


SOUTH EAST FOREST RESCUE




Representations on Dargues Reef Gold Mine, Majors Creek.

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South East Forest Rescue takes a firm stand on environmental protection of the native forest estate and expresses deep alarm at the welfare of forest-dependent threatened species and the cumulative impacts of industrial degradation of native forests that are exacerbating extinction rates and destroying soil, water, and carbon capacity, and we welcome the invitation to provide comment.

South East Forest Rescue strongly objects to the proposed mine at Dargues Reef. The mine is being planned in an area that is two kilometres from the township and directly upstream from residents. The timeline for submissions is spurious. There is no proposed secondary wall to be constructed on the tailings dam if the first wall fails. The tailings storage facility seems to have potential to impact Spring Creek and further the tailings facility should have a liner throughout, not just clay in some parts as implied.

No studies have been done for the Environmental Assessment on the mine's effect on the land beyond the actual mine site. The proposed mine is situated close to Majors Creek Araluen National Parks Reserve, Monga and Deua National Parks. Threatened, endangered and critically endangered species in the gorge below the proposed mine site, ranging from the Powerful Owl to the critically endangered *Eucalyptus kartzoffina* are not mentioned. This is contrary to current case law on definitions of significant impact.[1]

In the *Nathan Dam* case Black CJ, Ryan and Finn JJ held that 'impact' is not confined to direct effects but includes effects that are or would be a consequence of the action.[2] In both the *Hazlewood* case and the *Anvil Hill* case it was held that the impacts of Scope 1, 2 and 3 emissions must be considered.[3] In *Gray v The Minister* it was held that environmental assessments must also consider the emissions from the use of the product.[4]

The Dargues Reef Mine proposes to remove 130 mega litres of water per year from the local water table. This would cause a drop in ground water levels of between 1.5 and 10.5 metres. The water table currently supplies underground springs that provide drinking water for the local native animals and also keep the native flora watered. The dramatic drop in the water table could impact these native animals and their habitat.

Mining is an industrial activity that takes place in the natural environment, disturbing areas around where it occurs. These mining operations come with several direct and indirect environmental impacts which include waste-water spills and water pollution (chemical spills), visual changes, solid waste generation (containing waste chemical solutions), ground vibration, noise pollution and air pollution.

The almost complete consensus of public opinion is the requirement to leave the land in a better state than it was found, and to eliminate or drastically reduce land clearing and greenhouse gas emissions immediately. In concurrence with the Stern Report and the Mackey Report, action to avoid further land degradation should be an urgent priority. Accordingly, if no action is taken, the health of ecosystems and therefore the Australian public will be severely detrimentally affected.

Chemicals

The proponent makes scant mention of the chemicals to be used and no mention of their effects on biota. The Assessment Report states the company will transport 'sulphide concentrate'. We would state that this is a cynical understatement and an attempt to hide the real facts.

> The EA must provide details of the project that are essential for predicting and assessing impacts to waters: including the quantity and physio-chemical properties of all potential water pollutants and the risks they pose to the environment and human health, including the risks they pose to Water Quality Objectives in the ambient

[1] *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 134 LGERA 272
[2] *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 134 LGERA 272 at 288; see also *Re Australian Conservation Foundation* [2004] VCAT 2029.
[3] *Australian Conservation Foundation v Minister for Planning* above n2; *Gray v the Minister for Planning* [2006] NSWLEC 720.
[4] Rose A, '*Gray v Minister for Planning*: The Rising Tide of Climate Change Litigation in Australia' (2007) 29 *Sydney Law Review* 725.

waters (as defined on www.environment.nsw.gov.au/ieo, using technical criteria derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC 2000).[5]

Copper Sulphate Pentahydrate:
This chemical is also used as a fungicide. The effects on biology are listed as being slightly to highly toxic:

Taxa	Effects
Amphibians:	Development, Growth, Mortality
Annelida:	Accumulation, Behaviour, Enzyme(s), Morphology, Mortality, Physiology
Aquatic Plants:	Accumulation, Biochemistry, Growth, Mortality, Population, Reproduction
Cnidaria:	Growth, Mortality
Crustaceans:	Accumulation, Biochemistry, Cell(s), Development, Hormone(s), Mortality, Reproduction
Fish:	Accumulation, Behaviour, Biochemistry, Cell(s), Development, Enzyme(s), Feeding Behaviour, Growth, Immunological, Intoxication, Morphology, Mortality, Physiology, Population
Insects:	Mortality
Molluscs:	Behaviour, Feeding Behaviour, Growth, Intoxication, Mortality, Physiology
Nematodes and Flatworms:	Mortality
Phytoplankton:	Population
Zooplankton:	Behaviour, Feeding Behaviour, Intoxication, Mortality, Reproduction

The effects on humans is listed as being Moderately Hazardous. Copper sulphate is an irritant. The usual routes by which humans can receive toxic exposure to copper sulphate are through eye or skin contact, as well as by inhaling powders and dusts. Skin contact may result in itching or eczema. Eye contact with copper sulphate can cause conjunctivitis, inflammation of the eyelid lining, ulceration, and clouding of the cornea.

Upon acute oral exposure, copper sulphate turns to be only moderately toxic. According to studies, the lowest dose of copper sulphate that had a toxic impact on humans is 11 mg/kg. Because of its irritating effect on the gastrointestinal tract, vomiting is automatically triggered in case of the ingestion of copper sulphate. However, if copper sulphate is retained in the stomach, the symptoms can be severe. After 1–12 grams of copper sulphate are swallowed, such poisoning signs may occur as a metallic taste in the mouth, burning pain in the chest, nausea, diarrhoea, vomiting, headache, discontinued urination, which leads to yellowing of the skin. In case of copper sulphate poisoning, injury to the brain, stomach, liver, kidneys may also occur.[6]

Potassium Amyl Xanthate:
Xanthates are toxic to aquatic biota at concentrations of less than 1 mg/L and can be a water contaminant downstream of mining operations.[7]

Exposure of solid xanthates to moisture and heat causes decomposition and formation of carbon disulphide. The heat generated by hydration or decomposition could raise the temperature to the auto-ignition point of carbon disulphide.

Xanthates decompose in aqueous solution by dissociation, oxidation and hydrolysis. Hydrolytic decomposition is the main reaction in alkaline solutions while the other two reactions occur in acidic solutions. Potassium amyl xanthate is used in the flotation process in alkaline conditions, and therefore the main reaction is hydrolytic decomposition and the major decomposition product is carbon disulphide.

Decomposition of xanthates is accelerated at high concentrations and raised temperatures and is also rapid at pH below 7 and decreases as the pH increases.

[5] Director-Generals Requirements, Dargues Reef Gold Mine Project, Department of Environment Climate Change and Water, 2010.
[6] TOXNET, 1975-1986, National library of medicine's toxicology data network, Hazardous Substances Data Bank (HSDB), Public Health Service. National Institute of Health, U. S. Department of Health and Human Services, Bethesda, MD: NLM; Clayton G D, and Clayton F E, [eds] *Patty's Industrial Hygiene and Toxicology*, Third edition, Vol. 2: Toxicology, NY: John Wiley and Sons (1981).
[7] Xu Y, Lay J P, Korte F, 'Fate and Effects of Xanthates in Laboratory Freshwater Systems' (1988) 41 *Bulletin of Environmental Contamination and Toxicology* (5)683.

Toxicity data for xanthates has not been included in the proponents application.

The target sites are the central nervous system, liver and the spleen. Oral LD50 for xanthates in mice range from 411-583 mg/kg and in rats from 1000-2000 mg/kg.

The target sites for the adverse effects of potassium butyl xanthate both after single and repeated oral administration were the central nervous system, liver and kidneys indicating similar target organs for the various xanthates.

Inhalation of potassium amyl xanthate in a 30-day study produced adverse effects on the liver in dogs, rats and mice. The other affected organs were the kidneys in rats and the central nervous system in mice.

The target sites for all xanthates are the central nervous system, liver and kidneys. The adverse effects seen in the toxicity studies could be due to the xanthates themselves, their decomposition products or a combination of both.

Liquid solution of potassium amyl xanthate is strongly alkaline. Eye contact will result in mild to severe eye irritation. Contact with the skin will result in mild to severe burns of the skin. Ingestion of product will irritate mouth, throat and gastrointestinal tract. Inhalation of product vapours, mist may cause irritation of respiratory airways.

The Canadian Centre for Occupational Health and Safety (1994) has summarised a report by Rakhimova (1973) of acute exposure of a worker who opened a tank containing xanthates. The worker lost consciousness and was removed from the work site. On revival he was restless, vomited and had convulsive twitching of muscles in his arms and legs. He complained of difficult breathing, teary eyes and hoarseness and later developed light sensitivity and fluid accumulation in the eyelids and eye discharge.

In accordance with the health effects criteria detailed in the National Commission's Approved Criteria for Classifying Hazardous Substances (Approved Criteria), potassium amyl xanthate is classified as 'harmful' by the oral and dermal routes and as an eye and skin irritant. Based on the classification of its health effects, and in accordance with the Approved Criteria, potassium amyl xanthate is considered to be a hazardous substance.

According to the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code) Xanthates are classified as a dangerous good, Class 4.2.

3342 XANTHATES 4.2 II 0 P002 IBC06 B2 T3 TP33 4.2 III 223 0 P002 IBC08 LP02 B3 T1 TP33
This product is listed as a HAZARDOUS material under criteria of NOHSC
This product is classified as DANGEROUS GOODS by the criteria of the ADG Code
Hazard Category ..... Corrosive

The freshly prepared xanthate solution will contain low levels of carbon disulphide. This is formed by decomposition of some xanthate molecules during dissolution of dry PAX.[8]

During storage of xanthate solution there will be further decomposition of xanthate molecules producing yielding increasing levels of carbon disulphide in the solution. The rate of decomposition depends on factors such as the temperature of the solution and the presence of other elements and molecules.

Because it is a highly volatile liquid, carbon disulphide present in xanthate solution will produce carbon disulphide vapour which is toxic and extremely flammable (Flash Point -30^{o}C).
If the freshly supplied xanthate solution is to be stored for more than 5 days the presence of carbon disulphide

[8] LogiChem Material Safety Data Sheet, see <http://www.logichem.com.au/downloads/msds_xanthate_solution.pdf>.

becomes an important consideration in the safe storage and handling of the solution.
Atmospheric monitoring for potassium amyl xanthate is not carried out at the mine sites where it is used and there is no recognised methodology for potassium amyl xanthate, although random instantaneous monitoring for carbon disulphide is carried out at some of these mine sites.

Potential for fire is high during transport and storage if packaging is inadequate or damaged. The presence of moisture can lead to the formation of carbon disulphide, which is highly volatile and readily released at temperatures above 20^{o}C.

