topsoil) should be carefully managed to ensure the retention of the soil seed bank and its importance in rehabilitation activities.

Consideration may also be given to the blending of topsoil from Area D with additional suitable topsoil material to maximise the quantity with a contained seed resource. It is clear from soil investigations that the amount of topsoil resources available for progressive rehabilitation works are limited by salinity, acidity and general absence of capped material. The blending of topsoil from Area D with other topsoil resources represents an opportunity to increase the extent of cost efficient and effective rehabilitation works.

The stockpiling of native vegetation cleared from these sites (i.e. retained as whole sections or as mulch) may represent a useful resource for the reinstatement of fauna habitats, the potential control of soil erosion and conditioning of topsoil materials through added organic matter. Richmond Main East and Neath represent sites with the greatest potential for this mitigation measure (i.e. large trees and shrubs located on the chitter resource).

5.9.6.4 Tracks within Werakata National Park

The proposed operation is to occur during daylight hours starting at least 30 minutes after dawn and concluding 30 minutes prior to dusk, hence eliminating the potential for a direct impact on arboreal/ nocturnal mammals or birds. A speed limit of 40 km/h will be enforced for tracks traversing Werakata National Park to minimise the incidence of road kill.

Potential indirect impacts on arboreal mammal glide pathways will be mitigated by minimizing tree clearance along the track corridor to maintain a gliding gap of at least 20 m. Threatened plants located along the tracks will be identified and marked in the field by an appropriately qualified and experienced ecologist for exclusion from track construction and maintenance works. A surveyor will accurately locate these plants for future monitoring purposes.

5.9.6.5 Impact Amelioration

Impacts of vegetation clearing would be minimised through the implementation of various ameliorative works within the framework of targeted management planning. Ameliorative works may include, but not be limited to, the following actions:

- Removal/deterrence of native fauna from an area prior to clearing;
- Timing of clearing to avoid threatened fauna breeding seasons and microchiropteran bat hibernation seasons; and
- Collection of endemic seed for propagation and use in proposed revegetation schemes.

Ongoing management of impacts and associated monitoring of rehabilitated/revegetated landscapes and other indirectly impacted vegetation will occur, through the implementation of targeted management with measurable key performance indicators monitored to determine the success of mitigation works.

Impacts from the construction of culverts and other infrastructure within creek riparian habitats and over creeks would be minimised by adherence to standard construction guidelines and additional construction guidelines published by DPI Fisheries (NSW Fisheries 1999). Any necessary rehabilitation works would be undertaken using recommended guidelines.

5.9.7 Ecological Management

HEM will prepare and implement an Ecology Management Plan as part of the Mine Operations Plan. The plans will identify key performance indicators and the measurement thereof to ensure compliance with the principles of ecologically sustainable development.

The implementation of these management plans is expected to result in the maintenance and improvement of local biodiversity values in the medium to long term. The Ecology Management Plan will describe the methods used to successfully implement the progressive rehabilitation of the sites and the conservation of important roadside vegetation. Matters that should be accurately defined in the management plans include:

- The methods used for measuring the expected outcomes;
- The timing of revegetation/rehabilitation activities relative to clearing events;
- The type of plant materials to be used and their source;
- The collection and recycling of fauna habitat features;
- The methods associated with introducing plant material to cleared environments;
- The proposed monitoring methods; and
- Potential rectification methods for revegetation works deemed unsuccessful.

5.9.8 Conclusions

Vegetation removal from the sites and bush tracks edges will amount to approximately 78.0ha, consisting of 75.1ha past rehabilitation of limited ecological value and 2.9ha track side vegetation (Lower Hunter Spotted Gum Ironbark Forest or Kurri Sand Swamp Woodland). This vegetation loss will be mitigated by the rehabilitation of the Neath disturbance footprint (i.e. 16ha) with vegetation cover similar to the surrounding Lower Hunter Spotted Gum Ironbark Forest. Portions of the Aberdare East site (up to 8ha) will be rehabilitated with species consistent with Kurri Sand Swamp Woodland to mitigate the isolated limited loss of this vegetation from some track side environments.

It is considered that the benefits of removing carbonaceous materials from the disturbed former coal mining landscapes substantially outweighs the loss of biological values contained above these emplacements by delivering:

- Improved water quality outcomes (i.e. removal of pollution sources) within Black Creek , Swamp Creek and potentially Wallis Creek;
- Increased rehabilitation footprint, relative to existing vegetation cover;
- Improved rehabilitation outcomes through establishment of native vegetation cover similar to surrounding landscapes; and
- Reduced bush fire ignition points (i.e. from spontaneous combustion), hence reducing local fire frequencies and the consequential deleterious impacts on biodiversity.

