A HANDBOOK AND GUIDE FOR COMMUNITY CONSULTATION

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For the TELKWA COAL MINE PROPOSAL

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Allegiance Coal Ltd. has recently completed a series of "public" consultation engagements, plus media coverage from 2016 to 2017, that represent an intention to begin mining operations at the Telkwa Coal mine area. This text is intended to provide local and regional residents with some factual information, hazard identification and risk assessment regarding the 'known' and potential mine development and coal processing facilities at the Telkwa coalfields location.

COMMUNITY ENVIRONMENTAL ASSESSMENT

When approaching a major mine environmental assessment:

- Know the landscape/s or learn the landscape/s.
- Know ecosystem functions and attributes, such as grasslands, Core Ungulate Winter Range and forest canopy for snow-interception and thermal cover, summer and winter.
- Study hydrology/surface streams and drainage pathways, including hydrograph seasonal variability of flows.
- Learn aquatic ecosystem attributes and functions, including river temperatures.
- Understand hydrogeology and groundwater flow regimes.
- Keep in mind weather pattern variability, including snow-melt-patterns.

- Maintain local knowledge of fish and wildlife inventory.
- Know your own home and private land location compared to Haul Road access corridors and/or mine footprint.
- Retain your right to state your values and interests through "fair and open" communications/consultation channels.

After you have combined all of these values and functions, then place the mine development proposal over-top of those inventories. There will be unavoidable adverse impacts such as Open Pits and Waste Rock Dumps; there will be hazards created and risk permutations associated with those hazards.

The principle of environmental assessment is" to avoid or to prevent" adverse impacts, where possible. All of your review should keep that in mind, including long term adverse impacts (see money badly spent) for the Treatment of ARD/acid rock drainage.

Make a personal evaluation of whether you are able to receive accurate information and maps from the company, the current proponent is Allegiance Coal Ltd., and, to determine whether your concerns and your Local Knowledge are being "reflected" in the Mine Plan being proposed.

It may become easy to "just say 'no'"…but when some public just says "no" and other public members just say "yes", then government has an open field for decision-making that could adversely affect your interests and your home. I say "no" with reasons for my decision….reasons and evaluations that will also reveal to government/s, both B.C. and the federal government, that the long term costs of ARD management and creation of future liability represented by the current Waste Handling for the Telkwa Coal Mine proposal will become their long term responsibility.

SALEABLE COAL

There are major discrepancies between Allegiance 2/17/2018 public web-site statements and Ministry (both the B.C. Ministry offices/MoE & MEM/1998) relating to raw and saleable coal production, overall and by pit. At this point in time, there are three known and delineated operational coal extraction areas where total estimates for coal reserves are:

- Tenas Pit : 20million tonnes of raw coal
- Pit 3/Goathorn Pit : 15million tonnes of raw coal
- Pits 7&8 : 11million tonnes of raw coal

TOTAL: 46million tonnes

Allegiance Coal Ltd. 2018:

- Tenas Pit : 29.1million tonnes of raw coal
- Pit 3/Goathorn Pit : 22.1million tonnes of raw coal
- "Telkwa North" (pits 7&8) : 10.8 million tonnes of raw coal

TOTAL: 62million tonnes

*This series of incongruity cannot be explained due to an enhanced site core-drilling program (as of February 2018) but may be attributable to re-assessment of "known" data.

Please notice that if Allegiance calculations are correct, and their "strip ratio" of 5.8 to 1 (that is waste rock to raw coal) average across all open pits is also correct, there will be a production of **359.6million tonnes of waste rock** across the full mine life. This scenario is far worse, as regards Post Closure liability…. than the Mines Branch data that I am referencing here.

Environmental Assessment deals with the reality that for almost all mine development proposals, Mine Waste production and storage are a key aspect of risk assessment. Mine sites are and become permanent mine waste storage facilities through operational mine life and forever in Post Closure. The coal produced will be shipped away; the waste of mining operations will stay.

To quote Dr. William Price/Bill: **"Most of the products of mining, waste rock and tailings (see coarse Rejects and Tailings Fines at coal mines) remain on the site after mining. The large volumes usually make waste movement (removal)**

prohibitively expensive. Disposal procedure and location can have a large impact on reclamation results."

THE FULL MINE LIFE CYCLE

Almost all of the mining industry endorses the principle of evaluating the full mine life cycle and in British Columbia this has become a policy within the BCEAA/British Columbia Environmental Assessment Act for major mine projects.

First on-the-ground work in any form is Mineral Exploration surface and drilling, followed by Advanced Exploration phases, including core-sampling and analysis' program, that are the initial land-based intrusions. These activities are permitted under the Mineral Exploration Code and Mines Act provisions. Then:

- B.C. Environmental Assessment Act procedures and Approval Certificate
- B.C. Permits, Mines Branch and Ministry of Environment
- Construction Phase
- Operational Life of the Mine, with incremental Reclamation
- Decommissioning, Reclamation and Closure
- Post Closure, with site conditions that should be stable through time.