Potassium amyl xanthate decomposes releasing carbon disulphide and there may be some public exposure to carbon disulphide, particularly in the case of accidental spillage during transport. While potassium amyl xanthate is used in Australia, it is hazardous to health.

Carbon disulphide:
Xanthates in the presence of heat or moisture decompose and under the conditions of storage and use the major decomposition product is carbon disulphide. The national exposure standard for carbon disulphide in Australia is a TWA of 10 ppm with a skin notation which indicates that significant absorption occurs through the skin. Carbon disulphide is a dangerous fire and explosion hazard. Xanthates readily decompose at high temperatures and in the presence of moisture to evolve carbon disulphide. Carbon disulphide has a low autoignition temperature and is highly flammable and explosive. Carbon disulphide also produces adverse health effects.

Carbon disulphide can be absorbed by inhalation, through the skin and by the oral route. Acute exposure to high concentrations (500 to 1000 ppm) may result in psychosis and narcosis. Carbon disulphide vapour is a severe irritant to the eyes, skin and respiratory system, and the liquid may cause burns.

Repeated exposure to carbon disulphide vapour can adversely affect the central and peripheral nervous systems, including weakening of the leg muscles and damage to the peripheral and cerebral arteries. Carbon disulphide has been shown to contribute towards coronary heart disease in exposed workers, and severe effects on the retina of the eye have been observed. Hearing defects in workers exposed to carbon disulphide have also been reported.

Adverse effects on the reproductive system of workers has been noted. Menstrual disorders have been observed in female workers exposed to carbon disulphide levels below 3 ppm for 3 years. Decreased libido was observed in earlier studies while a later study revealed changes in sperm morphology when carbon disulphide levels were believed to be about 13-26 ppm but with excursions up to 250 ppm.

The exposure standard for carbon disulphide recommended by the National Commission is a time weighted average (TWA) of 10 ppm. Instantaneous samples using detector tubes indicate that at times, short-term excursions above 10 ppm occur in the mixing area during mixing activity at some sites. High levels were also recorded in the containers in ship holds on the arrival of xanthates at ports. The monitoring data indicate that there is the potential for exposure to high levels of carbon disulphide during mixing and transport.

Since the compound decomposes and the major product is carbon disulphide, there exists some potential for the contamination of the immediate atmosphere which may impact on public health. Release of the hazardous degradation products may also result from the decomposition of residual amounts of xanthates which remain in the aqueous phase in the tailings slurry, which will be discharged to a tailings dam.

Incidents
There is a potential for high worker exposure to Xanthates and carbon disulphide, during the mixing process, depending on the degree of automation. During tipping of the drums there is a likelihood of dust generation and spillage of the powder or pellets which could lead to worker exposure.

Two transport incidents have been reported in Alice Springs. One in May 1993 involved a chemical leak at the railway station. Six workers were hospitalised after inhalation of toxic fumes and 100 people were evacuated. The cargo consisted of 56 drums of xanthate. Some of the drums had lost their lids and the inner plastic lining had ripped due to the inferior quality of the packaging and mechanical damage.

In another incident in 1984 approximately 20 steel drums of xanthate had been loaded into a freight container together with medical equipment and supplies. On arrival of the container at its destination in Alice Springs it was found that a considerable quantity of the xanthate dust had escaped from the drums and had permeated the medical equipment and supplies.

Fire incidents involving xanthates have also been reported. In January 1994 a trial shipment of sodium ethyl xanthate packaged in 700 kg plastic bulker bags caught fire in the storage area at a mining site. The fire spread rapidly and three operations personnel and one fireman were affected by fume inhalation and hospitalised overnight.

The fire was observed to spread quickly from bag to bag, whereas only one drum containing sodium ethyl xanthate in the area caught fire. This highlights a major problem with the use of bulker bags in contrast to drums. The material continued to reignite and was disposed of immediately. The company concluded that the most likely cause was ineffective sealing of the inner bag due to manual tying of the inner plastic bag leading to the escape of carbon disulphide and the likely cause of ignition was a spark associated with a forklift unloading steel drums at the time of the fire. However, spontaneous combustion cannot be ruled out.

In November 1994, a shipment of 80 bulker bags each containing 700 kg of potassium amyl xanthate was unloaded for testing at Fremantle the first port of call, following the issue of a product alert by the manufacturer. The containers were taken by road to a transport yard at O'Connor after two days at the Fremantle port to facilitate product testing (temperature measurement). Two of the bulker bags that were found to be 'smoking' and another that was found to be unstable were placed in an empty freight container and isolated. The potassium amyl xanthate was allowed to burn under controlled conditions. The cause of the fire has not been determined. The likely cause may be spontaneous combustion following release of carbon disulphide.

In another incident, residents living in the vicinity of a mine using sodium ethyl xanthate complained of headache, dizziness, nausea and foul odour. Other symptoms reported were eye irritation, sore throat and impaired breathing. The ill effects were reported up to three kilometres from the mine site. The situation was thought to have been aggravated by the weather conditions. Atmospheric monitoring for carbon disulphide showed that the levels were below 10 ppm and yet there still was ill effects.

At least four of the incidents reported over the last two years have revealed deficiencies in packaging. Specific problems which have been encountered with the packaging are:

the lids of drums working loose during transportation and carbon disulphide given off; and
carbon disulphide release from bulker bags during transportation and storage.

These packaging problems led to the hospitalisation of several workers and in one incident the serious threat of fire to persons and property. The incidents highlight the need for a thorough investigation of packaging and in particular whether packaging meets the requirements of the ADG Code and, if so, whether there is need for change in the requirements.

Low dust levels are shown to be difficult to maintain. This is of great concern in view of the dermal toxicity of potassium amyl xanthate and the likelihood of carbon disulphide formation.

Xanthates and Ecology
Hydrolysis will be the main factor determining the environmental fate of minor residues associated with the tailings. Xanthates are hydrolytically unstable when exposed to acidic conditions, such as found in tailings dams. Data from animal studies are consistent with the observed human health effects.

Aquatic toxicity data for xanthates are variable, reflecting the unstable nature of the substance. High toxicity to fish and invertebrates is evident, particularly when test organisms are continuously exposed under flow-through conditions. Mortality has been observed at concentrations extending below 1 ppm.

Simple calculations indicate that xanthate levels in the tailings slurry are likely to be in the order of 1 ppm, consistent with measured values from Canadian operations. Therefore, concentrations of Xanthates likely to be found in the tailings slurry is toxic to aquatic fauna.

Direct discharge of xanthates or effluents containing them to waterways is unacceptable. [9] As Potassium amyl xanthate is highly toxic to aquatic fauna, ore tailings containing xanthate residues should therefore not be discharged to any waterways.

IF6500:
We would state that the listing for this flotation frother verges on the disingenuous. Is this frothers properties 2-ethyl hexanol, a-terpineol, diacetone alcohol, a ploypropylene glycol methyl ether, sodium dodecylbenzene sulfate, SDBS? Does it contain carbonodithioic acid, aluminium, iron salts and polymers?

Some examples of chemical properties of frothers are:
MIBC (CH3)2CHCH2CH(OH)CH3
DF-200 CH3(PO)3OH
DF-1012 CH3(PO)6.3OH
a-Terpineol CH3–C6H8–C(CH3)2–OH
Diacetone alcohol (CH3)2(OH)CCH2C(O)(CH3)

Interfroth 6500 is manufactured by Interfroth Chemical and Mining Services Pty Ltd. The company states the chemical properties of IF6500 are non-hazardous.

The MSDS for other flotation frothers state they are irritating to the eyes, respiratory system and skin and harmful if swallowed. They may aggravate existing medical conditions such as rashes, allergies or other sensitive areas. Symptoms may include reddening, swelling of affected areas with possible itching, burning or other discomfort. Inhalation of mists into lungs may cause pulmonary disorder.

They contain Poly[oxy(methyl-1,2-ethanediyl)], α-propyl-ω-hydroxy- 65-95 25265-71-8 Dipropylene glycol.

Petroleum hydrocarbon component, if separated from product, is combustible. On thermal decomposition oxides of carbon and nitrogen are produced.

MF351 Flocculant:
Magnafloc 351 is a non ionic coagulant and a polymeric flocculant in the Polyacrylamide range of chemicals. Dust generated in handling this product can be explosive if sufficient quantities are mixed with air.

Prolonged exposure may cause irritation , swelling, or dermatitis. Exposure may cause irritation to eyes and eye lids, may cause slight irritation of nose and throat, and may cause nausea and vomiting. MF351 can cause upper respiratory tract irritation.

[9] See <http://www.nicnas.gov.au/publications/car/pec/pec5/summary_report.asp>.

On thermal decomposition oxides of carbon and nitrogen, various hydrocarbons and /or ammonia are produced.

This chemical must not enter waterways. Cationic polyelectrolytes are toxic to fish due to their tendency to adsorb at the gill thus causing suffocation. Therefore unused or waste polyelectrolyte should not be discharged, or allowed to spill, into watercourses

Nitric Acid:
Nitric acid (HNO_3), also known as aqua fortis and spirit of nitre, is a highly corrosive and toxic strong acid. Nitric acid reacts with alkalis, basic oxides, and carbonates to form salts, such as ammonium nitrate. Nitric acid reacts violently with many organic materials and the reactions may be explosive.

Nitric acid is a poisonous liquid that gives off choking red or yellow fumes in moist air. The vapour is very irritating to the eyes, throat, lungs and corrosive to the teeth. If the vapour is inhaled in significant amounts it will result in severe coughing, chest pain and shortness of breath. Contact with the skin will result in a severe corrosive burn. Symptoms from swallowing nitric acid may include severe abdominal pain, burns to skin or mouth, fever, severe mouth pain, rapid drop in blood pressure, severe throat pain and swelling which leads to breathing difficulty and vomiting blood.

Symptoms from breathing in (inhaling) nitric acid may include bluish coloured lips and fingernails, chest tightness, choking, coughing, coughing up blood, dizziness, low blood pressure, rapid pulse, shortness of breath and weakness.

Nitric acid is an inorganic compound used primarily to make synthetic commercial fertiliser. The raw material is also used for the production of adipic acid and explosives, metal etching, and in the processing of ferrous metals. Further now that most adipic acid plants have implemented abatement technologies, nitric acid production is currently believed to be the largest industrial source of N_2O green house gas emissions.

Other chemicals
Heavy metals such as copper, cadmium, zinc, mercury, lead and arsenic are used in the mining of gold. Kalgoorlie Consolidated Gold Mines (KCGM) admitted on July 27, 2005, that the mine's roaster and carbon kilns were emitting five to seven metric tons of mercury per year.