Increased wildlife road kill along bush land tracks is a likely but tolerable short term outcome when considering the improved long term ecological amenity achieved through removing pollution sources associated with the emplaced carbonaceous materials and adverse fire regimes that arise from spontaneous combustion. Reduced speed limits and daylight operational hours will limit the impacts to diurnal species, in particular reptiles. Birds will avoid interaction with truck movements (i.e. reduced speed limits), with amphibians and arboreal mammals generally being active at night hence avoiding potential adverse interactions.

Potential negative impacts associated with the improvement of a track within Werakata National Park were identified by DEC as a key issue, such as increased unauthorized access, bush fires, traffic accidents and rubbish dumping. Mitigation is proposed including the installation of gates at either end of the proposed haulage track, which is to be opened by HEM staff only during operational hours. Any unauthorized access (i.e. vehicles/ motorbikes) along this track during the operational hours will be noted and reported by truck operators to aid the prevention of bush fires and illegal rubbish dumping.

Under this arrangement, it is considered that there will be fewer cases of bush fire ignitions and rubbish dumping. The long term management of these issues will eventually return to the NPWS, with the project benefiting future management of the National Park by the installation of access deterrents such as gates, bunds and improved fire trails.

5.10 Social and Economic Environment

Cessnock City Council identified in their 2004 ‘State of the Environment Report’ (CCC, 2004) that Council has a “significant role to play in the planning and development of services that contribute to the health and wellbeing of residents, as well as the provision of support, facilitation and co-ordination of established services, networks and collaborative partnerships.”

A draft Social and Community Plan for 2004-2009 was prepared to facilitate the achievement of this directive. This draft plan identified a range of important needs within the community, with the main issue relating to this project is maximising and increasing employment opportunities.

5.10.1 Background

The population of the Cessnock LGA at the 2001 Census was 45,204. This represents a 1.9% population increase since 1996, with this increase being higher than the national average of approximately 1.2% (ABS, 2001). The population of the Cessnock LGA is concentrated in a linear urban belt running east west between the two major townships of Cessnock and Kurri Kurri. The remainder of the population is located in outlying rural areas where many small towns and villages established during the height of coal mining in the Hunter Valley (CCC, 2004).

Economic indicators for the Cessnock LGA reflect a move towards the service sector, in particular tourism related activities, which is consistent with State and National trends. The decline in Cessnock's traditional mining and manufacturing industries has coincided with the rise of the wine, tourism, commercial and retail sectors (CCC, 2004).

Clothing, textiles and rural industries are also important to the Cessnock LGA. Poultry farming contributes over $15 million per year and there is substantial investment in chicken meat, egg production, timber milling and beef cattle (CCC, 2004).

5.10.2 Project Economics and Employment

The collection and transportation of carbonaceous materials to Hebburn No. 3, as defined by this proposed project, is wholly contingent on the continued operation of the Hebburn No. 3 processing plant. However, the current resource estimate for the Hebburn No. 3 processing plant, which has been downgraded since the initial estimate in 1998, now places the economics of the Hebburn No. 3 operation in jeopardy.

Forecast cash flows from the existing operation, based on currently approved reserves, indicate an earlier than expected cessation of processing activities at Hebburn No. 3, with a major outcome being the loss of current local jobs. Therefore, it is considered that the continued operation of the Hebburn No. 3 processing plant is contingent on the supply of additional carbonaceous resources such as those contained within the sites proposed in this project.

This proposed project is considered critical to the continued operation of the Hebburn No. 3 processing plant. The collective resource contained within the proposed sites is capable of returning longer term project viability. In terms of employment, the direct consequence of maintaining the Hebburn No. 3 operation by including this additional feedstock, is as follows:

- Maintain the existing workforce by maintaining/ improving project economics;
- Maintain the local contracted services that currently support the Hebburn No. 3 operation; and
- Without the continued supply of carbonaceous materials to the Hebburn No. 3 operation, 11 directly employed staff and 46 contractors will be lost.

5.11 Transport

Matters associated with the transportation of extracted carbonaceous materials and product coal throughout the locality is described in the following sections together with an evaluation of the likely interactions with the local community. Recommendations and mitigation measures are also provided. The specialist report prepared by Sinclair Knight Merz Pty Limited, 2006 is presented in **Appendix 8**.

