MineWatch Northland
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Presentation on Proposed Whangarei District Plan Changes 102: Minerals and 85A: Rural

1. Introduction

This evidence relates only to **Submission 0442**. We seek to withdraw Submission 0365.

By way of introduction: Minewatch Northland ("Minewatch") is a coalition of community groups and individuals who are opposed to the extraction of metals from hard rock ("hard-rock mineral extraction") because of its toxicity and high likelihood of harm to waterways, the environment and the wellbeing of people in the Northland region.

MineWatch was formed when central government opened up most of the Northland region to hard-rock mineral extraction, and financed initial aerial assessments to encourage exploration and mining companies to seek permits. MineWatch was – and continues to be – a community-based response to this approach, with strong connections to tangata whenua.

2. Reasons for opposing toxic mining in the Whangarei District

As background information, we wish to outline the reasons hard-rock mineral extraction is seen as harmful, as 'toxic'. More detailed analyses are appended:

- Appendix 1: A MineWatch Northland analysis of the risks of 'toxic mining', as applied to Evolution Mining Ltd's exploratory and possible mineral extraction activities at Puhipuhi
- Appendix 2: The technical section of the MineWatch Northland submission on the then-proposed Regional Policy Statement.

Both are indications of why toxic mining should be treated with high caution.

In brief: Hard-rock mineral extraction involves the excavation and crushing of, usually volcanic, rocks into a powder, the addition of water to produce a slurry then large amounts of a chemical reagent - usually highly toxic cyanide. Those metals of interest and perceived value – usually only a few grams per tonne of rock are removed and the rest, including excess reagent, is a waste product usually referred to as mine tailings.

This process also liberates toxic heavy metals including mercury, cadmium, arsenic, chromium and lead that were previously locked up inside the rock. Mine tailings invariably become highly acidic when the excess water contacts sulphates in the rock. The process produces so much toxic and highly acidic waste that storage at or near the mine, forever, is the only viable way to manage it. Storage is usually in "tailings" reservoirs behind an earth dam. These reservoirs invariably leak toxins into the environment and often fail disastrously.

The process leaves this toxic legacy whether the mineral extraction is from an open pit or from tunnels under the ground.

Given that hard-rock mining of gold (etc) has high risks of toxic damage, acid mine leakage and more, we submit that the 'avoid, remedy, mitigate' approach is not really sufficient to deal with those risks. Hard-rock or toxic mining presents a higher level of risk than many situations that the RMA approaches deal with. More appropriately, 'avoid' needs to be strengthened taking that position towards prohibition in places, and definitely a precautionary approach.

In sum, for the reasons outlined above, and in the appendices, MineWatch Northland is recommending a precautionary approach to hard-rock or 'toxic mining' in the District. Such an approach is widely-used and validated in sensitive environmental issues, has a well-rehearsed rationale, and should underlie Whangarei's District Plan provisions.

On this point, we allude to the Court of Appeal judgment in the case of Coromandel Watchdog Inc vs the Chief Executive of the Ministry of Economic Development, 2007, indicating strong precautionary approaches are sometimes appropriate, and the Bay of Plenty Regional Policy Statement. We also refer to Bay of Plenty Regional Policy Statement, which states that "The precautionary approach is a necessary response to unresolved issues of potential liability, environmental risks, economic costs, and cultural and social effects." We submit that toxic mining is a specific area where the level of uncertainty and the level of risk involved is such that a precautionary approach is highly desirable.

3. Submission summary

In broad terms, MineWatch Northland seeks to have wider arrangements for prohibiting hard-rock mineral extraction. Any over-emphasis on the alleged (though contestable) economic benefits from mineral extraction in Northland is regretted; initial emphasis must be on the environmental, social and cultural risks and benefits, with the onus being on economic benefits to tangata whenua and the peoples of Northland (not foreign companies) having to be proved as greater than those risks.

MineWatch submits that those risks are in fact greater than any supposed gains for Northland's environment and peoples, so there should – countering the orientation of the s42A Report – be room for prohibition of mining and that alternative be robustly considered in s32A analyses.