Much has been written and studied about the effects of these heavy metals therefore this submission will concentrate on Arsenite. Arsenite is extremely toxic to biota and is a carcinogen. This is evidenced by the effect on population drinking groundwater in Bangladesh, through contraction of skin cancer.[10]

There are two features of arsenic chemistry and behaviour that may cause an impact in the long term at the proposed Dargues Reef Gold Project, if not detected sufficiently early.

During the course of mining, the pockets of ore containing a higher concentration of arsenic compared to the rest of the ore are exposed to air and may oxidise leading to the creation of evaporites. This particular material should not be allowed to stand stockpiled on the surface for any long period of time. Although the area where ore is handled is bunded and material cannot be easily transferred off site, care will be needed to ensure that this does not happen and that pockets of ore are not stored in an unprotected fashion. Evaporites can be wind-blown and moved to other locations where an impact may be induced.

Furthermore the arsenic is soluble and might be of water quality concern.

[10] Dr Barry Noller, Deputy Director of the National Research Centre for Environmental Toxicology at The University of Queensland

When ore is converted to tailings, the product deposited in the tailings dam tends to exist in pockets reflecting the origin of the material. That is, arsenic concentrations may be higher in pockets associated with the original material than elsewhere in the tailings.

The physico-chemical properties of arsenic show that arsenic exists in soluble forms under reducing conditions, ie excluding oxygen as would be found in tailings at depth. Under such conditions arsenic converts to arsenic (III) or arsenite. Arsenite is extremely toxic to biota and is a carcinogen.

Further, in regards to the waste rock dumps, arsenic remains a potential contaminant due to the close proximity of Spring Creek, even though care may be taken with the design of the dumps and their covers to ensure that no seepage or run-off is likely to arise.

Overburden/Waste Rock

For most commodities there are clear trends of increasing solid waste burden, even allowing for the common lack of reporting of waste rock. For many commodities the extent of waste rock/over-burden mined far exceeds the ore mined, especially the case for copper, gold and black coal. On average, it takes 79 tons of waste to extract one ounce of gold, according to a conservative estimate by the No Dirty Gold campaign, a project of EarthWorks and Oxfam.

The chemical composition of the tailings has been assessed by analysis of just 3 samples of local granodiorite. There is likely to be considerable heterogeneity of the material actually mined as gold is not uniformly distributed throughout the granidiorite.

Given the extent of sulphides likely to be present in much of the tailings and waste rock, this could lead to significant risks such as acid mine drainage in the future, especially given the recalcitrant environmental problems caused by smaller scales at numerous abandoned and/or rehabilitated mining projects around Australia.

The two components include both the waste rock:ore ratio as well as the total quantity of waste rock. If the ratio continues to increase over time as is apparent for many minerals, this will lead to ever increasing volumes of waste rock to be managed. At present there is not sufficient data on the public record to examine this quantity of waste rock with respect to the potential for acid mine drainage or other environmental problems, leaving major uncertainty with respect to the long-term sustainability of waste rock production and management authorities.

The scale and nature of waste rock often presents significant environmental risks if not identified and managed accordingly. Historically this has not been achieved, with numerous former abandoned mine sites leaving major pollution legacies following closure.

Acid Mine Drainage

Acid mine drainage ("AMD") occurs when surface or groundwater flows from or over abandoned mine features containing sulphide mineralisation. Discharge from adits or open pits, as well as surface flow over and seepage through sulphide rich waste rock and tailings can produce acid drainage. Acid drainage begins with the exposure of iron sulphide materials to air and water.

The exposed, relatively insoluble sulphide materials are converted to soluble sulphuric acid and to iron compounds by oxidation. The sulphuric acid, in turn, dissolves other metals such as aluminium, copper, zinc, cadmium etc. Although these constituents can occur naturally in water in trace amounts, as a result of hydrologic and weathering processes, their concentration can increase substantially as a result of acid drainage.

AMD-polluted water is invariably quite toxic to aquatic ecosystems.

There are numerous mine sites around Australia (and internationally) which have left major legacies of acid mine drainage impacting on surrounding and downstream ecosystems, of which some infamous case studies include :

Mt Lyell – the 100 Mt of tailings discharged to the Queen and King Rivers until 1994 as well as the 50 Mt of waste rock has created perhaps Australia's most notorious environmental legacy of acid mine drainage impacts – which reach as far downstream as the marine ecosystems of Macquarie Harbour;

Mt Morgan – poor tailings as well as waste rock management has created a major legacy of AMD impacts in the adjacent Dee River, with the Queensland Government now liable for a rehabilitation cost of the order of $100 million or higher;

Rum Jungle – a complete lack of tailings and waste rock management during operations created a major legacy of AMD impacts in the adjacent Finniss River. The Commonwealth Government, as owner of the former project, contributed about $20 million for rehabilitation in the 1980's but this work is not meeting expectations – with recent evidence that the covers are allowing more water to infiltrate into the underlying waste rock – thereby continuing the AMD cycle. Significant pollution loads still emanate from the Rum Jungle waste rock dumps.[11]

These are a few among many others.

In conclusion there is no guarantee that even with testing the community and the environment will be protected. Acid generation testing (waste rock and tailings) is often inadequate and ends up being incorrect because of the distribution of acid generating material.

Rehabilitation

A major issue which is not widely acknowledged is that of the long-term effectiveness of rehabilitation measures. That is, the long-term performance of various engineering approaches to mined land rehabilitation to reduce surface water and groundwater pollution, erosion issues, gaseous emissions for example radon and methane, restore a productive land use following mining and the like. Although the engineering and regulatory standards are considerably better at present than in the past, there remains concern over long-term effectiveness.

On evidence mining companies seem to collapse before remediation is undertaken leaving the environment as 'an unfortunate victim.'

Finally, and perhaps most critically, there are not yet uniform standards or criteria for determining 'acceptable' rehabilitation.

Noise and Blasting

> Earthworks and drilling associated with the establishment of the box cut, ROM Pad and Tailings Storage Facility at the ROM area, access portal and tailings storage dam, have been predicted to exceed the noise criterion under inversion (night-time) conditions at several receivers.

These 'predicted' noise levels are models. The reality for residents is that sound and noise carry in rural areas. This noise will be 24 hourly. The truck movements and mining operations will exceed noise levels, use of explosives likewise, will shatter the peace rural residents are entitled to.

[11] Mudd G M, The Sustainability of Mining in Australia : Key Production Trends and Their Environmental Implications for the Future, Research Report No RR5, Department of Civil Engineering, Monash University and Mineral Policy Institute, October 2007.

At other underground gold mine sites residents have complained of excessive noise during exploration drilling and other mining activities. Communities like Stawell, Castlemaine /Kangaroo Flat and Kalgoorlie-Boulder residents state in the early morning the noise is so loud its unbearable.

Current noise limits for KCGM are not to exceed a maximum of 51 decibels in the evening or on Sunday at one location, a level just under what could be heard during normal conversation at a distance of two metres. However KCGM's own monitoring shows otherwise. The company states:

> Monitoring indicates noise from the existing KCGM operations exceeds the assigned noise levels in the noise regulations at all five reference locations, during both day and night.[12]

Earthworks and drilling associated with the establishment of the box cut, ROM Pad and Tailings Storage Facility at the ROM area, access portal and tailings storage dam, have been predicted to exceed the noise criterion under inversion (night-time) conditions at several receivers.

At Angus underground mine, even though 'blasts were below requirements' the mining company received 16 community complaints relating to blasting, noise and odour from January to March.

Vibration

In Stawell in Victoria there has been cracking of brick veneer houses. The mining company denies any responsibility, but houses which were sound for many years before gold mining resumed, have cracked.

It is known that vibration effects are cumulative and with 5 years of blasting it will not be surprising if cracks in neighbouring residents appear.

Ecology

The lack of coordinates on maps is of concern. Further the Assessment Report Ecology Section states datasets produced during this survey are 'compatible with those generated during the comprehensive regional assessment of forests' ("CAR ").

The notion that the CAR Reserve System is genuinely based on the principles of Comprehensiveness, Adequacy and Representativeness, is false as the declining populations of forest-dependent threatened species does not support the Assessment Report's argument. The output of the CAR was deeply biased towards logging industry objectives and as such is a flawed document.[13]

> …serious flaws in the information and scientific process underpinning the RFAs undertaken to date have been identified.[14]

To base a value judgment on whether an EEC is viable or not on CAR is therefore based on flawed data.

Of note is that a Preliminary Determination has been made to list the Ribbon Gum - Snow Gum grassy open forest as an Endangered Ecological Community by the New South Wales Scientific Committee.[15]

> Tablelands Frost Hollow Grassy Woodlands in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South western Slopes Bioregions is eligible to be listed as an Endangered Ecological Community as, in the opinion of the Scientific Committee, it is facing a very high risk of extinction in New South Wales in the near future,

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[12] See The Australian, http://www.theaustralian.com.au/news/nation/the-mine-thats-swallowing-a-town/story-e6frg6pf-1111115511984

[13] Compliance with the criteria meant that the protected reserves had to cover the full range of forest community types, be sizeable enough to allow for species survival and reflect the diversity of the individual communities see Hollander R, 'Changing place' Commonwealth and State Government Performance and Regional Forest Agreements' Paper presented to the Australasian Political Studies Association Conference, University of Adelaide, (2004).