All open pit mine developments become permanent mine waste storage facilities, forever. In addition to ARD-characterization of all waste and disturbed rock types, the principles of "segregation" and "containment" are critical management objectives. These are both enclosed within Geotechnical and Geochemical investigations; geotechnical for structural containment integrity and stability; geochemical for all hazards relating to acidic and/or metals entrained drainage flows.

Post Closure descriptions including all costs associated with Water Treatment (that is collection system, treatment and effluent discharge plus treatment sludge disposal) are part of the BC Reclamation Security Bond assessments. The goal of BCEAA is to decide whether a mine site, in Post Closure, will present any long term hazard for unsecured financial liability that may become the responsibility of government….and BC taxpayers. Post Closure should represent a secure site which guarantees that off-site environmental attributes and functions will be kept "safe".

Initial errors in data collection and/or data interpretation can result in poor management decisions and then cause increased operational cost, for mine sites that require ARD Treatment. These added financial costs can exceed the entire investment budgets of the initial mine development.

COAL MINE WASTE ROCK PRODUCTION

The excavation and deposition of various types of waste rock is an unavoidable consequence of Open Pit mining at the Telkwa Coal deposits.

The Telkwa Coal mine waste rock production varies across the three operational areas but averages at 5.8 to 1; that is, 5.8tonnes of waste rock to every one tonne of raw coal produced. That tonnage has been reported as cubic meters and the geochemical hazard that those waste rock types represent is what we will focus upon. Waste Rock tonnage estimates:

- Tenas Pit : 123million tonnes
- Pit 3/Goathorn Pit : 80million tonnes
- Pits 7&8/Telkwa North : 59million tonnes
- *plus waste coal @ 10% of total raw coal production volumes

The vast majority of waste rock types that will be excavated and/or exposed have tested to be "acid-producing"/PAG/potentially acid generating. That data includes the measurement that there is very little NP/Neutralization Potential present, by sample, by Zone or by overall Pit, except for sand and gravels (with silicate NP non-availability) and a granodiorite inclusion to the "north". Within the history of ARD: acid rock drainage/ML: metals leaching assessment at the Telkwa Coal property, there has never been credible data interpretation to support that any of the waste rock types sampled and described are Non-Acid-Generating, except for the sand and gravels.

Waste Rock types within the deposit are in layers, named “zones”, and they are:

- **Mudstone** (claystone), a “weathered clay”, estimated 29% of all waste rock by volume….high geotechnical hazard and unstable, unsafe for construction. Very little NP.
- **Sandstone**, this is sand particles bound together by minerals, those minerals can lose their chemical bonds and create fines. Mostly PAG/potentially acid generating, with little NP. *note that assumption has been that NP will also be exposed when fines are created, but no data to support such assumptions.
- **Siltstone/Green Siltstone**, friable resulting in fines and highly PAG/potentially acid generating.
- **Waste Coal,** friable resulting in fines and PAG.
- **Minor Conglomerate,** not assessed.
- **Sand and Gravel,** silicates will not provide available NP.

There is an important chemical/physical aspect regarding waste rock types at Telkwa. These layers of various geological depositions are extremely “weathered”, including the mudstone/claystone. To quote MEM; Dr. William Price/Bill, 1996 report, page 27: “….**and the Telkwa sandstone (medium strength) and siltstone (low to medium strength) and mudstone (very low strength). The lower strength of the Telkwa coalfield rock may result in more rapid and more complete weathering than the rock of the Allegheny Group (U.S.).”**

“Weathering” creates exposed surfaces for oxidation and for accelerated bacterial occupation and ARD oxidation reaction process. While it is true that AP/acid potential is accelerated by weathered fines; it is also true that weathering exposes NP/neutralizing potential that could slow ARD….but NP/alkalinity really is in short supply or not chemically available at the Telkwa coalfield group.

I do not have any past proponent inventory (Crows’ Nest or Manalta) that directly ascribes Waste Rock Type to the volumes that will be excavated, by pit, by Zone within a pit, except for the Mudstone @ 29% by volume as a Crows’ Nest/1990 estimate, so there can be no credible calculation for waste rock dump

NPR/Neutralization Potential Ratio (NP/neutralization potential to AP/acid potential) or even inventory for the final geochemical characterization, from ABA test results to NNP, of the waste rock backfill or waste rock dumps. …we have to wait for full disclosure of all ABA waste rock data that should be included within a detailed Allegiance Coal Ltd. Mine Plan and Waste Handling Plan.