4. Purpose of PC102

The purpose of PC102 is to give effect to the provisions of the Regional Policy Statement, and to improve existing planning for mineral extraction in general and in MEAs in particular. It is implied that the draft Plan Change provides provisions suited for quarrying operations currently consented and operating in MEAs or small operations. At face value, PC102 has a limited focus on quarries and aggregates – and if it was in fact so limited, MineWatch Northland might have little problem with the provisions outlined. If quarrying only was being addressed, hard-rock mineral extraction would – by implication – be prohibited.

However, the focus of submissions seems to also imply coverage of mining and large scale mineral extraction, not just quarrying, hence our responses below.

5. Definitions

While MineWatch Northland was initially considering seeking a definition for quarrying on the basis that PC 102 only apply to quarrying, on further consideration we acknowledge that this would make it difficult for the district plan to adequately control other types of mineral extraction, like hard-rock mining. At the moment, there is only quarrying activity carried out in the Whangarei District. It would be useful to have a fuller definition of mineral extraction and its related activities (specifically, that it includes a definition of hard-rock mineral extraction) in the Whangarei District Plan, and ensure that there are specific provisions that control hard-rock mineral extraction.

As such, we suggest a better approach would be specific provisions for mineral extraction that involves treatment and/or storage of mine waste and/or tailings. This would necessitate a definition of treatment which we suggest can be kept very simple: the chemical separation of constituents from mined soil or rock. We set out district plan provisions we believe are necessary to deal with mineral extraction that involves treatment and/or waste storage, in parts 8 and 9 of this presentation, below.

To be clear, and at the risk of perhaps stating the obvious, quarrying activities use ALL the extracts of for example limestone, taking off site, but that is far from the case with hard-rock mineral extraction. It is said that it takes 18 tonnes ore to get sufficient gold for one gold ring. Mineral extraction requires large scale processing of ore for extractions of gold and other precious minerals. Such mining creates an indefinite toxic legacy, due to how the ore is processed, the downside effects of that, and how the ore is disposed of later (in tailings dams, for example, never entirely secure, as Tui Mine at Te Aroha shows; on land; or partial insertion in the completed mine space, though with oxidation and subsequent oxidation there is never enough space to deal with waste). The need for tailings dams or similar are NOT included in PC102. Neither is leaching into underground aquifers or other waters.

We refer to the provisions of the Thames Coromandel District Plan – Appeals version (from 6 April 2017)
https://eplan.tcdc.govt.nz/pages/plan/Book.aspx?Exhibit=TCDC_Appeals2016_External - see Appendix 3 below. The definitions of the mineral extraction activities at the top of this matrix are all well-defined in that version of the TCDP. Most of the Thames Coromandel District Plan is accepted and therefore has force.

The approach taken in the TCDP-Appeals version, more robust than the proposed WDP, should be preferred.

On the basis of the above definitions, MineWatch Northland seeks prohibition of hard-rock mineral extraction in certain areas of the District.

6. Commentary on s32 analysis

In the s32 analysis, hard-rock mineral extraction has not been differentiated from other forms of mineral extraction, either sufficiently or at all. We seek a specific analysis relating to hard-rock mining.

In this written presentation, we are seeking certain prohibitions in relation to hard rock mining. Our submission sought more rigorous analysis in relation to the status of activities (discretionary, non-complying, prohibitive) included in hard-rock mineral extraction.

The analysis should also have included the costs and benefits (economic, social, cultural, environmental) of the alternatives.

7. Mineral Extraction Areas (MEAs)

We seek that the same rules for hard-rock mineral extraction should apply whether or not the activity is located within an MEA or its associated buffer zones.

We support the recommendation that the new MEAs can only be established by way of a plan change (noting that para 141 in the s42A report recommends the process for establishing new MEAs).

8. Plan provisions for hard-rock mineral extraction

The current proposed District Plan provisions do not differentiate hard-rock mineral extraction from other forms of mineral extraction.