5.11.1 The Local Road Network

Hebburn No. 3 Processing Plant and the associated sites are located in and around the Werakata National Park in the Cessnock / Kurri Kurri area of the Hunter Region. The area is bounded, and serviced by, three designated main roads: Main Road (MR) 132, Maitland Road which connects Cessnock with Kurri Kurri and then on to Maitland; Main Road (MR) 135, Leggetts Drive which runs from Kurri Kurri to its intersection with Lake Road; and Main Road (MR) 82, Lake Road which forms part of the route between Branxton and the F3 Freeway at Toronto.

Maitland Road has a posted speed limit of 60km/hr throughout the strip residential development through which it passes at Neath. In the area of the Neath site access, Maitland Road has been upgraded with 3.5m lanes and 2.5m paved shoulders. Further east, the road is in a poor state of repair with significant signs of movement within the concrete slab construction. The road passes over predominantly level terrain.

Lake Road runs east through Elrington and the Aberdare State Forest before intersecting with Leggetts Drive north of Mullbring, The speed limit is 100km/hr and the road is designated as an RTA Main Road and is over rolling terrain.

Leggetts Drive, designated as an RTA Main Road, runs between Kurri Kurri and Mulbring. The road runs through rural land with a slightly rolling terrain. The posted speed limit is 100km/hr.

Maitland Road, Lake Road and Leggetts Drive are paved uninterrupted two lane two-way roads. These are classified State Roads and are thus the responsibility of the NSW RTA. The percentage of length of road with sight distance less than 450m has been observed to be minimal. Maitland Road forms part of MR588, which meets MR9 west of Raymond Terrace, and is one of the major routes between Cessnock and the ports at Newcastle. MR220 (Lake Road and Branxton-Toronto Road) connects Cessnock with the F3 Freeway, thus providing an alternative route to the ports at Newcastle and a link to Sydney.

The main inter-regional road links are provided by two local roads:

- Neath Road, which runs roughly north/south between Maitland Road east of Neath, and Allandale Street, Kearsley ;and
- Duffie Drive, which runs roughly northeast/southwest between Maitland Road west of Neath, and Aberdare Street, Aberdare.

Neath Road is a two lane, two-way road carrying an annual average daily traffic (AADT) of only 710 vehicles. It passes through predominantly rolling terrain with only a small number of adjacent private properties that gain access from the road. Neath Road has a speed limit of 80km/hr and a vehicle weight restriction of 5 tonnes gross vehicle mass (GVM).

Duffie Drive is a two lane, two-way road with a posted speed limit of 100kph and a vehicle weight restriction of 25 tonnes GVM.

Hebburn No. 3 Processing Plant is bounded by Werakata National Park to the East, West and South and is accessed by privately constructed unpaved roads to the south through Werakata National Park, and the council controlled Hebburn Road to the north.

5.11.1.1 Local Public Transport

Rover Coaches run a regular bus service through the wider Cessnock region and is the closest bus service to the area impacted by the HEM proposal. Three services operated by Rover Coaches run along haulage routes proposed by HEM, these being 160, 162 and 164. The 160 and the 164 services run between Cessnock and Kurri Kurri (and beyond) using Maitland Road. The 164 runs 14 times a day and the 160 runs 5 times a day. The 162 runs 5 times a day using the major route between Cessnock and Kearsley.

School bus services operate via the following routes:

- Cessnock – Pokolbin – Rothbury;
- Cessnock – Talga Road;
- Laguna – Wollombi – Cessnock; and
- Lochinvar – Cessnock Rover Quorrobolong

Local bus services including a school bus service operate within the impacted area, however there will be no impact on these services as a result of this proposal.

5.11.1.2 Railway Corridors

The South Maitland Railway was built in 1907 by the Wickham and Bullock Island Company for the purpose of transporting coal. This railway runs east through Kurri Kurri and west through Cessnock.

Since the abandonment of mining operations at the Southland mine approximately two years ago, no regular train services have been operating, and consequently, its usage is very limited. No regular passenger services operate in the area.

Austar’s recent acquisition of the Southland Mine, and the resumption of mining operations, will result in rail transport recommencing in the near future. However, it is anticipated that the frequency of service will not exceed three rail movements per day.

5.11.2 Preferred Transport Routes

An analysis of the proposed transport routes, as discussed in *Section 4.0* Project Description, was completed by Sinclair Knight Merz (2006) to identify the most suitable transportation route for each site. The preferred transportation routes are discussed in the following sections.