In addition, the proponent should provide inventory all mine site areas that are **"disturbed, created, excavated or exposed"** (Dr. William Price/Bill; MEM-1997), for ARD/ML hazard and risks…..These are:

- Open Pit walls
- Process Plant waste production of coarse rejects and tailings fines
- Settling Ponds and Dams (Tailings Impoundment)
- Waste Rock utilized for construction, dams, yards and roads
- Waste Rock Dumps, out-of-pit
- Waste Rock backfill into open pits

There is also a wide range of mine effluent/liquid discharges that are associated with all mine components. These effluent flow volumes will not be an "average" but will increase or diminish dependent upon weather pattern variability and groundwater flow. The main locations for mine effluent discharge include:

- Open Pit de-watering and discharge from Settling Pond.
- Processing Plant water re-cycle and discharge from Settling Pond.
- Diversion Ditch system discharge? Settling Pond??
- Waste Rock dumps seepage, run-off and "flushing" discharge to……?

There has never been a reliable Water Balance estimate that would describe Mine Effluent Discharges by volume. And, the Telkwa River hydrograph, collected as monthly flow volumes, may not be able to dilute any liquid mine effluent discharge except for snowmelt periods and/or rain events.

While there will be seasonal variability of receiving stream flows, mine water pumping from the Open Pit in operational mode, will be relatively constant or even delayed due to groundwater discharge mechanisms. High groundwater flows into the open pit areas may not coincide with high flow of the Telkwa River.

Dependence upon “dilution” of the receiving stream/s and watershed river/s is a critical component of any mine effluent discharge Permit calculation.

MINE OPEN PITS

Within BC Environmental Assessment process there are descriptions for types of “adverse effects/adverse impacts”, some of which are not ‘avoidable’, for instance, the Open Pits:

- Tenas Pit: 3.6 km length…….. 1.3 km width……… 120 meters depth
- Pit 3/Goathorn Pit: 2.3 km length……… .75 km width……… 144 meters depth
- North Zone/Pits 7&8: unknown extent……………….. 150 meters depth

These open pit coal “mines” are massive; there is no effective mitigation for that adverse impact upon known landscapes. The Open Pit walls contain geochemical hazard that may result in ARD/acid rock drainage due to Wet/Dry cycles, groundwater discharge and weather pattern variability. The waste rock backfill and the waste rock dumps may be “covered” with soil and till, but the pit high-wall and the partial flooding of the open pits will not result in what industry likes to name….a Pit Lake. The implication of language to create false images is a key skill of the mining industry.

A back-filled, partially flooded open pit with high-wall is not Tyee Lake.

Language:

- **Mitigation**: An engineered, planned and implemented management solution that is intended to reduce and/or prevent adverse impacts; mitigations would include Dry Covers, Water Covers, Waste Rock Segregation and Haul Roads that do not go through the middle of town.

- **Remediation**: engineered repair of errors made during construction or site management, or, upgrades due to new legal standards for mine construction, such as Tailings Dam buttress or Diversion Ditch and settling dam upgrades due to Global Warming peak storm event re-calculations.
- **Contingency**: An engineering or management solution implemented when 'things' go wrong, for instance ARD is not prevented by dry cover and Treatment of ARD or ML is the contingency.

During the Manalta Coal Ltd. BCEAA, the company proposed that the Tenas Pit, the first to be mined, would be separated into three operational sections:

- Tenas Main Pit…………………………..NPR= 1.74 for waste rock volumes
- Tenas Pit with Pushback:……………NPR= 1.84 for waste rock volumes
- Tenas West Pit: ………………………..NPR= .74 for waste rock volumes

At NPR greater than 2…..may not produce acid…..NPR > 3 was the final choice of Ministry of Environment/Protection Branch staff during 1998. These "averaged" numbers above are straight from Manalta data and are ALL PAG/acid generating, as an "average". But averages are not used as the initial assessment when adhering to the B.C. ARD/ML Guidelines; representative samples at the full range of high-low are the beginning of assessment for ARD….not NPR by open pit.

Note that the data above **may not include Waste Coal that equals 10% of total raw coal extraction** cubic meter-volumes that are also PAG/potentially acid generating as characterized through ABA/acid base accounting test results.

"Overburden" is also pit waste. Composed of soil and clay till, overburden (low to medium NP) is also not included, by my own calculations, within these NPR "averages"….since those soils and tills can be used for both reclamation (re-contour soil deposition with grass seeding) and/or Dry Covers, but at now undisclosed volumes. And, this mine overburden may not be "blended" into the waste rock dumps, in-pit or aerial/on-the-ground.

In addition, since ABA/Acid Base Accounting lab tests' results were never collated by rock type or **waste rock type by volume,** we cannot accept even these averages as “real” inventory and analysis work. MEM named this discrepancy as **“an inaccurate volumetric assessment”:** 1996 MEM; BCEAA Application comments; Dr. William Price/Bill; page 12.

And, finally, to date no proponent thus far seems to have followed or adhered to the Phased Approach of the BCARD Guidelines, ABA/acid base accounting of raw data, with data tables and proper organization and tabulations. A correct approach and inventory accounting, reflecting the full range of geochemical mineral analyses, by waste rock type and waste rock volumes, was never submitted to government.