In response to the s42A report Paras 74 and 81:

These paragraphs conclude that specific mention, and presumably provisions (objectives, policies and rules), are not necessary in relation to “toxic mining and gold and silver mining”. The report’s author is of the view that these activities would be adequately managed and controlled under the consent regime that would arise out of PC 102 and the mineral extraction provisions elsewhere in the district plan.

We disagree. We firstly point out that all extraction of metals from hard rocks is a highly toxic process. As shown in the papers appended to this presentation, it is simply not possible to prevent any of the toxins that are produced by the process from entering the environment and causing harm, even when these mines are operating as designed. The consequences of failure associated with this type of mining are simply too high to contemplate. Further, these mines leave an indefinite legacy of toxic waste and risk of failure long after the miners have departed.

We agree that Rule PRE 2.1(3) of Plan Change 85A would ensure that most hard-rock mining would be a non-complying activity in the Rural Production environment and discretionary under most existing provisions. However, this does not preclude land-use consent applications in any of those environments.

Any land-use application, even for non-complying activities, has the potential to be non-notified and not be subject to scrutiny from people who truly understand their likely effects. Non-notification itself is a risk. With hard-rock mining, we maintain that a prohibition will achieve this by ensuring such mining must be subject to a plan change to establish an MEA, and an appropriate much greater level of scrutiny will result in the consequent process.

PC 102 does not have any rules except in the MEA section. MEAs will only ever cover a tiny proportion of the land in Whangarei district. The additional policy 10(c)(iii) in Min 1.3 and assessment criterion 1(c)(iii) in Min 2.2.1 is founded on the assumption that the effects of hard-rock mining can be avoided, remedied or mitigated. Our research, as documented in the appendices and mentioned above, indicates that this is simply not feasible, and probably not even possible.

9. Prohibition of hard-rock mineral extraction

We seek that the approach taken in the Thames-Coromandel district plan (TCDP) also be adopted in Whangarei District. The TCDP-Appeals version has very specific rules in relation to several mining-related activities and covering all zones in that district. The table of rules (Appendix 3) summarises this and is notable for the number of activities that are prohibited; it is the principle and foundation of that table, rather than the detail, that we are supporting here.

The Thames-Coromandel district has been the subject of intense pressure from mining companies, and push-back from anti-mining activists, for several decades. Whangarei District has a number of locations with geology of interest to gold miners. We strongly recommend that the benefit of the experiences in Thames-Coromandel and consequent provisions be applied in the WDP.

“There appears to be no prevention for an application for a large scale mineral extraction operation under the policies in the MIN 1 section. We seek such a prevention…”

10. Outcome sought

We seek ultimately, where possible, the prohibition of hard-rock mineral extraction in certain areas in this District. Puhipuhi, for example, could meet criteria (to be defined) for such prohibition, as could some coastal areas in the District. The ‘avoid, remedy, mitigate’ approach is limited in its ability to handle some issues. For the levels of risk we indicate, prohibition (at least in some areas) is the best option, and the objectives, policies and rules in the District Plan need to reflect that.

As this submission has highlighted throughout, the approach taken in relation to the Thames-Coromandel District Plan – Appeals version, be applied in Whangarei District as well.

Appendix 1: MineWatch Northland paper in relation to Puhipuhi and Evolution Mining on the argument about toxicity

How Puhipuhi waterways could be polluted is a big question. It's also about a future scenario so has largely anticipatory aspects rather than historical arguments that we can refer to as 'absolute proof'. That said, also available is our MineWatch Northland submission on the proposed Northland Regional Policy Statement (the technical content of that submission) which does go some distance towards perhaps **addressing evidential questions**, and cross-refers to plenty of research.