5.11.2.1 Aberdare East

The proximity of haulage route A1 to the rail level crossing on Caledonia Street and the poor sight distance to the north indicates that this route is only suitable to be used for outbound trips (i.e. empty vehicles leaving Hebburn No. 3 entering Abedare East). It would, therefore, be possible to use A2 for inbound trips with vehicles returning to the site via A1, however, this would result in a larger number of local residences being impacted upon, therefore A2 is the preferred option.

Utilisation of the Lake Road / Hebburn Road intersection for outbound trips would require the installation of traffic control devices and a reduction in speed limit. Therefore, the preferred haulage route for the Aberdare East site is A2 for inbound (loaded) trips and the alternate outbound route along the Tomalpin Fire Trail for unladen trips, also utilising A2.

It is recommended that advance warning signs of type, W5-22 'Trucks Entering' should be installed on the approach to the Lake Road / Hebburn Road intersection to advise approaching motorists of the potential for slow moving vehicles ahead.

It should be noted that if the Tomalpin Fire Trail (the fire trail between Hebburn No.3 and Kearsley) or Hebburn Road through the Werakata National Park cannot be used then the use of Neath Road would be undertaken subject to negotiations with Council regarding the current 5t load limit.

Alternatively the HEZ Spine Road, Leggetts Drive and Lake Road route could be adopted. This route is not preferred as it involves a substantially greater distance to be travelled per trip (22.9km as opposed to 9km for route A2), and also involves trucks being on public roads for the greatest amount of time, increasing the impact on surrounding traffic.

5.11.2.2 Neath

There are three haulage alternatives for Neath, being N1, N2 and N3.

The Route N1 intersects with Maitland Road at David Street, continues east to the level crossing before meeting Neath Road and an Energy Australia easement that connects with Hebburn Road to the Processing Plant. While this route is the shortest, significant road works would be required to permit trucks to safely use the level crossing.

The Route N2 uses David Street south to crown fire trails to an Energy Australia easement that provides a cleared haulage route east through the Werakata National Park to Hebburn Road and the Processing Plant.

The Route N3 travels along the length of David Street crossing Maitland Road. David Street terminates and the haulage route would continue along the existing fire trail through Crown Land to its intersection with a fire trail running in an east-west direction. The route then follows the fire trail across the rail line until it intersects with Neath Road, where it turns left and heads north along Neath Road.

The proposed railway crossing would need to be constructed to a Level 2 standard passive crossing, with the installation of 'Stop Signs' and a concrete pad over the tracks. Sight distances for the intersection with Neath Road are adequate for both the left turn movement, and also for the right turn movement required on the outbound trip.

The wide gravel shoulder at this point provides the additional benefit of acting as an informal acceleration area for laden trucks turning left from the fire trail.

Based on the significantly improved location of its access point onto Neath Road in terms of sight distance, it is recommended that the preferred haulage route for the Neath site would be N3 for both inbound and outbound trips to the Hebburn No. 3 processing plant.

Should approvals be granted for the use of fire trails within the Werakata National Park Route N2 would be the preferred haulage route and would be suitable subject to works to improve its intersection with Neath Road.

5.11.2.3 Richmond Main East

Route R1 travels along the graded abandoned railway easement through Lot 19 DP1061633 into ALC 4242, into Lot 14 DP716009 running along the northern side of the airstrip to Leggetts Drive approximately 600m south of the HEZ Spine Road. The route then continues on Leggetts Drive, the HEZ Spine Road, Hospital Road, and Hebburn road to the Processing Plant.

The route utilises the Product Coal Haulage Route (HEZ Spine Road) which crosses over the Richmond Vale Museum's tourist railway. Both approaches to this crossing have stopping bays. The passive crossing is controlled by 'Stop' signs.

An alternative access point onto Leggetts Drive opposite the Richmond Vale Railway museum, is inappropriate because of the requirement to make a right hand turn into Leggetts Drive through the existing right hand turn bay for south bound vehicles. Further, the proposed access point and the existing side road are currently offset by approximately 50m, requiring significant works to align the intersection as cross roads.

Haulage Route R1 is the preferred option for Richmond Main East. The intersection of Lot 14 DP716009 (northern side of airstrip) and Leggetts Drive has adequate sight distance to both the south and north.

5.11.3 Traffic Volume Impacts

Figure 5.13 illustrates the existing daily traffic ("before implementation") and maximum predicted increase in traffic from the proposed Project ("after implementation") assuming 18 laden vehicles per hour during daylight hours. It can be seen from Figure 5.14 that there will be a negligible increase in existing traffic volumes on the main roads proposed for haulage.