Needless to say, we can see that Allegiance Coal Ltd, seems to assert that there are substantial volumes of NON-PAG mine waste and that they can “segregate” that ‘safe’ waste rock from the PAG waste rock….but the company has not provided any methods or management procedures to support their claims.

When evaluating and interpreting data, the geology of the coalfields at Telkwa represent further complications: “The ‘sub-units’ of waste rock by type, by pit zone, by pit **show variability that may preclude “the practicality of segregation”….**that is separating PAG waste rock for special deposition as backfill within the Open Pits.

In 1997-98, Manalta proposed to “blend” waste rock within dump areas but MEM government agency comment replied:

“It is not clear how “within zone” variability will be factored into the waste management plans since the plan is for entire zones to be managed, rather than layers within the zone or laterally defined portions of zones that may be associated with differing depositional environments” …and…

“…sulphide created under reducing conditions from the dissolved sulphate of sea water. Since the Telkwa deposit was formed in an estuarine environment that was periodically inundated by salt water, inflow conditions occurred both at a single location over time and also across the site at any one time.”

So, we will have to examine Allegiance Coal Ltd.'s Waste Handling Plan. The company should not simply state that they will backfill all PAG waste rock into the pits; They should provide a detailed description of HOW they intend to identify, segregate and store PAG waste rock, until there is an exhausted open pit within which to place that excavated and "stockpiled" PAG waste.

Attention should be paid to the fact that, to date, the Allegiance "plan" is to merely laterally mine along the face of waste rock and/or coal seam, while simply shoveling coal to trucks and waste rock across the pit face into dump areas, also laterally aligned. This indicates an exposed, aerial waste rock dump that for years will not be "flooded under a water cover", if ever.

WASTE ROCK BACKFILL, GROUNDWATER AND OPEN PITS

"Some of the subpopulations (of waste rock) show a tendency for acid generation or acid consumption, however, the practicality of segregation would probably preclude the separation of the acid generating subunits." This quote from STATUS OF REVIEW: ARD/Metals Leaching Prediction and Prevention; 1996: Craig Stewart, Ministry of Environment; Protection Branch, Smithers.

Statements by Allegiance Coal Ltd. at an invitation-only Open House indicated that "backfilling" PAG waste rock into pits would be their 'mitigation' strategy to prevent ARD. And, they also stated that Non-PAG waste rock would be placed in on-the-ground unflooded waste rock dumps. The problem with such statements of assumption is that the total waste rock volumes will not "fit" back into any of the open pits, once mining has exhausted the coal beds.

- Tenas Pit……………………..45% of volume of waste rock can be backfilled.
- Pit 3/Goathorn……………..30% of volume of waste rock can be backfilled.
- North Zone/7&8…………..20% of volume of waste rock can be backfilled.

*What is the calculated backfill capacity for PAG waste rock storage, by open pit, compared to PAG waste production, including Waste Coal volumes?

Note that these estimates only apply to the “capacity” by volume of the open pit/s; not to the permanent flooding of those pits by the groundwater table elevation.

Since it is acknowledged that there are “perched” water-tables associated with the coal seams/zones at the Telkwa coal fields; the true elevations of the groundwater table, once the coal is excavated are unknown.

In addition**, “All pit areas located on hillsides. Pits are open-ended downslope towards local creeks and the Telkwa River. Pits expected to be partially flooded at closure. Final flooded areas are SMALL AND ARE LOCATED IN THE UP-SLOPE PORTIONS OF EACH PIT DEVELOPMENT.”**

And, “Faults and fractures present in all pit areas may reduce or preclude flooding ability. NO EVIDENCE TO DEMONSTRATE UNTIMATE PIT AREAS WILL HOLD WATER.” Page 32: 1997 BC MEI Status of Review; Dr. William Price/Bill.

When is a proposed “mitigation strategy” simply words of assertion with no feasible management or engineering capacity to achieve stated goals? A partial water cover with height fluctuations of Wet/Dry cycle is far worse than no water cover at all.

If backfilling is completed, at the end of Tenas Pit mining, for instance, there will still be massive Waste Rock Dumps, placed immediately adjacent to those Open Pit locations and all drainage from those waste rock dumps seems to channel straight into the pit-wall/s and pit water-table. ARD from those Waste Rock Dumps, during operations, will severely complicate Water Management/de-watering of pit/s and will require Treatment prior to discharge to the Telkwa or the Bulkley Rivers.

If waste rock is placed into pits and then **is exposed to Wet/Dry cycles**, which will accelerate ARD from PAG rock types, both oxidation and flushing, that Waste Handling strategy will create long term costs for ARD Lime Treatment. If pit flow enters groundwater through fractures or fault lines how will the company even be able to collect ARD contamination for treatment?