In summary, the following elements of the argument are relevant, and taken together they make a cogent case for stopping Evolution Mining Ltd (EVN) continuing exploratory drilling, and from being allowed to move on from their current exploratory stage on to mining:

* Some historically researched aspects include Puhipuhi being the area with the highest concentrate of **mercury** in NZ - mercury having well-proven disastrous effects on waterways, biota, human health (cf the Minimata Declaration). There have been anecdotes of human health issues in Whakapara / Puhipuhi area quoted for decades, and documented incidents of mercury eg affecting pastures when mercury-laden minerals are laid on the road and burn pasture etc. Mercury is **a crucial risk factor** in relation to the case proving toxic mining and pollution.

* Evolution (EVN) says from their baseline studies (which are NOT peer-reviewed, only carried out by EVN's own contractors) that there is not evidence of current mercury pollution. Their testing was **biased**, and **excluded** certain sites where test drilling has been done. They also obscure the issue by saying that this water testing means there is no problem, even though these are **merely baseline studies** and do **not address the effects of any potential future mining**.

* The current exploratory drilling process itself (let alone any future mining, as proposed) is **already producing toxic water**, some spilt on site. The Regional Council (NRC) isn't closely monitoring the water issue at all, but we have clear evidential photos of EVN removing toxic water arising from the drilling to date, from pods we saw beside the drilling site in a larger tank, to the **hazard waste disposal** site in East Tamaki Auckland, a clear indication that what they are dealing with is toxic. This has been a council stipulation, that they test their tailings water and if it is high in heavy metal for example, it has to be transported to the hazard waste site. Also we have photos of their 'cowboy' drilling approach where there overflows went into surface water, their hazardous accident clean up kit not being maintained and in a state of readiness.

* Puhipuhi is the **highest rainfall** area in Taitokerau. And, as EVN and geologists admit, the mountain's aquifers are complex and **no-one knows how the waters** (including any polluted waters) **move** under the mountain, and which drill hole or future mine site would release water into those aquifers.

* EVN has only had experience in **dry Australian drilling** and mining, Puhipuhi is (in my terms) a 'guinea pig' for them to try out. They also, from their own statements (inc annual reports, Jake Klein's statements), have not carried out 'greenfields' (ie 'from scratch') mining before. These factors add real need for a **strong precautionary approach** to avoid polluting waterways.

* **Mercury** issues arise not from quick solubility in water (as EVN quickly points out, but obscuring the issue) but its **residence in waterways silt, later to be disturbed,** and from what happens (well researched and documented) with sulphides / sulphites to create what is called **'acid mine drainage'**

* The toxicity issues do not just arise from the local concentrations of mercury. **Hard rock mining is a dirty process** (well researched and documented), **releasing arsenic, antimony,** etc. These, **particularly when oxidised,** become toxic in underground aquifers and above surface streams. In Puhipuhi's case, these streams **largely head westwards** to the far coast - through local streams, Hikurangi Swamp, Wairua and Norther Wairoa Rivers (where tangata whenua are trying to restore threatened tuna numbers) to the Kaipara Harbour (where 98% of Nth Island schnapper are spawned). The effects and risk levels from the mining process itself are high.

* Toxic pollution also arises as an issue **from the treatment of ore that is mined**. It takes something like 18 tonnes of ore to make one gold ring - the quantities of risky toxic material involved, once mined, are huge. EVN has refused several times to say where they would take the waste ore. At least they will likely have to be **treating** the ore near the mining site. For most of EVN's Australian mines this involves **cyanide**, which - while there are some ways of dealing with it - is risky; no matter how the treatment works, there are high risks from the treatment of the ore (which is why one of their workers now resident here calls this 'a dirty business')... risks to the waterways.

* Even if some of the waste ore can eventually be replaced down mine-holes, much of it (oxidised, expanded, toxic) will not be able to be dealt with that way. Hence the need for **waste tailings dams**. These are notoriously risky - as they tend to **leach** arsenic and the like (cf Waitekauri Dam, Coromandel; a clear case at Dee River in Queensland, well-researched - www.abc.net.au/radionational/programs/backgroundbriefing/toxic-mine.../4518922 .
They are also often insecure and at **risk of breaking** (plenty of international examples, eg Rio Doce Brazil Nov / Dec 2015, as well as in NZ: eg the Tui Mine above Te Aroha, for which the risky tailings dam has already cost taxpayers $20m+ in remediation). Waste tailings dams are **high impact risks** (if they break) and a key pollutant issue once they do. EVN brushes this lightly - but they would, wouldn't they? - and they do so without evidence.