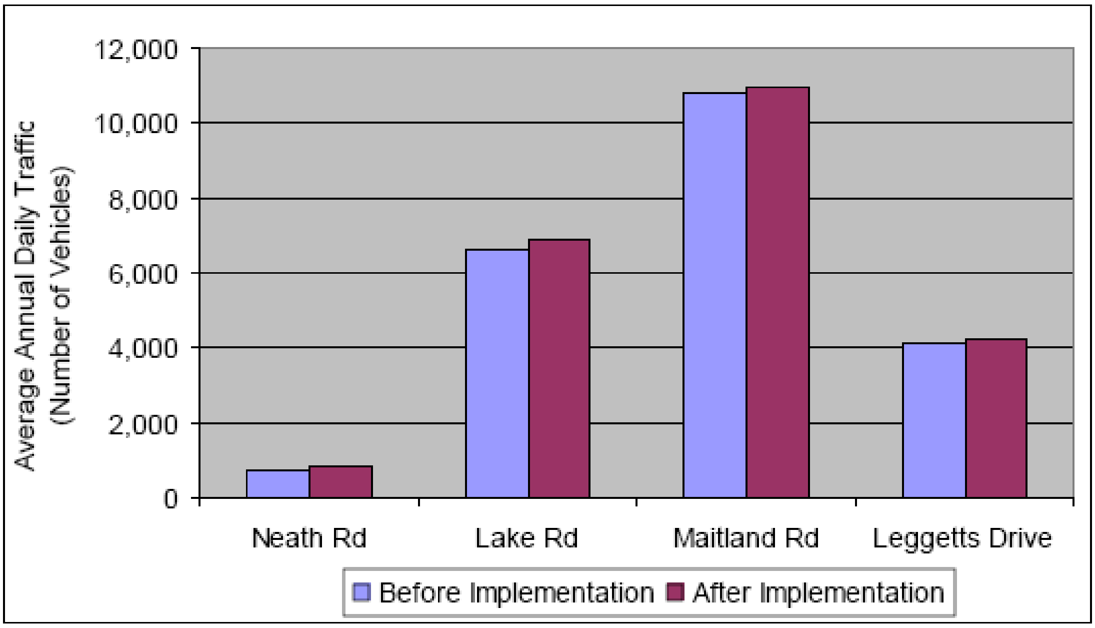

Figure 5.13: Before and after traffic volumes on key public roads proposed for haulage.

There will be some traffic generation arising from employees accessing each site. The impact of traffic generated by staff will be minimal as only a transient operation is in place at each of the sites. Given the remoteness of each of the sites, public transport is unlikely to provide a viable alternative for staff to use to travel to and from work.

5.11.4 Road Condition

The inspected road sections consist of a mix of various road categories (collector, arterial and major) built to different standards in terms of road geometry and pavement properties. Generally most inspected sections appear well maintained. Three sections, HEZ Spine Road, Leggetts Drive and Lake Road are very well maintained. Four sections, Allandale Street, Caledonia Street, Neath Road and David Street are well maintained.

The main roads that were safety audited, Leggetts Drive, Lake Road and the intersection of Maitland Road and David Street, have been constructed and maintained to a high standard. Neath Road has issues relating to delineation, road edge formation and shoulder provision.

The safety of these roads can be enhanced through minor remediation procedures and on-going maintenance in particular road edge formation. The road pavement edges should be checked regularly and repaired where necessary to maintain a sufficiently wide road pavement (at least 6m to comply with the minimum standard specified by Council for these roads) and to provide a smooth transition between the road pavement and gravel shoulder area.

5.11.5 Level Crossings

There are two existing rail level crossings, one on the HEZ Spine Road, and the other between Maitland Road and Neath Road (Route N1). A new crossing is proposed on Routes N2 and N3.

The main issue in relation to rail level crossings potentially impacted by this proposal is the crossing on Neath Road adjacent to its intersection with Maitland Road.

The current configuration of the intersection of Maitland Road, Neath Road and the rail level crossing has insufficient storage length to accommodate a 19m vehicle wishing to turn from Maitland Road and comply with the ‘Stop Sign’ at the Type 2 level crossing. Consultation with the RTA indicates that the use of this intersection by long vehicles would be unacceptable without considerable realignment of Maitland Road to provide an adequate storage bay at the crossing.

The return route suffers from a similar problem on the Neath Road side of the railway line, in that there is adequate room for a truck to safely “Give Way’ at Maitland Road without part of the truck and trailer combination blocking the rail line.