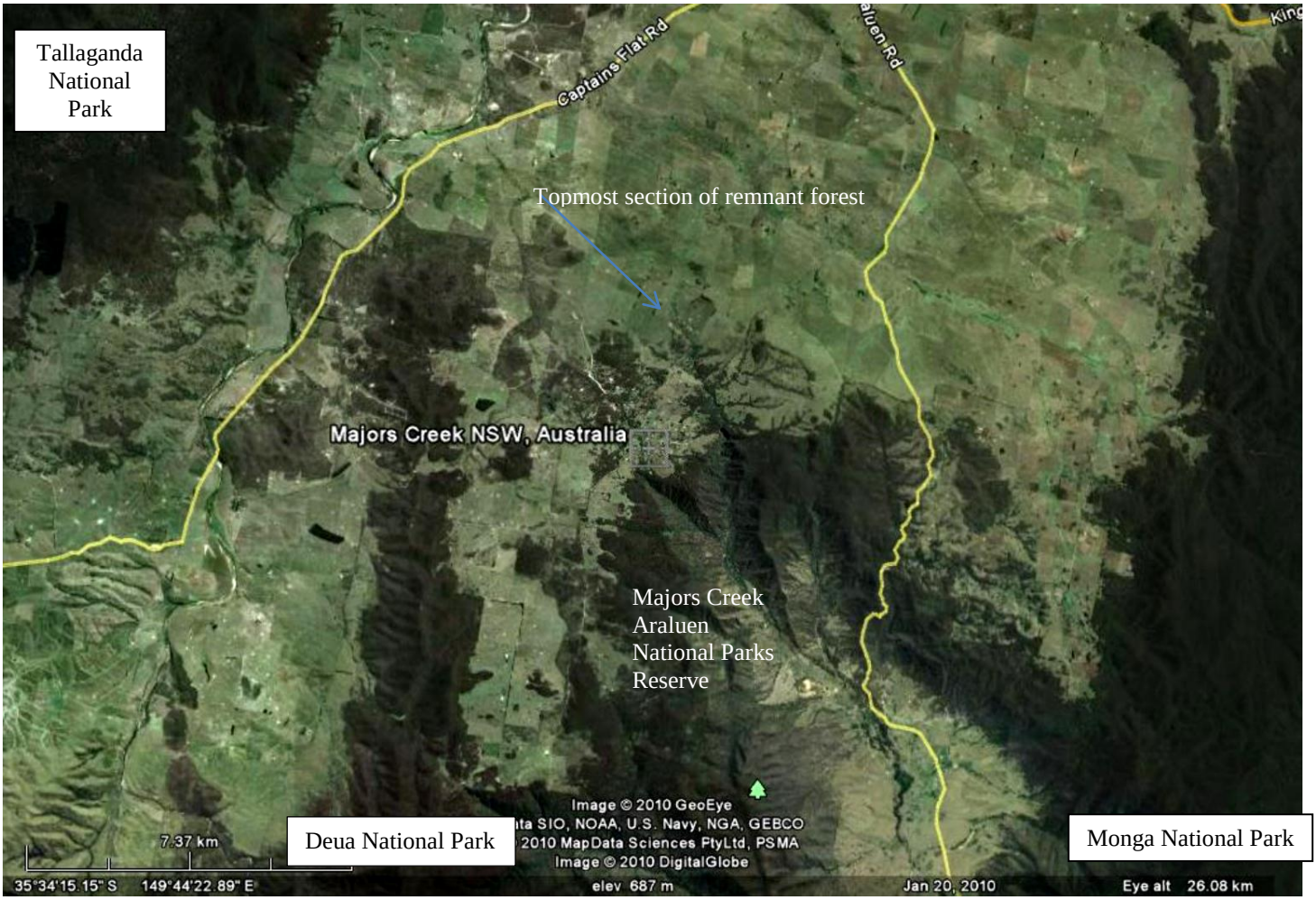
[14] See McDonald J, 'Regional Forest (Dis)agreements: The RFA Process and Sustainable Forest Management' (1999) 11 *Bar Law Review* 295; Redwood J, 'Sweet RFA' [2001] 26 *Alternative Law Journal* 255.

[15] NSW Scientific Committee Preliminary Determination, < http://www.environment.nsw.gov.au/determinations/tablelandsfrosthollowsPD.htm>; see Fischer J, Lindenmayer D B, 'The Conservation Value of Paddock Trees for Birds in a Variegated Landscape in Southern New South Wales: Species Composition and Site Occupancy Patterns' (2002) 5 *Biodiversity and Conservation* 807. NSW Scientific Committee Preliminary Determination, < http://www.environment.nsw.gov.au/determinations/tablelandsfrosthollowsPD.htm>.

as determined in accordance with the following criteria as prescribed by the Threatened Species Conservation Regulation 2002.

The public exhibition has now closed and the final determination in the positive will be likely.

The remnant Ribbon Gum forest provides shelter and habitat to many fauna. It provides a much needed corridor between the Monga National Park, Majors Creek Araluen National Parks Reserve, Deua National Park and Tallaganda National Park.



Clearing of any native vegetation is not ecologically sustainable. The definition of ecologically sustainable development currently in place is contained within the *Protection of the Environment Administration Act1991* (NSW) at s6(2):

Ecologically sustainable development can be achieved through the implementation of the following principles and programs:

(a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
In the application of the precautionary principle, public and private decisions should be guided by:
(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
(ii) an assessment of the risk-weighted consequences of various options,
(b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,
(c) conservation of biological diversity and *ecological integrity*—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.

There is much uncertainty on the effects of climate change but one of the certainties is that land degradation and native vegetation clearing is one of the biggest causes.

> The loss of natural forests around the world contributes more to global emissions each year than the transport sector. Curbing deforestation is a highly cost-effective way to reduce emissions; large scale international pilot programmes to explore the best ways to do this could get underway very quickly.[16]

The Stern Review goes on to state in Annex 7f:[17]

> Deforestation is the single largest source of land-use change emissions, responsible for over 8 $GtCO_2$/yr in 2000. Deforestation leads to emissions through the following processes:

If logged and cleared the carbon stored within the trees or vegetation is released into the atmosphere as carbon dioxide, either directly if vegetation is burnt (i.e. slash and burn) or more slowly as the unburned organic matter decays. Between 1850 and 1990, live vegetation is estimated to have seen a net loss of 400 $GtCO_2$ (almost 20% of the total stored in vegetation in 1850).[18] 80% was released into the atmosphere. The removal of vegetation and subsequent change in land-use also disturbs the soil, causing it to release its stored carbon into the atmosphere.[19]

The Assessment Report repeatedly states that, as the area to be cleared is small, there will be no negligible effects. We would contend that this statement is erroneous and only serves the proponent.

While much is made of the undertaking not to destroy any hollow bearing trees the undertaking to not destroy any feed trees or habitat trees is missing from the Assessment Report. This is not acceptable.

Listed Endangered Ecological Communities

Of note is that there is no mention in the Assessment Report that in 2006 The NSW Scientific Committee made a Final Determination to list the Araluen Scarp Grassy Forest in the South East Corner Bioregion as an Endangered Ecological Community ("EEC").

The Assessment Report states:

> A small strip of Native Grassland was also identified. However, due to the narrowness of the strip (<5m) and location adjacent to an eroding stream bank, the community was determined not to be viable.

The Natural Temperate Grasslands of the Southern Tablelands (NSW and ACT) is listed as an endangered ecological community. If the point of listing an EEC community is that it is endangered then to allow it to be destroyed seems in complete conflict with everything known about biodiversity and the point of its listing. It is also in tension with other legislative instruments.[20] The Department of Environment Climate Change and Water has developed 18 Priority Actions to enable recovery of this EEC. Destroying an EEC is not one of the Priority Actions.

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[16] The Stern Review on the Economics of Climate Change, < http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm>

[17] The Stern Review, above n10, 'Emissions from the land-use change and forestry sector'.

[18] Baumert, Herzog and Pershing 'Navigating the Numbers: Greenhouse Gas Data and International Climate Policy' Washington, DC: World Resources Institute (2005); see also Houghton 'Revised Estimates of the Annual Flux of Carbon to the Atmosphere from Changes in Land Use and Land Management 1850-2000' (2003) 55 *Tellus B* 378.

[19] Houghton J T, 'Tropical Deforestation as a Source of Greenhouse Gas Emissions' (2005) in *Tropical Deforestation and Climate Change*, Moutinho and Schwartzman [eds]; see also Intergovernmental Panel on Climate Change (2001): 'Climate change 2001: the Scientific Basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change' Houghton JT, Ding Y, Griggs DJ, et al [eds], Cambridge: Cambridge University Press; also Food and Agriculture Organization of the United Nations (2005): 'State of the World's Forests' Washington, DC: United Nations.

[20] Eddy D, 'Managing Native Grassland: A Guide to Management for Conservation, Production and Landscape' (2002) World Wide Fund for Nature Protection, available at <http://wwf.org.au/publications/managing_grasslands/>; see Rehwinkel R, 'Revision of PATN Analysis of Grassland Associations Within the Natural Temperate Grassland Endangered Ecological Community in the Southern Tablelands of NSW' (2009) Report to NTG Recovery Team; see also Sarah S, Dorrough J, Rehwinkel R, Eddy D, and Breckwoldt A, 'Grassy Ecosystems Management Kit: A Guide to Developing Conservation Management Plans' (2005) Environment ACT.

Fauna Survey Methods

Studies have been undertaken which suggest that spotlight surveying methods are ineffective for detecting arboreal mammals. Detectability of arboreal marsupials by spotlighting depends on weather conditions.[21] Spotlight transects may substantially under-estimate the actual abundance of animals in a given area.

On survey methods scientific judgment on surveying runs thus:

> Unless the probability of detecting a species when it is present is equal to 1, false negative observation errors will occur in species surveys. The probability of detecting the presence of the case study species in any single standard survey based on spot-lighting and call elicitation has been found to be very low (Pr[detection/ presence] ~ 0.12–0.45); making the reliability of absence data a potentially serious form of uncertainty in our case study. Recent studies have demonstrated the negative impact that false-negative observation error may have on species habitat analyses, meta-population models and monitoring studies.[22]

The Lindenmayer study found that spotlight searches on species that are smaller and faster moving than the Greater Glider for example the sugar glider, *Petaurus breviceps*, or partially terrestrial mountain brushtail possum, *Trichosurus caninus*, are likely to yield even lower detection rates.

We would state that this proposal triggers the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and requires the Commonwealth's approval before proceeding. Federally listed animals within four kilometres of the project include:

New Holland mouse (*Pseudomys novaehollandiae*): listed as vulnerable;
Araluen Zieria (*Zieria adenophera*): listed as endangered;
Button Wrinklewort (*Rutidosis leptorrhynchoides*): listed as endangered;
Araluen Gum (*Eucalyptus kartzoffiana*): listed as vulnerable
Grey Deua Pomaderris (*Pomaderris gilmourii var. cana*): listed as vulnerable;
Spotted-tailed Quoll (*Dasyurus maculatus*): listed as endangered.

Ecosystem Maintenance

Scientists advocate an approach based on maintaining ecosystem structure and function, and therefore ultimately protecting more species.[23] Protecting species and diversity is a key way to do this thereby enhancing ecosystem resilience, so that they are able to maintain their functions and processes.

> Fauna experts consulted during the Response to Disturbance Project have recommended that corridors and riparian buffers be expanded to 200 m for yellow-bellied gliders, 1 km along major rivers for owls, 240 m for fishing bats and golden tipped bats, and 1km between catchments for stuttering frogs.[24]

Fragmentation of the landscape and the consequent habitat loss is the major threat to biodiversity.[25] It has been suggested that fragmentation within a forest will force the inhabitants of the logged forest patch into the surrounding forest, thereby causing dysfunctional behaviour due to higher than normal densities.[26] This phenomenon is reduced when the remaining forest is left intact.

Roads result in fragmentation of the landscape, but they also have much broader and wide ranging effects. At

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[21] Lindenmayer D B, Cunningham R B, Donnelly C F, Incoll R D, Pope M L, Tribolet C R, Viggers K L, and Welsh A H, 'How Effective is Spotlighting for Detecting the Greater Glider (*Petauroides volans*)?' (2001) 28 *Wildlife Research* 105.

