Established 1968
New Zealand Freshwater Sciences Society

GST No. 51-999-762
Website: http://freshwater.science.org.nz/

21 May 2010

RE: SUBMISSION ON SCHEDULE 4 STOCKTAKE DISCUSSION DOCUMENT

This submission is on behalf of the executive committee of the New Zealand Freshwater Sciences Society (Inc) (NZFSS) which was has over 370 current members drawn from the freshwater academic, consultancy, teaching, and management communities. The Society holds an annual conference to facilitate the exchange of research findings and applications, and publishes books synthesising research results, such as *Freshwaters of New Zealand* produced in association with the New Zealand Hydrological Society.

The purpose of this submission is to highlight issues associated with any proposal to expand mining activities within the so-called "conservation estate". Our Society is particularly concerned about any activities that detrimentally affect freshwater ecosystem values. The freshwater environments most likely to be affected by mining are streams and rivers, as these directly receive drainage waters from land-based activities. As streams and rivers flow in a downstream direction, any impacts can be transported off-site to other parts of river systems and their discharge points (e.g., lakes, estuaries). Thus, our primary concern is over potential adverse effects on freshwater ecosystems associated with mining in and downstream of sensitive areas.

Our submission is divided into four themes:

1. Freshwater values in the Conservation Estate;
2. Construction and roading effects;
3. Waters quality and biodiversity impacts;
4. Management and remediation.

1. Freshwater values in the Conservation Estate

The conservation estate contains most of New Zealand's remaining unmodified stream and river systems. Land under Schedule 4 encompasses the most highly valued areas of all of New Zealand's conservation estate, and these areas are therefore also likely to contain streams, rivers, lakes and wetlands of high conservation value. Thus, the proposal to remove land from Schedule 4 is targeting ecosystems, including freshwater ecosystems, that have previously been identified as New Zealand's most valuable conservation areas.

A very high proportion of New Zealand's freshwater fauna (e.g., insect and fish species) is not found anywhere else on the planet, and some species have very restricted distributions within New Zealand. For example, the threatened caddisfly *Kokiria miharo* is only known from the West Coast of the South Island. Threatened species are endangered to varying degrees by human activities, including degrdation or pollution of their habitats. Some of these species (e.g., the longjaw galaxias and the caddisfly *Oeconesus augustus*) are considered as rare as the takahe

and kakapo, and rarer than other iconic birds such as the North Island brown kiwi. New Zealand is a signatory to the International Union for Conservation of Nature (IUCN) Convention on Biological Diversity as well as other conventions (such as the United Nations Ramsar Convention on wetland conservation) aimed at protecting biodiversity. Thus, the New Zealand government has a national and international responsibility to protect its biodiversity, including freshwater biodiversity.

Unmodified streams, rivers, lakes and wetlands often have the highest ecological values and high biodiversity in locations close to the coast, such as the Coromandel Peninsula and Paparoa Ranges. Forested coastal streams with intact connections to the sea are extremely important for native freshwater fish because several species migrate to and from the sea to complete their life cycles. For example, the threatened giant kokopu and short-jawed kokopu live in forested streams as adults, but spend part of their juvenile lives at sea before migrating upstream as whitebait. Short coastal streams, which provide important habitat for native fish species, are likely to be more sensitive than larger rivers to mining impacts.

Although some freshwater values are recognised in the Discussion document (e.g., Parakawai Geological Area, Otahu Ecological Area), we consider the freshwater ecological values potentially threatened by mining in the conservation estate are much broader and more widespread than acknowledged. For example, a recent analysis of subcatchments of high conservation value in the Waikato region has highlighted the Coromandel area as supporting a large number of regionally significant stream and river sites, including several provisionally ranked in the top 10% nationally, reflecting the predominance of high quality forested headwater streams in close proximity to the coast (Leathwick & Julian 2009). In addition, freshwater systems with geothermal activity (e.g., the Taupo Volcanic Zone - p.6 of Discussion document) or draining certain geologies (e.g., limestone) may support rare, highly productive or unusual combinations of freshwater species that may be threatened by human activities such as mining. For example, Haase (2008) recently described 46 new species of hydrobiid snail, several of which are known from only a few limestone springs and seeps.

NZFSS emphasises that freshwater ecological and biodiversity values in the Conservation Estate are generally high, particularly for forest streams close to the sea. Any sites considered for removal from Schedule 4 status should firstly be demonstrated to have low or insignificant conservation value.