Therefore, based on this assessment, the proposed route ‘N1’ is unacceptable for both inbound and outbound trips without significant reconfiguration of the Maitland Road / Neath Road intersection

5.11.6 Road Safety

Between 2000-2005 the annual average number of accidents involving a heavy vehicle as the primary vehicle was compared to the annual average total number of accidents. For Leggetts Drive, approximately 24% of all accidents per year involved a heavy vehicle as the primary vehicle. However, the overall number of accidents per year is relatively small (i.e. average between 4 and 5 accidents per year) with the percentage of heavy vehicle accidents equating to approximately 1 heavy vehicle accident per year.

Maitland Road recorded 2.9% (1.2 heavy vehicle accidents per year) and Lake Road recorded 4.4% (1.6 heavy vehicle accidents per year). Therefore, accidents involving heavy vehicles are not disproportionate within the overall population of crashes.

Given that the increase in the number of heavy vehicles generated by this proposal is relatively small, it can be concluded that the additional loading on the road network resulting from this proposal will not have a detrimental impact on truck related road crashes for the region.

5.11.7 Recommendations

The following measures will be carried out to improve the safety of the above mentioned haulage routes:

- Installation of warning signs on all approaches to the various access points to the road network to advise approaching motorists of the increased truck activity (Type W5-22);
- Ensure truck drivers are appropriately inducted and are cognisant of local speed limits and sensitive areas such as roads in the vicinity of schools;
- Where possible trucking will be minimised during key times for the pick up and set down of school children at local schools;
- Liaison with Cessnock City Council and the Roads and Traffic Authority prior to commencement of operations to determine appropriate standards and requirements for construction and maintenance (see Voluntary Planning Agreement in Section 6);
- Maintenance of sealed carriage ways free of loose material;
- Ensure trucks removing fine carbonaceous materials are appropriately selected to minimise spillage;
- Provision of a Level 2 Passive Rail Crossing on route N3 at its intersection with the South Maitland railway; and
- Development of a traffic management plan for the extraction of these resources in consultation with Cessnock City Council and the Roads and Traffic Authority.

5.12 Utility Services

Underground utility services such electricity, fibre optics, water and sewer lines occur within the locality, with the location of this infrastructure mapped by the various authorities responsible for these services. It is also recognized that the mapping of underground services may invariably be inaccurate due to limited ground survey or unrecorded route deviations based on localised constraints.

In some cases these utility services may overlap with the carbonaceous emplacements subject to this development. In recognition of this constraint, it is proposed to undertake the necessary searches for all underground utility services for each site prior to the collection of carbonaceous materials to limit the risk of interrupting these services.

Depending on the utility type and degree of map accuracy, a buffer of adequate dimensions (e.g. 5 m) denoting an 'excavation exclusion zone' will be placed around each utility service that transgresses the emplacement areas to limit the likelihood of service disruption. This buffer will be marked in the field using suitably visible materials to declare the presence and type of utility service. Suitably trained and experienced operators under appropriate supervision will undertake work within these excavation exclusion zones.

5.13 Hazard and Safety Assessment

This section describes hazards and mitigation measures identified in consultation with Hunter Enviro-Mining (Operations) Pty Limited and key stakeholders.

Each site will require a commitment to compliance with the Occupational Health and Safety Act 2000 and additionally as each site is classified as a coal mine they will similarly require compliance with the Coal Mine Health and Safety Act 2002 and Coal Mines Regulation Act 1982.

A Health and Safety Management System will be developed for each site as a component of the MOP. The purpose of a health and safety management system will be to provide the primary means to ensure the health, safety and welfare of employees and others including people directly affected by the site rehabilitation. Under the Coal Mine Health and Safety Act 2002 and Coal Mine Regulation Act 1982 a person (or persons) will be nominated as the operator and manager for each site and specified within the MOP.

The identified hazards include:

- Site security and public access
- Onsite personnel safety;
- Safety of other road and or fire trail users;
- Increased public access to bushland areas through improvement of fire trails resulting in illegal rubbish dumping and potentially arson;
- Soft ground within open tailings cells;
- Unshaped steep excavation faces;
- Spontaneous combustion; and
- Hydrocarbon spills from machinery (fuel refilling or hydraulic leakages, oil spills).