[22] Wintle B A, Elith J, and Potts J M, 'Fauna Habitat Modelling and Mapping: A Review and Case Study in the Lower Hunter Central Coast Region of NSW' (2005) 30 *Australian Ecology* 719.

[23] McIntyre S, Barrett G, Kitching R, and Recher H, 'Species Triage – Seeing Beyond Wounded Rhinos' (1992) 6 *Conservation Biology* 4 p604; see also Walker B, 'Conserving Biodiversity Through Ecosystem Resilience' (1995) 9 *Conservation Biology* 4, p747.

[24] From CRA Report 'Draft Assessment of Forest Management Practices for the Eden RFA' CSIRO Forestry and Forestry Products and Andrew Smith, Sestscan and Pat O'Shaughnessy and Associates, (1997), ne27esfm, ISBN 0-642-28398-2 p48.

[25] Benson J, 'Past, Present and Future: the Role of Scientific Knowledge in Nature Conservation' (1993) *National Parks Journal* February, p17; see also Wilcove D S, Rothstein D, Dubow J, Phillips A, and Losos E, 'Quantifying Threats to Imperiled Species in the United States' (1998) 48 *BioScience* 607.

[26] Hagan J M, Vander Haegen M, and Mckinley P S, 'The Early Development of Forest Fragmentation Effects on Birds' (1996) 10 *Conservation Biology* p188.

the landscape scale, roads disrupt ecosystem processes and, at both a fine and coarse scale, cause a loss of biodiversity.[27] In this proposal's case the transportation of hazardous chemicals elevates the risk of environmental damage.

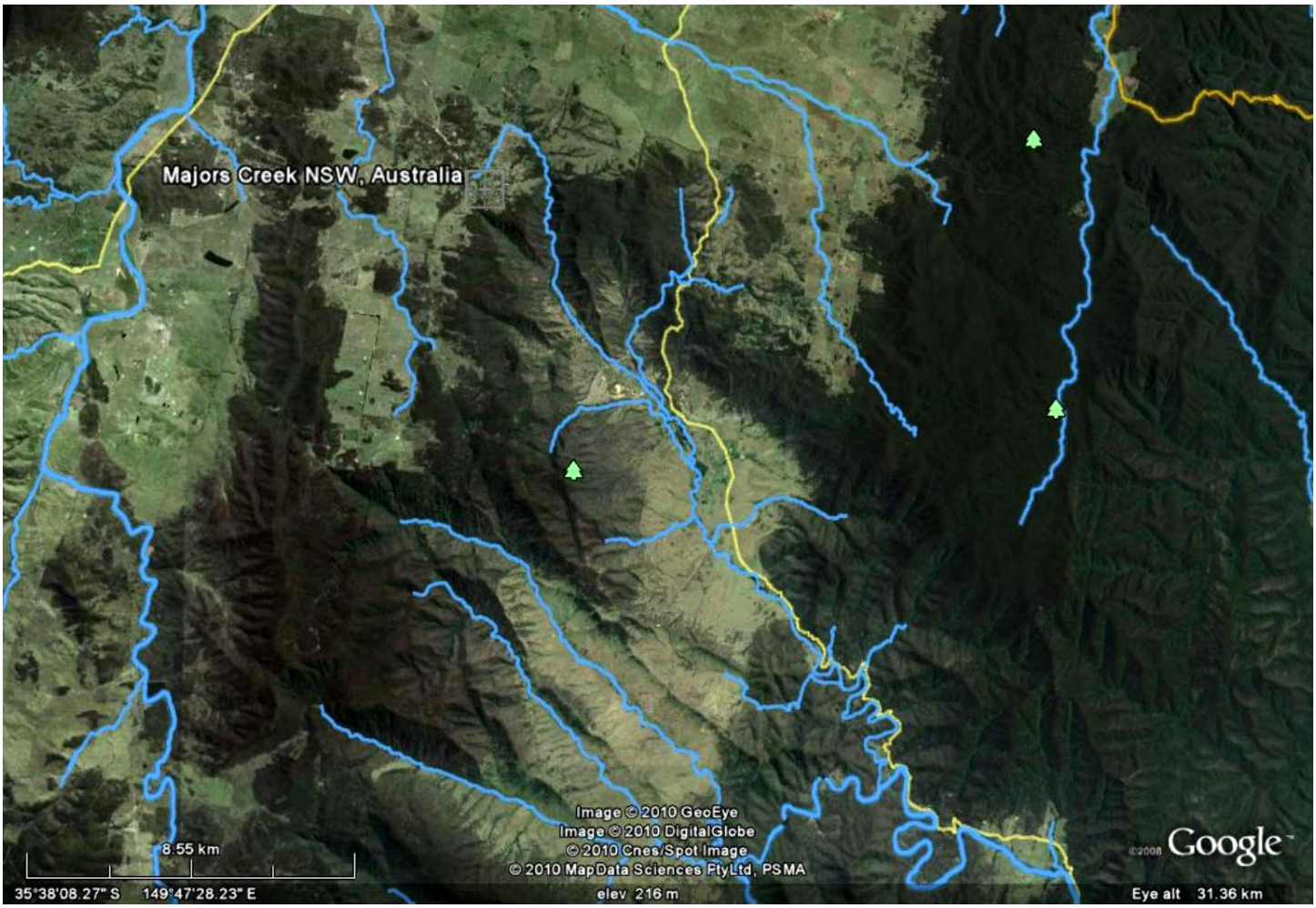
As stated in the Assessment Report the trees in the Ribbon Gum forest are between 120 -200 years old. To destroy these trees for the sake of a project that has a five year life span verges on the corrupt. Further much of the Assessment Reports Ecology Section recommends that further more comprehensive surveys be undertaken.

We would remind the Department of Planning that Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands, Clearing of native vegetation and Human-caused Climate Change have all been listed as Key Threatening Processes under the *Threatened Species Conservation Act 1995* (NSW).

Groundwater

> Maximum operational water requirements for mineral processing, dust suppression, underground mining and workshop wash-down purposes have been estimated to be approximately 885ML/year. Of this approximately 755ML/y can be reclaimed from the tailings storage facility. Therefore approximately 130ML/y of make-up water will be required as a maximum.

The water table currently supplies underground springs that provide drinking water for the local native animals and also keep the native flora watered. The dramatic drop in the water table would be a disaster for these native animals and their habitat. Spring Creek feeds into Majors Creek which passes through the Majors Creek Araluen National Parks Reserve and then feeds into the Deua River which turns into the Moruya River which passes through National Park and then out to the Pacific Ocean.



[27] Forman R T T, and Alexander L E, 'Roads and Their Major Ecological Effects' (1998) 29 *Annual Review of Ecology and Systematics* 207.

Three sources of water are identified in the Assessment Report by the proponent:
1. Water recovered by dewatering the active mine
2. Water captured in 8 surface dams constructed under the 'harvestable rights' provisions of the *Water Act 2000*
3. Water pumped from old abandoned mines.

Seemingly the water modelling has been based on an inadequate understanding of how water catchments work. There seems to be an assumption that the surface dams will not be affected by the draw-down in the regional water table and will somehow be filled by hortonian overland flow.

However most run off in these catchments will be due to baseflow, sub-surface stormflow or overland flow which is the result of exfiltration of interflow in saturated zones.[28]
Borefield studies undertaken by the proponents show that the regolith and granodiorite aquifers are tightly connected. Any surface dams constructed in the zone surrounding the mine which may be even slightly affected by the draw-down in the water table are unlikely to yield significant volumes of water.

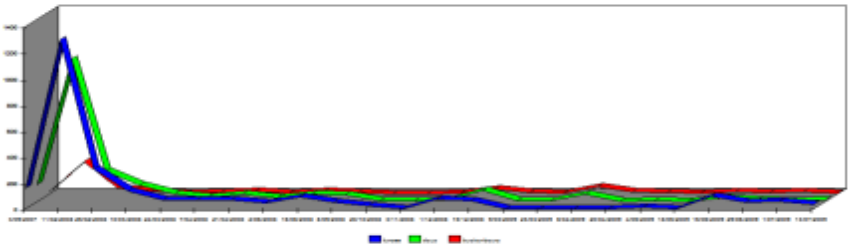
The strategy to attempt to replace lost baseflow in Major's Creek with releases from the 'harvestable rights' dams is unlikely to succeed due to the poor yield from those dams.

The use of water recovered from abandoned workings will definitely reduce the baseflow in Majors creek and lower the regional water table. The Project would result in lowering of groundwater levels within the Shoalhaven Catchment.

A failure to secure the baseflow in Majors Creek will have adverse impacts on the valuable peach orchard production at Araluen and ultimately the urban water supply scheme for the Eurobodalla Shire due to the recent upgrade in extraction capability from the Deua River.

The severity of the prolonged drought and inclement climate change conditions is readily portrayed by the flow recordings of the three rivers, the Tuross, Deua, and Buckenboura, in the Eurobodalla Shire. The Shire's water supply depends upon these rivers. Since the last minor flood peak in 2010 these rivers have been extremely low.

Eurobodalla Rivers Water Flow 2007-2009 (ML/day)[29]



[28] Bonnell M, 'Progress in the Understanding of Runoff Generation Dynamics in Forests' (1993) 150 *Journal of Hydrology* 217; see also Hewlett J D and Hibbert A R 'Factors Affecting the Response of Small Watersheds to Precipitation in Humid Areas' (1967) International Symposium on Forest Hydrology, Pennsylvania State University, 29 August to 10 September, 1965, Pergamon, Oxford, pp 275-290; O'Loughlin E M, Cheney N P and Burns J 'The Bushrangers Experiment: Hydrological Response of a Eucalypt Catchment to Fire' (1982) *Proceedings of the First National Symposium on Forest Hydrology,* National Conference Publication No. 82/6, Institution of Engineers of Australia; and see also Topalidis S and Curtis A A, 'The Effect of Antecedent Soil Water Conditions and Rainfall on Runoff Generation in a Small Eucalypt Catchment' (1982) *Proceedings of the First National Symposium on Forest Hydrology,* National Conference Publication No. 82/6, Institution of Engineers of Australia, p45.

[29] Collated data from Eurobodalla Shire Council Eurowater "Eye on Supply" statistics, <http://www.esc.nsw.gov.au/site/Water/index.html>.

There is no proposed secondary wall to be constructed in case the first wall of the tailings storage facility fails. The clean water diversion structure around the tailings storage facility appears to be a mainly a surface drain/bund. This will intercept hortonian overland flow but not intercept the interflow of subsurface water. In prolonged wet conditions, such interflow, concentrated in natural fissures, might threaten the integrity of the low-permeability layer of the tailings storage facility.