* EVN say they will meet NZ's environmental standards - but these **standards are not high**, and are **not closely monitored**. Another reason for precaution.
In all, the above line of argument and the pieces of research alluded to, plus common sense and critical tikanga-based approaches, give a strong indication that the call of Ngati Hau to prevent water pollution by way of opposing toxic mining (an appropriate term for hardrock mining for eg gold and silver, as at Puhipuhi) is **wellbased and totally justified**… Even if, at bottom line, the argument is simply **about precaution**. There are **plenty of scientific and cultural and social reasons** for such precaution.

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Appendix 2: Technical Content of MineWatch Northland's submission on the then-proposed Northland Regional Policy Statement

"Hard-rock mining" is a term used to describe the process in which metals are extracted from rock by crushing it to small particles, wetting the resulting rock dust to a slurry then treating the slurry with a chemical reagent that removes the metal of interest.

The most common reagent is cyanide (CN-) ions. The process is particularly suited to the extraction of gold because cyanide is one of the few substances that can ionize (remove an electron from) gold atoms[i]. The process is completed by removing the metal-cyanide complex molecules them retrieving the metal using further processes.

The hard-rock mining processes result in extremely large quantities of waste rock slurry. For example, typical gold ore contains between 1 and 5 grams of gold per tonne of ore[ii]. This slurry contains residual cyanide and almost always becomes highly acidic through ongoing chemical breakdown of rock minerals – most commonly metal sulphides which are chemically altered to sulphuric acid when exposed to oxygen and water[iii]. The breakdown releases various metals, many of which are highly toxic - mercury, cadmium, lead, arsenic, chromium and/or antimony. Less toxic, but far from non-toxic metals like copper, nickel, zinc and titanium are also common in mining waste[iv].

Because of its toxicity, this waste rock slurry must be prevented from becoming dust that can be blown around. This is most commonly achieved by keeping the tailings slurry wet virtually forever. The most common management method for wet tailings is storage in reservoirs or ponds behind an engineered dam[v], although many hard-rock mines simply discharge the tailings directly into waterways.

Virtually all, if not all, tailings reservoirs discharge water into the groundwater and/or surface water. The tailings are almost always kept wet with a constant inflow of natural water that counteracts evaporation during dry periods. With active control of inflows and a cover over the reservoirs, it is theoretically possible to eliminate discharges of surface water from tailings reservoirs. However, discharges into groundwater can only be eliminated with the use of completely impermeable liners. These are extremely expensive and, in all likelihood, impractical. Contaminated water continues to seep indefinitely through all liners with finite permeability.

Many tailings reservoirs are not lined, either because of inadequate regulation or because the mining company successfully argued that the geology of the site meant that lining was unnecessary.

The acidity accelerates the weathering and chemical breakdown of all molecules in the waste rock that contain metals. It also ensures that most of the ions in those metals are more highly mobile in soils, both by displacing more metal ions into solution and decreasing, or even reversing, the usual negative charge on soil particles in the receiving environment[vi].

Most heavy metals bio-accumulate in the food chain of the receiving environment[vii]. People who source some, or all, of their food and water from that environment are high in the food chain, so the risks associated with toxic metal contamination of water are significantly magnified. Even extremely low levels of contamination are likely to cause ongoing harm to the environment and the people living in it.

Cyanide residues are also highly toxic. At some hard-rocks mines, cyanide ions are converted to cyanates prior to discharge into the tailings reservoir or environment. Cyanates are less toxic than cyanide, but much more persistent, so remain in the reservoir for much longer[viii].