WASTE COAL PRODUCTION

There are 5 Zones identified within the three Tenas Pit mine units; the geology looks like a multi-layered cake, tilted to the North.

Zones are a simple method for identifying raw coal extraction layers and also characterizing waste rock geochemistry, by rock type. There are “high Sulphur/Sulphide Sulphur” sediments directly above coal seams in Zones, 2, 3 and 5 within the Tenas Pit.

In 1997-98 Reports there is also a broad statement that 10 to 11% of coal (by volume/by tonne??) will be “waste” rock…due to these stated facts:

- Some of the coal zones will not be mined due to shallow depth/narrow and impossible segregation required by shovel.
- Interface-coal between economic coal zones and waste rock is filled with coarse rejects and is not economic to process.

Waste coal tonnage or volume are estimated through comparison of final raw coal tonnage. Waste coal volumes will measure in at 4million cubic meters, minimum. This waste coal has tested PAG according to reports, through ABA/acid base accounting testing.

The waste coal volumes represent a unique and critical hazard. In addition to being PAG and producing ARD/acid rock drainage, this waste coal could ignite and burn, for decades. If temperatures become high enough within waste rock dumps or even pit backfill dumps, coal can ignite and burn. This outcome is due to the fact that ARD is an “exothermic” reaction and creates heat, whether driven by straight oxidation or thiobaccillus ferrooxidans bacterium.

Heat can be further amplified by convection (the chimney effect), that creates intensified oxygen diffusion of oxygen into the waste pile and increases “rates of oxidation” within massive waste rock piles. The resulting “hot zones” that may be present in mixed waste rock dumps or even in-situ coal seams can ignite coal. Coal fires have occurred throughout the U.S., Australia, China (see almost every coal producing country), even within open-pit-backfilled dumps. The hazard and risks for coal waste fires is known and must be prevented at all cost.

There is no Risk Assessment matrix or Predictive Model for coal fire hazard at this time. Once these fires start they are extremely difficult to extinguish. This means that the hazard of waste coal must be addressed within the Waste Handling Plan for Telkwa Coal mine development.

All texts show that Telkwa coalfield is peat as a series of dry land versus marine intrusion across millions of years. I also remember one geochemical engineer that said there may have also been hydro-thermal intrusions in the area, that is, super-heated, Sulphide-bearing water from volcanic events. All coal excavated from Telkwa has tested PAG. So, not only do certain waste rock types and/or waste rock sub-units represent ARD hazard, all coal and all waste coal does as well.

Many technical presentations tend to reflect an assumption that ARD is a constant, a process of reactivity that in turn creates an “average” flow and an “average” acidity but those conditions are not reflected within monitored, known acid-generating waste rock dumps. ARD is a cycle of oxygen-diffusion and thermal convection combined with flushing events such as snow-melt and storm events. Peak flows become a hazard, combined with annual ARD volumes.

GEOCHEMISTRY

ARD/Acid Rock Drainage…..or, Acid Mine Drainage…..or, “acid generation” are all the same hazard. Industry likes ARD but you can use the name with which you are most comfortable.

A great deal of discussion during the Manalta BCEAA process in 1997-98 was centered around the sample/lab Manalta procedures that used Total Sulphur instead of Sulphide Sulphur. However, tests also showed that most samples showed Sulphide Sulphur to be equal to 75% of the Total Sulphur inventory. New ABA testing may reveal more accurate calculations but differentiation of Total to Sulphide Sulphur does not seem to be a critical ARD issue, especially when we consider the Thiobaccillus bacterial complication. This bacterium thrives on Sulphur.

Trace Metals, see Heavy Metals…….the mining industry prefers trace metals, since that makes the hazard sound "less"….use whatever you would like as description.

Geochemistry is about the minerals within rock/s…or even soils….and at the Telkwa coal fields sulphide Sulphur and pyrite…..and maybe arseno-pyrite (see Arsenic release into ARD) are the main drivers for the process of ARD.

When sulphide minerals are exposed to ambient atmosphere/air as 02/oxygen; a complex chemical (and biochemical) reaction occurs that could take a book to explain. Simple version; oxidation occurs producing soluble-metals salts/SO3….and then, all you need to add is water/H2O to result in H2SO4-sulphuric acid. That is ARD, with heavy metals dissolved within flow.

In addition to dissolving the heavy metals that are within the mine rocks/waste rocks, ARD can entrain and dissolve metals within stream sediments to increase both **acute and chronic toxicity** of the ARD flow to aquatic organisms. Metals thus are a part of the acute toxicity for ARD; but acidity alone is acutely toxic, and so metals are only a part of the adverse effects discussion. One aspect of heavy metals is that they are persistent contaminants through time and unlike "acidity", metals can enter the food-web, organisms and fish as Chronic Toxicity that without killing organisms can eventually affect reproductive success.