The failure of the tailings storage dam at Captains Flat, which contaminated vast reaches of the Molonglo River with heavy metals, resulting in Lake Burley Griffin being rendered biologically poor is one such example.

Energy Use

> A high voltage connection agreement will be required to permit connection of the proposed electricity transmission line to the existing transmission grid from Country Energy which holds an electricity distributor's licence under the *Electricity Supply Act 1995*.

Mining of hard rock and processing the ore and transporting the concentrate will all use considerable fossil fuel energy. The electricity usage is predicted to be between 36 444 885 kWh to 46 662 513 kWh per year for a total of 209 735 707 kWh for the 5 years of the project.

With climate change mitigation being listed as apriority by both the State and Federal Governments to approve a project that has such considerable usage of fossil fuels seems hypocritical, particularly as anthropogenic climate change has been listed as a Key Threatening Process.

Air Quality

The Project Site is situated in a rural area with no major sources of air pollution, the local air quality is good and the community wishes it to stay that way. The township of Majors creek is two kilometres from the mine site.

Low dust levels are difficult to maintain. This is of great concern in view of the toxicity of many of the chemicals used in this project. Research has shown that current standards for dust protection are not being met in some mines.

The inhalation of dust particles less than 10 microns (PM10) is known to increase death and asthma attacks. With the pit close to residents and schools this dust is a major concern. Further issues such as sulphur dioxide emissions and silicosis have not been addressed in the Assessment Report.

Silicosis

Silicosis is an lung disease which is caused by repeated and prolonged exposure and inhalation of relatively high levels of free silica dust. Exposure typically occurs when rocks containing silica are ground up during mining or quarrying operations; if inhaled the dust can cause scarring in the lungs. While there are often no outward symptoms of the disease, breathlessness and coughing can occur. Silicosis also has the potential to cause chronic respiratory disease.

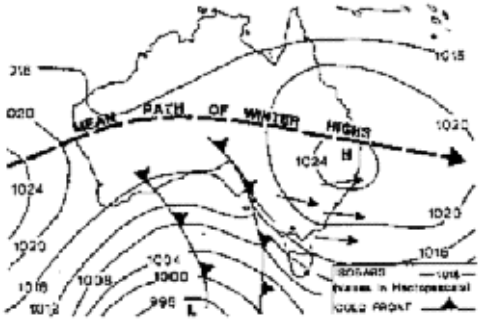
While the causes of silicosis are well known, according to a recent Australian Senate enquiry, there is still a lack of understanding about the actual size of the problem. Throughout the industry, it is not known whether the current standards of risk minimisation for exposure to inhalable silica are enough to eliminate the risk of the disease completely.

What is known is that particles that pose the greatest risk are in the respirable range, and are extremely fine at a size of 2.5 µm or even less than 1 µm. On top of this, there is concern that existing exposure standards are not providing safe levels of protection for mine workers.

Pollution Impacts via Airborne Pollutants and Emissions

In April 2007 the Western Australian fined KCGM $25,000 for sulphur dioxide emissions that affected Coolgardie residents. Every year the south coast experiences dust storms and westerly winds. In 2009 there

were two severe events within a week of each other. This northward movement of the high pressure systems and the mid-latitude cyclones results in predominantly west to south-west winds across most of NSW in winter.[30]



The weather patterns show that if there is chemical or toxic release into the atmosphere in Majors Creek it will effect the residents of the south coast if there is a south westerly or westerly wind.

Other Issues of Consideration

The Majors Creek Fault Line
A major fault line runs along Majors Creek. It has been subject to minor slippage in the past 30 years and major slippage in the past. No assessment seems to have been made of the effect of slippage from the Majors Creek fault line. There is no reference to this in the Environmental Assessment.

The proposed Dargues Reef tailings dam and the Dargues Reef Mine itself is only 1.5kM away from the Majors Creek fault line. Any slippage on this fault line would result in the failure of the dam impacting on residents and the environment.

Radon Gas Exposure
This is not mentioned in the Assessment Report, nor have the community been informed, of the depth and extent of mine tunnels. The vertical mine shaft is proposed to be 500 metres deep. The horizontal tunnels will extend out for possibly more than two kilometres. This is of particular relevance as, in most areas of decomposed granite, radon gas is a particular hazard at depth.

Radon gas is a major health hazard, and this is well known to the Majors Creek community as residents have been warned of the danger with regard to home cellars and enclosed rooms like bathrooms with little ventilation, by medical experts and geologists.

It is symptomatic of the Assessment Report that there is no mention of Radon gas and further there appears to have been no testing of Radon gas levels in the three existing historic mine shafts. There is also no mention in the Environmental Assessment of monitoring Radon gas levels, nor of the threat to worker health.

[30] See 'What Drives NSW Weather' Department of Primary Industries, 2009.

Aboriginal Heritage

There are known Aboriginal women's sites within ten kilometres of the proposal. Further cultural objects were found within the area of the proposal indicating that if a more thorough survey were to be conducted there is a likelihood of more objects being discovered.

Inconsistency in The Survey Results

When compared with the consultant's poorly developed 'predictive model' for predicting past Aboriginal occupation and the potential to find evidence of such occupation in the Spring Creek study area, one particular conclusion drawn by the archaeological consultant is not consistent with the 'predictive' model that he infers would apply to the current study area.

The archaeologist expresses surprise at the results of the field survey where a significant number of Aboriginal Objects, as defined under the *National Parks and Wildlife Act 1974* (NSW) 'archaeological sites', were found in the immediate proximity to the study area's Spring Creek and that prior to more recent European land management activities it was likely that there would have been a lot more evidence of past Aboriginal occupation present along the banks of Spring Creek (see Section 7, Discussion).

He then states, in contradiction, that the Spring Creek environment was unlikely to have been a location favoured by past Aboriginal inhabitants as an occupation area but would have been merely part of an Aboriginal movement corridor between more suitable and habitable areas.

Surely then the archaeologist should have been questioning the results of the field survey if he was surprised by the results of the field survey. The presence of a relatively large number of geographically separate Aboriginal site locations should have been a trigger to create some concern in the consultant's mind as to question what had in fact caused the unexpected presence of Aboriginal stone artefact scatter sites along the banks of a creek which he defined in his report as 'ephemeral' in nature.

Survey Area Coverage.

None of the material talks about survey area coverage. DECCW should have required a map of field survey coverage of the survey area and a description of the coverage strategy and a justification for such a strategy.

Field survey coverage details should include, for example the percentage of survey area covered, patterns of on-foot or vehicle coverage, surface visibility, other impediments to effective coverage of the study area.

These are essential components of any Aboriginal archaeological study (Witter 1995) and should have been required as an integral component of any assessment of the Aboriginal Heritage report by the statutory reviewing authority.

Furthermore, whilst there is no map provided which identifies survey area coverage, it would appear that the survey focused primarily upon archaeologically sensitive alluvial/colluvial stream banks only.

In comments from one of the Aboriginal community participants (Bell, pers coms 2010, Appendix) the participant stated that he was concerned that they were not afforded an opportunity to visually inspect the entire study area.

There seems to be no evidence that even a representative sample of each survey area landform was in fact visually inspected during the current Dargues Reef project archaeological study. We would suggest that the impeding destruction of Aboriginal cultural heritage should not be treated as some kind of guessing game.

We would state, based on these assertions that DECCW will have difficulty approving of the standard or percentage coverage of the field survey, or furthermore be able to validate the standard of the survey.

Landform Based Archaeological Sensitivity Assessment
The report makes no attempt to provide to the reader, and most importantly to a DECCW reviewer, a description of survey area landform and /or Study Area landforms.

No attempt is made to formally classify and differentiate between the various survey area landforms such as alluvial creek banks, alluvial and colluvial creek bank terraces, adjacent low hillslopes and hillslope terrace, spurlines and spurline crests, for example.

All of the above mentioned landform units, many of which occur within the Dargues Reef study area, may be considered to have high levels of archaeological potential, depending upon levels of past disturbance, along with varying levels of assessed archaeological sensitivity, based upon existing Aboriginal site distribution patterns and predictive models.

From the copies of topographic maps and aerial photos provided in the report the alluvial stream banks, of which the report author refers to in his report as containing numerous Aboriginal 'sites' (Aboriginal Objects as defined under the Act) are not the only archaeologically sensitive landforms contained within the study area. However, they appear to have been the focus of the field survey.

This is yet another example of the narrow scope of the Assessment Report and the lack of regard to impact.

Aboriginal Community Consultation
The copy of the Letter to Registered Aboriginal Stakeholders is evidence that there is no attempt to obtain from any of the registered stakeholders /Aboriginal community groups, known information on the cultural significance of the Dargues Reef study area.

This information should have been critical to the integrity of the field survey and should have been obtained prior to commencement of the field survey.

The Oxford Dictionary definition of consultation is (verb) 1. seek information or advice from; 2 seek permission or approval from; ORIGIN Latin *consultare*, from *consulere* 'take counsel'.

Given the devised and non culturally sensitive strategy by the consultant for the involvement of such a large number of Aboriginal community representatives as participants in the field survey it is difficult to understand how any one group who had rostered representatives present during the course of the field survey could have obtained an understanding of the development proposal and its potential impact upon Aboriginal cultural heritage.

The strategy for community consultation and involvement would have been better served whereby a small number of representatives, considered to be the most relevant to the study area, were given the opportunity to participate in the entire survey. This could then have been followed by a post field survey inspection of the other identified stake holders. Priority in choosing the most relevant group reps to attend the field survey would have been more appropriately established using community reps who identified specific cultural and physical knowledge of the study area and or the attended by reps of the statutory Aboriginal land council. The strategy employed by the consultant was clumsy and inappropriate for the above reasons. DECCW should not accept this below standard methodology.

Significance Assessment
The consultant seems to be confusing Social Significance with the all encompassing term Cultural Significance. The consultant, whilst attempting rather clumsily and grossly inaccurately to define what cultural significance is for the purpose of his report, certainly appears to be totally unfamiliar with international cultural significance assessment criteria and protocols, that is ICOMOS or the Australian ICOMOS (the *Burra Charter*) standards, criteria and definitions in his section of the report on Significance Assessment.

The *Burra Charter* states that Cultural Significance is comprised of a number of assessable criteria:

- Social
- Aesthetic
- Scientific
- Historic

Aboriginal communities have right to a major interest in aspects of their cultural heritage. However the term cultural signficance was never intended to be exclusive of the views and aspirations of the broader community.

The consultant attributes interest in Aboriginal cultural heritage only to the Aboriginal community. His extremely poor grasp and confusion of the *Burra Charter* provisions for assessing Cultural Significance is clearly displayed when he excludes the remainder of the broader non-indigenous community from attributing cultural significance to aspects of Aboriginal archaeological heritage.