Mitigation measures adopted to reduce the probability of the above hazards and/or lessen the detrimental impact are detailed below:

- Installation of gates across fire trails to limit access outside of operational hours, keys will be issued to Rural Fire Services (RFS), the land owner and DEC where relevant;
- Application of a reporting system for truck drivers and site personnel that identifies a site officer of unknown vehicles or unauthorised persons onsite or using roads in the area;
- Installation of signage along haulage routes at key intersections to highlight the usage of the road by heavy vehicles;
- Appropriate induction for all drivers that highlights areas of sensitivity, such as School zones and the Werakata National Park;
- Restriction of speeds to 40km/hr on National Park fire trails and local roads (such as Government Road, David Street or the eastern end of Caledonia Street) used for haulage;
- Special induction of operations staff that work in or adjacent to the tailings emplacements;
- Maintenance of external fences within Aberdare East and erection of signage that reinforces the dangers associated with entering the land;;
- Repair of existing fences at Neath and erection of signage that reinforces the dangers associated with entering the land;
- Given the proximity of adjoining residence construction of fences around sedimentation / pre-borehole discharge dams, if water qualities are expected to be poor;
- All excavations on site including tailings drainage trenches and dams will be constructed to ensure there is an appropriately graded escape ramp;
- At completion of each day extraction faces will be reduced to a safe batter;
- Installation of warning fence and signs around open tailings cells and drainage trenches, limiting access to soft ground;
- Rapid management of spontaneous combustion issues where identified through excavation and tracking the material with a dozer or excavator;
- Inclusion of hydrocarbon spill kits in all machinery for rapid cleanup in the event of leakages or spills; and
- All storage of chemicals (such as small amounts of herbicide, lime or flocculant) to be stored appropriately within a lockable container with Material Safety Data Sheets (MSDS) collated and in an obvious and readily accessible location.

5.14 Bush Fire

5.14.1 Existing Bush Fire Setting

Cessnock LGA is located within a heavily vegetated part of the lower Hunter Valley with vegetation cover principally being shrubby open forest (e.g. Lower Hunter Spotted Gum Ironbark Forest) and shrubby woodlands (e.g. Kurri Sand Swamp Woodland) with strong vegetation connectivity. The rolling hills and broad drainage lines give rise to gentle slopes that are generally less than 10^0 with average slopes being between 4^0 and 8^0. Dry windy climatic conditions generally occur between September and December, which represents the main fire danger period. In considering these factors, Rural Fire Service has mapped of bush fire prone lands of the area and has modelled bush fire behaviour using the maximum fire danger index (FDI) of 100.

Locally, most bush fire events are a consequence of arson. While lightening strikes do account for some fires, most are deliberately ignited. One unique source of bush fire ignitions within the locality is from subterranean spontaneous combustion associated with carbonaceous emplacements derived from former coal mines. Hot, dry, windy summers often assist the incidence of spontaneous combustion within these carbonaceous emplacements by reducing soil moisture, hence increasing heat and oxygen supply to the contained coal thereby promoting ground fires.

5.14.2 Potential Bush Fire Impacts and Mitigation

The main source of bush fire events within the locality is arson, an activity that is relatively difficult to control and not generally associated with any single event or activity. Improved access to certain areas may increase the likelihood of arson activity, which the proposed development will potentially induce through the improvement of proposed fire trail transportation routes.

However, this improved access will also be met with increased usage by transportation staff, which will counteract the increased arson potential by contestant monitoring. In addition, lockable gates will be installed and maintained where necessary to limit access.

However, of substantial benefit to the local area is the removal of a known bush fire ignition source, this being existing and/or potential ground fires contained within the carbonaceous emplacements. The collection and rehabilitation of each site will remove the spontaneous combustion source hence eliminating the incidence of bush fire events arising from these locations.

Severe local fire events have been recorded within the locality, with loss of life and property being a direct consequence. The action of removing the contained carbonaceous materials from each site is considered a proactive activity that will indirectly mitigate the incidence of bush fire activity within the locality.

The benefits arising from this activity are substantial for local residents by reducing the occurrence of uncontrolled bush fire events (i.e. likelihood) hence limiting the risk of life/ property loss and biodiversity impacts (i.e. conservation of significant biodiversity values within Werakata National Park by permitting the implementation of appropriate fire management regimes).

5.15 Heritage

5.15.1 Aboriginal Heritage

Given the very high level of disturbance at the three sites the potential impact to items of archaeological significance is considered low, with limited scope for variation of the project. As such Archaeological Risk Assessment Services (ARAS) was commissioned to develop an appropriate strategy in consultation with the Department of Environment and Conservation to appropriately assess aboriginal heritage. The strategy involves the following to be undertaken immediately prior to and during construction and operational activities:

- Input from the Mindaribba Local Aboriginal Land Council (LALC) concerning cultural aspects for each of the sites and associated haulage routes, in conjunction with ARAS;

- Field work to be undertaken by ARAS after the chitter and tailings have been collected and for any widening of access tracks to accommodate truck transport. The fieldwork will be undertaken by ARAS with the assistance by Mindaribba LALC and findings reported; and

- An upfront search of AHIMS registers to potentially locate known aboriginal sites along haulage routes or at the three sites.