Observe that "dissolved" metals (dissolved into the water column) are more readily available for biological effects than "total metals". However, if metals as Totals (metal salts/thio-salts) are within mine effluent discharge/s and are deposited along stream and river beds, they can be acted upon by bacteria, digested and become a contaminant-metal of the food-web…..or, be turned into a "dissolved metals concentration" when the next flush of acid water is released into the receiving stream and river.

All geochemical reactions are enhanced by the mass and configuration of waste rock piles and dumps due to exothermic heat production, convection and oxygen diffusion cycles. Oxidation and thiobaccillus/biochemical oxidation create heat through electron exchange. The chimney effect of heat transfer brings more oxygen and that increases ARD reaction rates.

Geochemical reactions such as ARD/ML are also enhanced through the creation of "fines"…see waste rock friability description and "weathering" above. Fines create surfaces upon which reactions will occur. Siltstone is one example of this.

Ministry of Mines "Status of Review-1997", page 6: Dr. William Price/Bill: **"A significant portion of the waste materials and exposed pit walls that will be created by the Telkwa coal project are predicted to have a potential for metals leaching and/or ARD….and may have major adverse impacts on aquatic resources and create severe impediments to the reclamation of mined land."**

The mine industry prefers to describe ARD as a series of "averages" or imply a steady "average" drainage of ARD production but here in our climate with our snow melt patterns and precipitation events, we can see and have quantified as data patterns long-term…. that surges and major flushing events create huge periodic hazards not accounted for when only "averages' are used. **So, there are windows of high-hazard flushing events due to Waste Rock Dump and Pit Wall ARD surges which can kill aquatic life if those flows are not contained and treated prior to discharge, even if annual averages show dilution."**

Two key aspects of ARD:

- pH
- acidity

The measurement of pH is a logarithmic scale with pH-7 being neutral. As pH decreases to pH 3 and lower within the waste rock mass or pit wall, ARD is occurring, with major feedback loops and sustaining functions such as thermodynamic exchanges. Most consequential ARD pH ranges between 2.3 and 2.7pH. Low pH is acidic and can dissolve metals into solution. Consider low pH to be a bunch of hydrogen atoms bouncing around looking for something to enter (valence plus1)…hydrogen ion concentration is the measure of pH.

Acidity can move in tandem with low pH but it is an entirely different measurement. Think of acidity as molecules of Sulphuric Acid, as a ppm/parts per million. Now with pH at a constant 2.5, there can be a range of Acidity ppm from 4,000ppm to 45,000ppm. The difference will be in the rate of oxidation and the flushing mechanism flow strength. And, that differential flow multiplied by acidity concentrations, will directly affect any “safe” dilution rates that will be required.

Now, during snowmelt periods and/or storm events, ARD flushing will occur; huge surges of ARD will flow at amplified acidity concentrations out of the waste rock dumps and from the pit walls that are unflooded or partially flooded. This flushing event may not occur each year; there may be “average” ARD years. In well-established waste rock dumps, during “dry year/low snow pack” periods of time, oxidation will merely build up oxidation-products with little flushing….and then heavy snowmelt pattern or even a storm-event will flush ARD out as a surge, a peak flow.

Assumptions have always been made that during Spring/snowmelt, dilution from high flows will “take care” of ARD discharge to receiving streams when quite the reverse outcome has been proven. When ARD within massive PAG-waste-rock-dumps is subjected to high flow and flushing events; acidity overcomes dilution.

Thus, acidity as an inventory measurement of ARD is not so easy to “dilute”, especially at the higher concentrations of ppm. So, do not allow anyone to tell you that it is “easy” to treat ARD or that the Telkwa River can dilute acidic flows.

It all depends upon acidity and Sulphuric Acid ppm. And, while Telkwa Coal mine is not a metal mine, the same Sulphide oxidation and flushing “rules” apply. In the eastern United States thousands of creeks and streams have been killed due to past-practices of coal mining/coal waste handling and ARD. The only difference between ARD-coal mines and ARD-metal mines will be the entrained metals in solution, the fact remains, acidity kills.

There is one key difference between metal mines and coal mines and that is Coal Waste Fires. **“…..it has been estimated that more than 500 coal waste -bank (see**

waste piles) or coal strata fires exist in the United States." J. Richard Jones: "Fire Diagnostic Simulation for Burning Coal Waste Banks."