Doing so denies that highly significant Aboriginal archaeological sites in Australia have any value to the broader lay community, except for the scientific and educational values of the sites. Whilst the value of Aboriginal archaeological sites for their scientific and educational significance is not denied, intrinsic value is something which many of the broader community attach to such highly significant entities, regardless of the details of the scientific or educational value.

This is evidenced by much of the tourist information of the area in which Aboriginal cultural heritage seems to be of high interest to the broader community.

Nevertheless the significance assessment for the artefacts was not conducted due to an unsubstantiated claim that ‘no Aboriginal Objects would be impacted as a result of the development proposal’.

It seems the consulting archaeologist did not enter into any discussion of the overall significance of the Dargues Reef study area to the Aboriginal community with the relevant Aboriginal community groups, or even attempt to put the discovery of the recorded ‘sites’ in any Aboriginal cultural context.

It would appear that the Assessment Report fails to address this aspect of ‘significance assessment’.

Aboriginal Site Management

Whilst it would appear that there is no proposal to impact ‘known’ Aboriginal sites (objects) there are no formal protective measures described within the report such as fencing, flagging and protective buffer zones around recorded Aboriginal sites within the study area.

How does the proponent intend to ensure that ‘accidental’ impact does not occur ?

Whilst there is mention in the assessment of areas of PAD in the survey area there was no material relating to this matter in the Assessment Report. The existence of PADs is a major issue in such a large area survey and especially where surface visibility might impede effective surface coverage.

The comment that PADs are not recorded as sites on the DECCW AHIMS register is erroneous. DECCW accepts PAD recordings on the database.

There seems to be no scientific data or justification in the material of the Assessment Report to support the view that there are no areas of PAD in the study area.

In conclusion once an item of Aboriginal cultural heritage is destroyed, it is lost forever.

Conclusion

The greenhouse gas emissions of the project have not been off-set in any way. The authors state this proposal triggers the precautionary principle. The Precautionary Principle is Principle 15 of the *Rio Declaration*:

> Where there are threats of serious or irreversible environmental damage full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment.[31]

As McClellan CJ stated:

> Thus, the inherent uncertainty or bias in the scientific method combined with (generally speaking) a perennial lack of resources and a consequential lack of data to assist scientists, leads inevitably to the conclusion that there is likely to be an incomplete understanding of the full extent of the environmental impacts of any particular act or activity proposed. That prospect, supported by empirical observations gathered world-wide, led to the development of the precautionary principle as a commonsense approach to avoid or minimise serious or irreversible harm to the Environment.[32]

Because of the above stated reasons, we believe that this project should never have been considered and certainly should never be approved. As shown the cost to the environment far outweighs the minimal gain of employment. This form of mining relies more on the use of large machinery than large amounts of labour. Five years is very short period of time therefore any job benefits are not all that impressive thus the amount of financial benefit to the community will be minimal.

Of note is that once a year, every year, the community of Majors Creek hosts a music festival. This festival brings in a great amount of financial benefit to the community. Certainly this mining project will halt the festival. Therefore this project will leave the community in deficit.

The Assessment Report does not usefully contribute to the debate as it fails to adequately address a wide range of public health problems. Additional to the dust concern is the health risk associated with exposure to arsenic in mine tailings, especially for children. To allow the proposal to proceed under these health concerns with the proponent self-regulating and monitoring would be negligent.

Other voiced concerns have focussed on an increase in stress due to noise, vibration, loss of property values, harassment and disruption of general lifestyle and amenity. The proposal has already caused anxiety and depression in Majors Creek's close-knit rural community.

In addition, the Assessment Report states the company will clear valuable forest on which fauna and flora rely.

The gold mining industry is a powerful lobby group. The industry justifies its assault on communities and the destruction of the environment with the promises of jobs and economic benefit, but at the conclusion invests its profits elsewhere and leaves the community with a dangerous mess. When the mine closes a further risk is the large and dangerous void, which will have to be made secure for hundreds of years.

Furthermore, with what is current scientific knowledge on the effects of climate change nothing about this proposal can be seen to have any mitigating factors and in fact will help exacerbate the effects of climate change.

South East Forest Rescue would recommend that this proposal be rejected.

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[31] The Rio Declaration, *Convention on Biological Diversity*, Rio de Janeiro, 5 June 1992, Entry into force for Australia: 29 December 1993, Australian Treaty Series 1993 No 32.

[32] In *BGP Properties Pty Limited v Lake Macquarie City Council* [2004] NSWLEC 399 citing Trenorden J et al in *Conservation Council of South Australia v Development Assessment Committee and Tuna Boat Owners Association* (No 2) [1999] SAERDC 86.

'Small' Underground Gold Mine- Jundee

Appendix A

List of Species of the Area: Results of On-Ground Monitoring

Rare and Endangered Species Within a Three Kilometre Radius of the Dargues Reef Gold Mine Project

Species	Comment	Listing Status
Araluen Gum (Eucalyptus kartzoffiana)		
Powerful Owl (Ninox strenua)	These regularly nest within one to two kilometres of the mine.	vulnerable
Barking Owl (Ninox connivens)		vulnerable
Araluen Zieria (Zieria adenophera)	The only wild specimens of these are within five kilometres of the proposed mine project	critically endangered
Majors Creek Leek Orchid (Prasophyllum sp. Majors Creek)		endangered
New Holland mouse (Pseudomys novaehollandiae)		vulnerable
Button Wrinklewort (Rutidosis leptorrhynchoides)		endangered
Grey Deua Pomaderris (Pomaderris gilmourii var. cana)		vulnerable
Spotted tailed Quoll (Dasyurus maculatus)		endangered
Brush tailed Rock Wallaby (petrogale penicillata)	The existence of this species in the Majors Creek gorge, one to two kilometres from the mine site, was verified by DNA testing by Steve Dovey of the NSW National Parks and Wildlife Service, as well as on ground observation.	critically endangered
Gang gang Cockatoo	These are transitory, visiting the area within two kilometres of the mine, usually for four to six weeks each autumn.	threatened
Red tailed Black Cockatoo	Transitory, visiting the Majors Creek gorge area usually for two to three weeks in December or early January.	endangered
Spotted Quoll	These were last sighted seven years ago. They may well be locally extinct	endangered
Bettong	Nesting sites last observed two years ago	
Red Goshawk	These live and nest within the gorge and cliffs just below the mine site	endangered
Grey headed Flying fox (Pteropus poliocephalus)		threatened
Little Pied Bat	Present in small colonies	vulnerable
Eastern Bentwing bat(Miniopterus schreibersii oceanensis)	Only one confirmed capture in the four kilometres downstream from the mine. More study on bat species here is needed.	vulnerable
Squirrel Glider (Petaurus norfolcensis)		vulnerable
Araluen Rock Python Status	It has none of the markings of the Southern Rock Python and is visually dissimilar to any recognised species. It exists only within the Majors Creek gorge, four to six kilometres downstream from the proposed mine site	once identified would be critically endangered

Endangered Ecological Communities

*Natural Temperate Grasslands of the Southern Tablelands (NSW and ACT).

*The Araluen Scarp Grassy Forest has been listed as an endangered ecological community.

*Ribbon Gum Snow Gum Grassy Open Forest: Tablelands Frost Hollow Grassy Woodlands in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South western Slopes Bioregions.

Many species exist locally only within the gorge below the mine site. These include:

- The southern most natural occurrence of Bunya Bunya nut trees.
- The southern most natural occurrence of Ficus coronata, or Sandpaper Fig: not endangered, but present in only two gullies in this region, both affected by the proposed Dargues Reef Mine Project.
- The southern most natural remnant of Cabbage Tree Palm.
- An otherwise unknown pink subspecies of the common brown snake
- Backhousia myrtifolia or Grey Myrtle: one of the few remaining remnants of backhousia dry rainforest canopy left.
- Notothixos subaureus: parasitic mistletoe.
- Dodonaea viscosa: a local subspecies, not yet positively identified.
- Adiantum formosum: giant maidenhair not endangered but this is the only area locally where it appears.
- An unnamed stringybark (possibly a hybrid of the red and yellow stringybarks): still to be positively identified.
- Macropus rufogriseus: Red necked Wallaby: not threatened, but almost extinct in this district. This appears to be the single surviving local population.

Other species:
These include 127 species of birds, eight species of snake of which some examples are the Common Wombat, Eastern Grey Kangaroo, New Holland Mouse, echidna, Black-tailed Wallaby, Wedge-tailed Eagle, Aquila audax, lyrebird, Pretty-faced Wallaby, Brushtail Possum, Ringtail Possum and Sugar Glider. The Wedge-tailed Eagle, Aquila audax is listed as a declining species in this area, Crimson Rosella Platycercus elegans, Eastern Yellow Robin and Grey Fantail.

Appendix One and Appendix Two of the Assessment Report Ecology Section 2, although mis-named, contain lists of species found within the site. This should be proof of the biodiversity contained within the area. As seen many species are water dependent or ground dwelling.

Species recorded in EA survey by their own admission
• Echidna *Tachyglossus aculeatus*
• Eastern Grey Kangaroo *Macropus giganteus*
• Swamp Wallaby *Wallabia bicolor*
• Ringtail Possum *Pseudocheirus peregrinus*
• Sugar Glider *Petaurus breviceps*
• Wombat *Vombatus ursinus*
• Verreaux's Tree Frog *L. verreauxii*
• Bleating Tree Frog *Litoria dentata*
• Spotted Grass Frog *Limnodynastes tasmaniensis*
• Peron's Tree Frog *Litoria peroni*
• Lesueur's Tree Frog *Litoria lesueurii*
• Common Eastern Froglet *Crinia signifera*
• Striped Marsh Frog *Limnodynastes peroni*
• Southern Green Stream Tree Frog *Litoria nudidigata*
• Eel *Anguilla australis*
• Mountain Galaxias *Galaxias olidus*(fish)
• Gippsland Water Dragon *Physignathus lesueurii howitti*
• Eastern Bluetongue Skink *Tiliqua scincoides*
• Three Toed Skink *Hemiergis decresiensis*
• Weasel Skink *Saproscincus mustelina*
• Southern Cunningham's Skink *Egernia cunninghamiana*
• Gippsland Water Dragon *Physignathus lesueurii howitti*

- Southern Water Skink *Eulamprus heatwolei*
- Red-bellied Black Snake *Pseudechis porphyriacus*
- Chocolate Wattled Bat *Chalinolobus morio*
- Large Forest Bat *Vespadelus darlingtoni*
- Southern Forest Bat *Vespadelus regulus*
- Little Forest Bat *Vespadelus vulturnus*
- Gould's Long-eared Bat *Nyctophilus gouldii*
- Lesser Long-eared Bat *Nyctophilus geoffroyi*
- White-striped Mastiff Bat *Tararida australis*
- Agile Antechinus *Antechinus agilis*