Various methods are suggested for the treatment and "neutralisation' of the toxic byproducts of hard-rock mining. The most common, by far, is treatment with an alkaline substance like quicklime or limestone. Carried out correctly, this neutralizes the acid in the effluent and reduces the solubility of many of the metals in the effluent.

Unfortunately, it is simply not chemically possible to remove all toxic metals from mine effluent.

- Metal hydroxides only form at high pH and their solubility is highly sensitive to the pH. Additional processes, for example oxidation, are required for some metals. Overall, this is a costly process that demands constant and ongoing attention to detail;
- According to a report by Kurucak[ix], the optimum pH ranges from pH 7 (neutral) to 11(strongly alkaline) across the metals of interest (the report does not state the optimum pH for mercury). With this large variability in pH, the removal process would have to be carried out individually, at differing pH, for each metal ion in the effluent;
- Even at the optimum pH, the only metal hydroxides that precipitate are those at concentrations above the solubility limit. A dissolved residual remains at, or close to, the solubility limit;
- A metal ion must be dissolved in water before it can precipitate out, so this process can only be applied to effluent water that can be captured. A significant proportion of mine effluent cannot feasibly be captured – especially that which leaks into groundwater and is then dispersed by the natural movement of water through the ground;
- Toxic metal ions will constantly dissolve into solution from the solids in the tailings, particularly with the high acidity in most tailings ponds; and
- The reviewed literature is silent on how precipitated (toxic) metal hydroxide is disposed of. It is believed that the only suitable way is to send the precipitate back into the tailings pond, which completely defeats the purpose of neutralisation.

Rigorous independent evaluations of hard-rocks mines, including many in the most highly developed nations have found most of them wanting. These include comparisons of predicted and actual water quality at hard rock mines. Here is a selection of quotes from some of the studies:

- "Arsenic concentrations greater than 2,000 mg per litre were found in the tailing materials… and [arsenic concentrations] in the lake sediments [downstream were] up to 1,104 mg per litre."x
- "It is estimated that the 3 million tons of tailings left from the gold mining activities at Goldenville, Nova Scotia , contain 470 kg of cadmium, 37 tonnes of lead, 6.8 tonnes of mercury, 21 tonnes of arsenic and 2.6 tonnes of titanium. Although the mines were closed over 50 years ago, sedimentary records of metal loadings into Lake Gagogan [downstream of the mine] show that the release of metals from the tailings has not slowed down."xi
- "Results of soil samples at the mining site Villa de la Paz-Matehuala, Mexico, reported concentrations between 19–17 384 mg/kg Arsenic, 15–7200 mg/kg copper, 31–3450 mg/kg lead and 26–6270 mg/kg zinc, while the concentrations in dry stream sediment samples vary between 29–28 600 mg/kg arsenic, 50–2160 mg/kg lead, 71–2190 mg/kg copper, and 98–5940 mg/kg zinc. The maximum arsenic concentration in pluvial water storage ponds, near the main potential sources of pollution exceeds, by a factor of 5, the Mexican drinking water quality guideline. …"12
- "[In] the `Cerrito Blanco' area located 5 km east of Matehuala, …the … arsenic concentration exceeds the guideline by a factor of 100, …a severe health risk."xii

Numerous failures are reported at hard-rock mines in a single book published in 2006[xiii]. The book describes a study of twenty five mines, all in the USA. Of those, eighteen, or 72%, had experienced at least one failure. Seven mines had experienced two failures, three had experienced three and one had experienced four failures:

These evaluations also show how mining companies regularly understate and/or under-estimate the effects of hard-rock mining activities.

Worldwide in the last fifty years, tailings dam failures have been reported at an average rate of four per annum[xiv]. Many of these have resulted in spillages of tailings into the environment and some have resulted in losses of life.

The failures are reported variously as slope instability, subsidence, foundation failure, seepage and/or overtopping. The failures are caused by a range of factors including heavy rainfall, earthquakes, poor design and/or inadequate maintenance.