Metals Leaching/ML is also a Sulphide-oxidation driven process, where there is enough NP/usually Calcium Carbonate-CaCO3 within the minerals of waste rock types as excess NNP/Net Neutralizing Potential to neutralize the flow. However, some heavy metals during this neutralization process, once they are "dissolved" are not removed from the water column, since the pH does not go alkaline enough to form those metals into salts. Some of those metals are present, in undisclosed concentrations, by rock type, by layer, by sub-unit at the Telkwa coalfields; first Crows Nest metals' accounts:

- Cd; Cadmium; a nerve toxin and can accumulate/bio-accumulate.
- As; Arsenic; tri-valent-As is a chronic toxin and can accumulate.
- Mn; Manganese; affects human brain development
- Pb; Lead; Pb is a chronic and acute toxin and can accumulate
- Al; Aluminum; depending upon pH, can affect fish respiration.
- Zn; Zinc; Zn is readily taken up into fish tissue, via gills and skin.
- Cu; Copper; acute toxin at very low ppm/.004 to the entire food-web, kills algae, periphyton/bugs, benthic community and fish all at once.
- Fe; Iron; can detox other heavy metals through co-precipitation, unless Fe-concentrations at high ppm create toxic levels by themselves.
- Sb; Antimony; little data, toxicity mild.
- Se; Selenium; mutagenic, a chronic toxin: tri-valent form acutely toxic.

And, I have no data that attributes waste rock types/by pit or pit sub-unit to these metals or any ppm data that measures concentrations within predicted mine discharges or ARD by pit, by waste dump, to inform prediction-outcomes according to potential toxicity of ARD, let alone mine effluent discharge prediction, by location.

Please learn Periodic Table shorthand.

During the 1997 Manalta Field Trials there were various test pads of "blended" waste rock placed upon HDPL-plastic liners and drainage from each was collected.

The results for metals included:

Tenas Pit identified trace metals: Cd, Cu, Mn, Fe, Ni, Zn, Al.

Pit 3/Goathorn identified trace metals: Cd, Cu, Mn, Fe, Ni, Zn, Al.

So, the metals seem to have a coal field representation and convergence that are present across differing pit locations. However, while waste rock types, such as 'sandstone' are described, there is little to no metals-ppm lab-data provided within the reports I have retained. Instead two things are noted:

- "In 1998, they (metals) were detected using a more sensitive method at ug/L (parts per billion) level."
- "Concentrations of some metals as "dissolved" also correlated with pH."

Sensitive detection limit-sampling is extremely important when investigating Metals Leaching/ML….especially for metals such as Cadmium and Selenium.

Hazard areas for ML at Telkwa, within past mine plan descriptions include:

- Any free water flooding of Open Pits.
- Tailings Impoundment free water/supernatant.
- Tailings interstitial (pore water) water volumes within impoundment.

In the example of Metals' Leaching risks, neutral pH water flow can have heavy metals dissolved within the water column. Some of these heavy metals, such as Cadmium or Selenium, are incredibly difficult to "treat".

MINE SITE RECLAMATION AND LIABILITY

There are legal requirements, as mine development disturbance progresses, for Mines Branch/Mines Ministry to collect a Reclamation Bond, to pay for mine site reclaim (mostly soil and grass-seed) re-contour and removal of buildings…plus restoration where possible of surface drainage flows. The Reclamation Bond is refunded to the company as work proceeds.

The Reclamation Bond is a sort of insurance or assurance that reclamation work will be completed as described and approved with the Mines Act Permit.

However, if long term liability for the mine site includes any form of ARD/ML, assurance/Bond legal requirement is altered. When ARD/ML Treatment facilities are required, a Security Bond is required, amounting to the annual cost estimates across a one hundred year timeframe. Annual Cost estimates include:

- Treatment chemical additives, such as Lime, as both Unit Cost per tonne and annual total consumption throughput.
- Maintenance of Collection system ditches, pumps and pond dams, and spillways.
- Fuel.
- Hydro, including hydro pole replacement when needed.
- Access road maintenance, since lime delivery must continue to the site.
- Repair, maintenance and on-site workers budgets.
- Environmental monitoring, including EEM/Environmental Effects Monitoring and Effluent Discharge bioassay prior to treated water discharge, etc.
- If Dry Covers and/or Water Covers require maintenance or “repair”, these will also require budgetary allocations. *There may need to be pump-capacity for water cover increases to maintain permanent effective prevention of ARD.

Security Bonds can amount to $30million up to $65million and more, here in BC. B.C. was the first province in Canada to require a Security Bond; that money (as a Letter of Credit) was arranged for Placer Dome’s Equity Silver Mine. That Security Bond amount has increased from $31million to the current $65million due to increased cost of Lime, increased ARD acidity loading to Treatment Plant through decades and other site management costs that have increased even while the Canadian economy “inflation” index was low.

The money within a Security Bond is intended to pay for mine site management if the company "de-faults". This money will only pay for ARD treatment and mine site budget; it is not adequate or meant to "clean-up" or to "fix" the ARD hazard.

WATER: HYDROLOGY AND HYDROGEOLOGY

Hydrology is surface water flows.

During the Manalta Coal Ltd. BCEAA process, the Telkwa River was described as "flashy", that is, high periods during snowmelt and/or storm events in the mountains, which then crash into low-flow. Part of this Telkwa River hydrograph is due to the fact that the river is not lake-headed and depends upon mountain basin run-off and wetlands plus ice-field melt during summer months.