The AHIMS search for the study area is included within **Appendix 9**.

5.15.2 European Heritage

Aberdare East (closely associated with the Aberdare Shaft and Aberdare East Collieries) and Neath (Neath and Aberdare North Collieries) both have a significant historical past in the context of the Cessnock/Kurri Kurri coal fields. During the mine closure buildings on these sites were demolished (with the exception of the coal laboratory and HPOTS buildings at Aberdare East).

The areas that HEM are seeking to rehabilitate are not known to contain any items of historical significance as the project seeks to recover waste emplacements. Should items of potential historical significance be uncovered works will cease in the immediate vicinity until a qualified archaeologist can make an assessment.

5.16 Visual Assessment

5.16.1 Existing Visual Character of the Area

Densely developed settlements south of the line between Cessnock and Kurri Kurri typically occurs as ‘ribbons’ along the main roads, with the highest density of urban development situated along Maitland Road and at Kearsley. These areas are predominantly fully developed and have a typical residential visual appearance.

Directly adjoining these urban areas are isolated cleared rural/ residential lands and large tracts of native vegetation cover. Native vegetation cover is widespread and a dominant feature of the locality and exists within a variety of landscapes ranging from low elevations to ridge tops. Native vegetation cover is frequently observed from developed landscapes and gives an accurate indication of the bush land values that heavily characterise the Cessnock local government area.

Locally, former coal mining lands have been excluded from the majority of development activity and have consequently contributed to the establishment of the bush land backdrop. These past mining lands mostly comprise lands cleared of native vegetation, natural regenerating lands and intact native vegetation, with the latter land cover type likely to have been influenced by past logging activities. Cessnock City Council has not assigned any strategic plans for the redevelopment of these former coal mining lands indicating that the current visual appearance of these areas is likely to remain.

5.16.2 Visual Impact

The visual impact of the project on Aberdare East, Neath and Richmond Main East is expected to be relatively minor. In the long term, the proposed landscape alterations are considered of benefit to the development of an improved visual catchment. Haulage of the carbonaceous materials from the sites is likely to result in a brief, but consistent visual impact for residences adjacent to the proposed haulage routes.

The following discussions identify the benefits for each site.

5.16.2.1 Aberdare East

The Aberdare East site is located approximately 150 m south of the developed urban landscape of Aberdare East. There are no other developed landscapes or public locations that have viewpoints of the site. From the developed areas to the north there are filtered views of the site, with trees located between the site and the urban landscape acting as a partial screen of the tailings deposit.

Onsite works will not impact the extent of existing screening offered by the intermediary tree cover. The project will reduce existing surface levels by up to 10 m, with the resultant landscape designed to approximate previous natural topographic conditions that are consistent with a drainage corridor of lower elevation to the surrounding environment. These works will effectively remove the elevated tailings deposit from view, with the bush land backdrop located further to the south and east becoming more visible.

5.16.2.2 Neath

The Neath site is located approximately 150 m north of the developed urban landscape of Neath. The site is a closed catchment and can only be viewed from developed landscapes or public locations to the south. From potential viewpoints there are heavily filtered views of the site, with a dense cover of native vegetation located between the site and the urban landscape acting as a screen of the tailings deposit.

Onsite works will not impact the extent of existing screening. The project will reduce existing surface levels by up to 10 m, with the resultant landscape designed to approximate previous natural topographic conditions. These works will effectively remove the elevated tailings deposit from view, with the bush land backdrop located to the north likely to become more visible.

5.16.2.3 Richmond Main East

Richmond Main East is a remote location within a rural setting with nearby dwellings located at least 400-500m from the deposit. There are few public accessible viewpoints of the site due to its remoteness (i.e. Richmond Vale Road), with only distant views available (i.e. 500 – 1000m). Potential viewpoints are obscured only by natural topography, with no tree cover within the surrounding rural lands to the south or east impeding visual access to the site.

Onsite works will not impact the visual character of the surrounding rural landscape. The project will reduce existing surface levels, with the resultant landscape designed to approximate previous natural topographic conditions. Grass cover will be returned to the site hence providing a final landform that is consistent with the surrounding environment.

5.16.3 Visual Impact Mitigation

The short time frame of the project combined with the expected enhanced visual character of the proposed final landform and limited visual impacts from site activities indicate there are no specific mitigation measures other then the rehabilitation of the site as proposed and use of haulage roads where possible that minimise impacts to residential dwellings.