One of the highest death tolls was at Stava in North Italy in 1985 in which 268 people perished. The Baia Mare cyanide spill in Romania in 2000 resulted in the spillage of an estimated 100 tonnes of cyanide into the Someş River from the gold mine at Bozinta Mare. The polluted waters eventually reached several major river systems including the Danube, which flow through several countries. The spill killed an estimated 1,400 tons of fish and destroyed the livelihoods of hundreds of fishermen along the Tisza River in Hungary. In some Romanian and Hungarian towns the drinking water supply had to be shut down for some days and the water supply in the village of Bozinta Mare has reportedly never recovered. The spill has been described as the worst environmental disaster in Europe since Chernobyl[xv].

One tailings dam failure has been reported in New Zealand – at the Golden Cross Mine near Waihi in 1995. No tailings were released, but the dam remains in place and is an ongoing failure risk. The tailings dam at Tui Mine, near Te Aroha, is located on a hillside above the town. If it ever fails, the toxic tailings would flow directly into, and through, the town.

Perhaps the most troublesome issue with hard-rock mines is the indefinite toxic legacy they leave behind after extraction has ceased.

To minimise the toxic harm caused by abandoned hard-rock mines, active treatment of tailings must to continue virtually forever, if not forever[xvi].

A recent New Zealand example highlights how vital this is. The Tui Mine above Te Aroha was abandoned in the 1970s without a proper cleanup. It has recently been cleaned up at a cost of more than $22 million, all funded by New Zealand taxpayers. Presumably, the cost of ongoing management, including the treatment of ongoing discharges, will also fall on the taxpayer.

Because of these challenges, it is usually not possible to manage the effects of abandoned hard-rock mines in a way that completely safeguards the ecosystems and communities in the receiving environment.

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Appendix 2 (contd)

References and Notes

[i] http://en.wikipedia.org/wiki/Gold_cyanidation

[ii] http://www.nature.com/nature/journal/v495/n7440_supp/full/495S4a.html Under the heading "Reuse and Recycle".

[iii] A comprehensive list and description is given in Reference ix.

[iv] Various examples of this are given in peer reviewed studies, for example Dispersion and toxicity of metals from abandoned gold mine tailings at Goldenville, Nova Scotia, Canada by H.K.T Wong, A Gauthier, J.O Nriagu, in *Science of The Total Environment* Volume 228, Issue 1, 22 March 1999, Pages 35–47

[v] U.S. Environmental Protection Agency Office of Solid Waste - Special Waste Branch (August 1994): *Design and Evaluation of Tailings Dams.* Technical Report EPA 530-R-94-038 NTIS PB94-201845

[vi] RG McLaren and Cameron, KC (2nd ed, 1996): *Soil Science – Sustainable Production and Environmental Protection.* Oxford University Press. Pgs 168 to 172.

[vii] One example is in "Bioaccumulation of heavy metals in organs of fresh water fish Cyprinus carpio (Common carp)" R. Vinodhini; M. Narayanan (March 2008). Int. *J. Environ. Sci. Tech*, 5 (2), pp 179-182.

[viii] US. Environmental Protection Agency Office of Solid Waste - Special Waste Branch (August 1994): *Treatment of Cyanide Heap Leaches and Tailings.* Technical Report EPA 530-R-94-037 NTIS PB94-201837. Section 3.2.

[ix] Nural Kurucak (2006): *Selecting Suitable Methods for Treating Mining Effluents*. A report prepared for the "PerCan" mine closure course.

[x] J.M. Azcue, A. Murdoch, F. Rosa & G.E.M. Hall. "Effects of abandoned gold mine tailings on the arsenic concentrations in water and sediments of Jack of Clubs Lake, B.C." In *Environmental Technology* Volume 15, Issue 7, 1994. Pages 669-67

[xi] H.K.T Wong, A Gauthier & J.O Nriagu: "Dispersion and toxicity of metals from abandoned gold mine tailings at Goldenville, Nova Scotia, Canada". In *Science of The Total Environment* Volume 228, Issue 1, 22 March 1999, Pages 35–47

[xii] Israel Razo, Leticia Carrizales, Javier Castro, Fernando Díaz-Barriga, Marcos Monroy: Arsenic and Heavy Metal Pollution of Soil, Water and Sediments in a Semi-Arid Climate Mining Area in Mexico. In *Water, Air, And Soil Pollution*, February 2004, Volume 152, Issue 1-4, Pp 129-152

[xiii] Kuipers, J.R., Maest, A.S., MacHardy, K.A., and Lawson, G. 2006. *Comparison of Predicted and Actual Water Quality at Hardrock Mines: The reliability of predictions in Environmental Impact Statements.* This book can be downloaded from the internet for free.