2. Construction and roading effects

Irrespective of whatever methods are used to extract ore, roads and other infrastructure (e.g., for power) will need to be built to access sites. Inevitably, roads will be heavily used as both access roads for large mining vehicles and earth-moving equipment, and also as haul roads for trucks moving ore from extraction areas. These roads are typically unsealed and travel in part along otherwise unmodified stream valleys. Research on the effects of pine forest harvesting clearly demonstrates that frequently-used, unsealed roads are a major source of sediment delivered to streams. Accumulations of sediment have a multitude of detrimental effects on aquatic life, including abrasion of animals, clogging of gills, and smothering of streambed habitats. Dust is an ongoing issue with these roads and suppression efforts involving water spraying may lead to further sediment runoff. In addition the construction of road culverts across streams has the potential to limit access for native species of migrating fish found in these streams.

NZFSS considers adverse effects from construction and use of infrastructure in sensitive environments to be of particular concern for freshwater environments.

3. Water quality and biodiversity impacts

Mining in areas with frequent rainfall involves contact between freshly-exposed rock and water. Groundwater that intersects mining activities will ultimately flow or be discharged to stream and river receiving systems. As noted above, these freshwater ecosystems are typically of high ecological value where catchments are otherwise undeveloped. Adverse effects on freshwater ecosystems from mining are commonly associated with (i) acidification of waters, for example where coal seams are high in pyrite, and (ii) mobilisation of toxic heavy metals and metalloids (Harding & Boothroyd 2004, McCullough 2007). Acidification may have direct adverse physiological effects on animal life and dissolved metals from the ore, such as aluminium, copper and zinc, can be toxic above critical (typically very low) concentrations (ANZECC 2000). These metals may act synergistically together or with other stressors, such as the aforementioned sedimentation impact, and can enter food chains leading to bioaccumulation of metals in higher organisms such as fish and aquatic birds both in rivers and downstream in the sea.

So-called Acid Mine Drainage (AMD) consists of acidic, iron-rich leachate, generated by both chemical and microbial oxidation of iron and sulphur minerals exposed to atmospheric conditions (Johnson 2003). When exposed to air, many waters that have come into contact with coal seams and workings will precipitate iron and sulphur across the streambed, rendering conditions unsuitable for sensitive freshwater species that become smothered by it. These affected streams typically support few species (Proctor & Grigg 2006). Based on work in New Zealand streams, Bray et al. (2008) reported that algal diversity was reduced by 75%, while stream insect diversity can be reduced by 84% (Harding JS pers. comm.) and fish diversity by 90% (Greig et al. in press) compared to natural streams unaffected by mining activities. Development of AMD remains one of the many concerns arising from mining near natural waterways. Several studies have shown that the negative impacts of mining are often self-sustaining and can remain for a very long time.

NZFSS advises that some forms of mining can have significant long-term adverse effects on aquatic life where drainage waters intersect exposed rock and enter sensitive freshwater environments. Therefore the effects of mines on downstream environments should be an important consideration in assessing any sites for removal from Schedule 4 status.

4. Management and remediation

The geochemical, geological and ecotoxicological complexity of effects associated with mining drainage entering freshwater ecosystems pose significant challenges to the effective management of mining impacts. Management strategies centre on avoiding impacts, or reducing toxic inputs of acid and heavy metals, remediating effects, and monitoring impacts thereafter to advise future remediation attempts and document any recovery (Harding & Boothroyd 2004).

The Discussion document states (p.2) that:

> *"… modern mining techniques mean that adverse effects, such as on water quality, can be strictly controlled ..."*

In relation to Waste and water, Table 3 states:

> *"Tailings are deposited within an engineered embankment. There are stringent limits on water discharge quality and quantity. There is an emphasis on reducing, reusing and recycling water to minimise waste water volumes."*

Current mining operations in New Zealand are required to adopt extensive and long-term treatment and remediation. However, these systems, using 'modern mining techniques', can experience significant problems in maintaining the required standard of treatment. While a

number of remediation techniques for freshwater environments have been applied internationally, their success has been variable and only a limited number of methods have been tested in New Zealand. In particular, there may be problems effectively treating water quality in high rainfall areas (Trumm 2006). Site-specific characteristics will dictate which remediation activities are effective, and these may require pilot-scale testing in the field to determine effectiveness over the long-term. Any decisions regarding the location of mining activities should be balanced against the risks and consequences of treatment failure, and the legacies these would have in high value freshwater environments.

NZFSS considers statements that the effects of mining on freshwater ecosystems can be "strictly controlled" by management practices should be treated with caution. In the event that mining occurs on Schedule 4 land, NZFSS advocates the application of stringent controls that reflect the quality of and risks to receiving environments, rigorous long-term monitoring, and requirements to maintain treatment in perpetuity if required.

Signed of behalf of the New Zealand Freshwater Sciences Society by:

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