Ptilonorhynchus violaceus Satin Bowerbird
Anthus novaeseelandiae Richards Pipit
Neochmia temporalis Red-browed Firetail
Stagonopleura guttata Diamond Firetail
Hirundo neoxena Welcome Swallow
Hirundo nigricans Tree Martin
Cincloramphus cruralis Brown Songlark
Coturnix ypsilophora Brown Quail
Cygnus atratus Black Swan
Tadorna variegata Australian Shelduck
Chenonetta jubata Australian Wood Duck
Anus superciliosa Black Duck
Anus rhynchotis Australasian Shoveler
Anus gracilis Grey Teal
Anus castanea Chestnut Teal
Aythya australis Hardhead
Tachybaptus novaehollandiae Australasian Grebe
Tachybaptus poliocephalus Hoary-headed Grebe
Phalacrocorax melanoleucos Little Pied Cormorant
Phalacrocorax sulcirostris Little Black Cormorant
Pelecanus conspicillatus Australian Pelican
Egretta novaehollandiae White Faced Heron
Egretta garzetta Little Egret
Ardea pacifica Pacific Heron
Threskiornis molucca Australian White Ibis
Threskiornis spinicollis Straw-necked Ibis
Platalea flavipes Yellow-billed Spoonbill
Elanus axillaris Black-shouldered Kite
Accipiter fasciatus Brown Goshawk
Aquila audax Wedge-tailed Eagle
Hieraaetus morphnoides Little Eagle
Falco berigora Brown Falcon
Falco longipennis Australian Hobby Hawk
Falco subniger Black Falcon
Falco peregrinus Peregrine Falcon
Falco cenchroides Nankeen Kestrel
Gallinula tenebrosa Dusky Moorhen
Fulica atra Eurasian Coot
Actitis hypoleucos Common Sandpiper
Elseyornis melanops Black-fronted Dotterel
Vanellus miles Masked Lapwing

Macropygia amboinensis Brown Cuckoo-dove
Phaps chalcoptera Common Bronzewing
Ocyphaps lophotes Crested Pigeon
Leucosarica melanoleuca Wonga Pigeon
Calyptorhynchus funereus Yellow-tailed Black-cockatoo
Callocephalon fimbriatum Gang-gang Cockatoo
Cacatua roseicapilla Galah
Cacatua sanguinea Little Corella
Cacatua galerita Sulfur-crested Cockatoo
Psittacidae *Alisterus scapulasis* Australian King Parrot
Platycercus elegans Crimson Rosella
Platycercus eximius Eastern Rosella
Cacatua roseicapilla Galah
Cacatua galerita Sulfur-crested Cockatoo
Cuculidae *Cuculus pallidus* Pallid Cuckoo
Cacomantis pyrrhophanus Fan-tailed Cuckoo
Cacomantis variolosus Brush Cuckoo
Ninox novaeseelandiae Southern Boobook
Podargus strigoides Tawny Frogmouth
Hirundapus caudacutus White-throated Needletail
Apus pacificicus Fork-tailed Swift
Dacelo novaeguineae Laughing Kookaburra
Todiramphus sancta Sacred Kingfisher
Eurystomus orientalis Dollarbird
Climacteris leucophaea White-throated Treecreeper
Malurus cyaneus Superb Fairy-wren
Pardalotus punctatus Spotted Pardalote
Pardalotus striatus Striated Pardalote
Sericornis frontalis White-browed Scrubwren
Gerygone olivacea White-throated Gerygone
Acanthiza reguloides Buff-rumped Thornbill
Acanthiza chrysorrhoa Yellow-rumped Thornbill
Acanthiza pusilla Brown Thornbill
Acanthiza nana Yellow Thornbill
Acanthiza lineata Striated Thornbill
Smicrornis brevirostris Weebill
Anthochaera carunculata Red Wattlebird
Anthochaera chrysoptera Little Wattlebird
Philemon corniculatus Noisy Friarbird
Manorina melanocephala Noisy Miner
Meliphaga lewinii Lewin's Honeyeater
Melithreptus lunatus White-naped Honeyeater
Lichenostomus chrysops Yellow-faced Honeyeater
Lichenostomus leucotis White-eared Honeyeater
Melithreptus brevirostris Brown-headed Honeyeater
Phylidonyris novaehollandiae New Holland Honeyeater
Acanthorhynchus tenuirostris Eastern Spinebill
Microeca leucophaea Jacky Winter
Eopsaltria australis Eastern Yellow Robin
Petroica boodang Scarlet Robin
Petroica phoenicea Flame Robin
Psophodes olivaceus Eastern Whipbird

Cinclosoma punctatum Spotted Quail-thrush
Pachycephala pectoralis Golden Whistler
Pachycephala rufiventris Rufous Whistler
Colluricincla harmonica Grey Shrike-thrush
Rhipidura fuliginosa Grey Fantail
Rhipidura leucophrys Willie Wagtail
Grallina cyanoleuca Magpie Lark
Monarcha melanopsis Black-faced Monarch
Coracina novaehollandiae Black-faced Cuckoo-shrike
Lalage sueurii White-winged Triller
Artamus cyanopterus Dusky Woodswallow
Cracticus torquatus Grey Butcherbird
Gymnorhina tibicen Australian Magpie
Strepera graculina Pied Currawong
Strepera visicolor Grey Currawong

Appendix B

ACF Newsletter August 1986

The Chemical Threat

Mercury — A Resurrected Problem

by Judith Wright McKinney, ACF Honorary Life Member, poet and author

In 1982, a team of scientists from the Departments of Chemistry and Zoology at Monash University published a study of mercury contamination in the Lerdereg River in Victoria, resulting from old goldmining operations.[1]

Mercury was used almost solely in amalgamation processes to extract gold and silver from ores during early goldmining in the 19th century. Its use ceased for the most part with the invention of the cheaper and more effective cyanidation process, which contributed to a revival of mining in the 1890s. By that time, however, a great deal of mercury had been 'lost to the environment', where, as a liquid heavy metal, it remains in tailings heaps and stream sediments. In the case of the Lerderderg River study, though mercury levels in the water itself were low, concentrations in the sediments were high enough to reach 30 to 700 times the normal background value. At contaminated sites studied, larger river blackfish could contain the highly toxic mercury and its derivative methyl mercury at levels beyond the Victorian Health Department's statutory limit set for mercury in seafood. (Blackfish are bottom feeders and sedentary, increasing the chance of concentration of heavy metals.)

Mercury as a serious toxic pollutant became notorious in the Minamata Bay disaster in Japan, when a factory discharge of mercury into the bay caused a serious outbreak of poisoning with many deaths, and permanent crippling in survivors. To disturb, or rework, stream sediments can, as Dr P.S. Lake put it in a personal communication,[2] "remobilise the sedimented mercury and create a new pollution hazard." As to possible methods of recovering it, these have not been made clear in the available literature. But in an environmental study produced by a NSW firm, Mehilo Pty. Ltd., the proposal was made to separate it from the gold by 'handwashing' and to bottle the mercury for resale. This proposal was described by Dr Lake as "an incredible admission in that it reveals that there must be, in the areas to be mined, an enormous amount of mercury." He points out that

> "in our work on a *badly contaminated* river (his emphasis), the Lerderderg River near Melbourne, the mercury could not be isolated in such a fashion — its concentration in the sediments was too low, but the concentration was still high enough to give rise to serious contamination."[3]

Yet, the Mongarlowe River in which the mining firm wishes to dredge and mine is at present supporting a "rich invertebrate fauna and valuable Macquarie Perch populations" which justify, according to a study carried out over the area proposed to be damned for an additional water supply for Sydney,[4] strong protection from silting, pollution or activities causing change in the quality of the water.

It seems clear then, that over the half-century or so since the use of mercury ended in the Lerderderg catchment, sediments have continued to release mercury and its organic derivative, methyl mercury, into the food chain; while in the case of the Mongarlowe River where mining effectively ceased about 1880, there has been time for the contamination to become more stabilized.

The recent return to prominence of gold mining in Australia which is predicted to increase to the level of, perhaps an achievement for Australian production, of third place in the world[5] * within a few years, has turned the industry's attention to the old fields where new methods of production could result in as much gold being recovered as was taken in the first place. However, the occurrence of great amounts of mercury mixed with, or in proximity to, the recoverable gold, will pose problems for water quality control and for fisheries. Australian gold production has leapt already from 40 tonnes in 1984 to a projected 100 tonnes for 1987. Most if not all old gold fields lie in river valleys and stream catchments. Since water, not gold, is Australia's most precious resource, considerable conflicts loom ahead between water users and miners.

The amount of potential contamination from mercury 'lost to the environment' — as authorities delicately put it, may be estimated from the statement by the scientists concerned in the Lerderderg River study that

> "it has been estimated that the weight of mercury consumed in the amalgamation process is of the same order as the weight of gold recovered . . . For instance, the amount of mercury potentially released to the environment from the Bendigo field, one of the richest early fields in Victoria, would amount of about 900 tonnes."

Mercury, as a factor in the amalgamation process in the extraction of gold, is emerging again after m years during which the cyanidation process was used. At Tennant Creek mine, where Peko-Wallsend has been using mercury in extraction, the firm was recently heavily fined for exposing an immigrant worker to mercury poisoning.[6] The stated attempt to extract and bottle mercury in the case of the New South Wales lease granted to Mehilo Pty Ltd near Mongarlowe, may be the beginning of a major attempt to bring old goldmined areas back into production while hushing up the danger it implies. Water quality, fisheries both commercial and amateur, oyster and other shellfish production, farm water supplies and livestock, and workers exposed to the dangers of mercury contact, may now all be at risk.

Notes:

1. *Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field.* B.M. Bycro. B.A.W. Coller, G.B. Deacon, D.J. Coleman & P.S. Lake. Environ. Pollut. Ser. A. 0143–1471/82/0028–0135/502.75. Applied Science Publishers Ltd., England 1982. Printed in Great Britain.
2. Personal communication to Rondale Pty. Ltd., March 1986.
3. Personal communication to Judith Wright McKinney, 30 April 1986.
4. *Welcome Reef Project*, Environmental Study: Aquatic Life. Consultants: Snowy Mountains Engineering Corporation in association with New South Wales State Fisheries. Metrop. Water Sewerage and Drainage Board, Sydney, Feb. 1978.
5. *The Australian Gold Book*, compiled by A.C. Goode & Co., Information Australia, 1986. Available from firm or publisher, $120.
6. 'Damages for mercury poison victim', Andrew Bolt, *The Age*, Tuesday 2 April 1985, p. 6.

* See Financial Review 7 June 1990: Australia now producing 10% of world gold, expected to rise to 12% this year pre-introduction of gold