[xiv] http://www.tailings.info/knowledge/accidents.htm

[xv] http://toxipedia.org/display/toxipedia/Baia+Mare+Cyanide+Spill

[xvi] http://groundtruthtrekking.org/Issues/MetalsMining/AcidMineDrainage.html

Appendix 3: TCDP-Appeals version – s37.4 of Pt III – the rules

<table>
<tr><th colspan="6">Table 1 - Activity Status</th></tr>
<tr><th>Zone</th><th>Mineral processing</th><th>Quarrying</th><th>Surface mining</th><th>Underground mining</th><th>Waste rock/tailings storage</th></tr>
<tr><td>Rural (A4, A25, A29)</td><td rowspan="2">Non-complying (A25)</td><td rowspan="2">Restricted discretionary (A29)</td><td rowspan="2">Discretionary (A4)</td><td rowspan="2">Discretionary</td><td rowspan="2">Non-complying (A25)</td></tr>
<tr><td>Rural Lifestyle</td></tr>
<tr><td>Industrial</td><td>Discretionary</td><td>Restricted discretionary</td><td rowspan="3">Prohibited</td><td rowspan="3">Discretionary</td><td>Non-complying</td></tr>
<tr><td>Light Industrial</td><td>Discretionary</td><td>Restricted discretionary</td><td rowspan="2">Prohibited</td></tr>
<tr><td>Marine Service</td><td>Non-complying</td><td>Non-complying</td></tr>
<tr><td>Airfield</td><td rowspan="2">Non-complying</td><td rowspan="2">Non-complying</td><td rowspan="2">Non-complying</td><td rowspan="2">Discretionary</td><td rowspan="2">Prohibited</td></tr>
<tr><td>Road</td></tr>
<tr><td>Commercial</td><td rowspan="3">Prohibited</td><td rowspan="3">Prohibited</td><td rowspan="3">Prohibited</td><td rowspan="3">Prohibited</td><td rowspan="3">Prohibited</td></tr>
<tr><td>Gateway</td></tr>
<tr><td>Pedestrian Core</td></tr>
<tr><td>Conservation (A64)</td><td>Non-complying (A64)</td><td>Discretionary(A64)</td><td>Non-complying (A64)</td><td>Discretionary (A64)</td><td rowspan="4">Prohibited (A64, A37)</td></tr>
<tr><td>Open Space</td><td rowspan="3">Prohibited</td><td rowspan="3">Non-complying</td><td rowspan="3">Prohibited</td><td rowspan="2">Non-complying</td></tr>
<tr><td>Recreation Active</td></tr>
<tr><td>Recreation Passive</td><td>Discretionary*</td></tr>
<tr><td>Coastal Living</td><td>Prohibited</td><td>Prohibited</td><td rowspan="4">Prohibited</td><td>Non-complying</td><td rowspan="4">Prohibited</td></tr>
<tr><td>Extra Density Residential</td><td rowspan="3">Prohibited</td><td rowspan="3">Prohibited</td><td rowspan="3">Non-complying</td></tr>
<tr><td>Low Density Residential</td></tr>
<tr><td>Residential</td></tr>
<tr><td>Village</td><td rowspan="2">Prohibited</td><td rowspan="2">Prohibited</td><td rowspan="2">Prohibited</td><td rowspan="2">Non-complying</td><td rowspan="2">Prohibited</td></tr>
<tr><td>Waterfront</td></tr>
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