The Telkwa River is at low flow for at least five months every year, as an average. The hydrograph history records this. So, mine effluent discharges may not be "diluted" by Telkwa River flows. And, while the Telkwa River has flow variability and sometimes lacks dilution capacity, the proposed coal mine will require water-balance effluent discharges 24/7 from various locations across the mine site Settling Ponds:

- Open Pit de-watering pumped discharge.
- Process Plant Yard pumped discharge.
- Diversion Ditch system flows.

Effective "Containment" is a principle of the BC ARD Guidelines. A mine would have a Diversion Ditch system to direct run-off flows away from open pits and plant site. The water volumes collected are usually just **discharged** or directed into drainage of local creeks and or rivers. There will be an Effluent Discharge Permit from MoE regarding Total Suspended Solids/TSS (and metals) **for this discharge,** as a free water volume, by day, by month, by year.

Hydrology as surface run-off during all seasonal variability, will also affect pit water inflows that will require pumping, that is de-watering the pit, to allow mining operations to proceed. At most mining operations open pit pumps run 24/7. That pit water/mine effluent **will also be discharged** under a MoE/Ministry Permit: TSS/Total Suspended Solids and metals and Nitrates (result of pit blasting)…..to local streams and/or the river.

The Processing Plant site and yard should be engineered to shed precipitation and snow-melt and that flow will be directed to a "Settling Pond" **and then discharged.** Note that coal dust will be a primary air-quality issue and will also report as TSS to collected mine site water flows. Coal dust entrained in plant site run-off will enter Settling Pond…What are the management procedures for guarantees of compliance of Permitted Effluent Discharge regarding plant site?

Hydrogeology is groundwater. Groundwater can discharge into surface flow, depending upon terrain features or even flow-velocity during snow-melt. The geology of the Telkwa coal fields also affects groundwater movement:

- Layers of sand and gravel segregate seepage flow paths.
- Faults and fracture zones further consolidate flow volumes.
- There are also layers within the coalfields of permeable sandstone/siltstone that will facilitate flow.
- The coal seams/layers have created wide but shallow perched water tables within and adjacent to the proposed open pits.

This last issue is important since at this time it would be very difficult to accurately predict the final "flooded" open pit water levels, by elevation.

At Telkwa coalfields the groundwater has been described as shallow, perched water-tables above the coal seams. This hydrogeological condition will be permanently altered as open pits are excavated. Final groundwater table elevation can only be estimated at this time.

One last key issue……if groundwater becomes contaminated with acidity and heavy metals due to Pit Wall, Waste Rock Dump/s and/or Tailings Impoundment exfiltration, collection of those underground flows will be extremely difficult, if not impossible. All groundwater at the Telkwa coal fields eventually discharges to the Telkwa and the Bulkley Rivers.

THE TAILINGS IMPOUNDMENT

One mine site component missing from the Allegiance "mine plan" is the necessary location for a tailings impoundment. An impoundment would:

- Provide a guaranteed water supply to the Processing Plant.
- Contain both Coarse Rejects and Tailings Fines as these waste volumes accumulate (that have tested PAG) under a Water Cover (not yet guaranteed permanent) from the Processing Plant.

It is "known" that huge volumes of water are required to process coal for markets. Where is that water coming from?

It is "known", as an estimate, that **more than 13.2million cubic meters/m3 of process plant waste will be produced across the Full Mine Life Cycle**. Where will that plant waste be stored, if not within a tailings impoundment?

*Also please note that final "coal washing" may require an additional "clean water" pond for final washing-process function. Where is that pond to be located? How will "clean water" make-up flows be delivered? We really need to see a detailed Mine Plan and Waste Handling Plan from Allegiance Coal Ltd.

A "Settling Pond" does not seem adequate for even the small version/low tonnage mine to plant throughput Allegiance is describing. Where is the solid plant waste disposal circuit for Coarse Rejects and Tailings?

A drilled "well" does not seem adequate, for a water supply, to run even a "portable processing plant", and yet that it what is described by Allegiance within their Investor update, 2017.

And, finally, how will the mine site components and Process Plant water requirements change, as regards the Allegiance Mine Plan/Waste Handling Plan when “ramped up” coal production throughput reaches 1.5million tonnes of saleable coal annually?

The hazard of tailings impoundment dams, proposed by the Manalta Mine Plan to be 40meters in height becomes a key hazard with many risk factors of malfunction and/or failure. An impoundment is “sized” according to the free water requirements of the Process Plant water recycle system and the solid waste produced by the process plant, that is, **Coarse Rejects and Tailings Fines**. The dams must contain, as incremental “rises”, all Process Plant solid waste and free water recycle. What construction materials will be used to construct the impoundment dams? Open Pit Waste Rock? Soil and Till overburden? Quarry rock?

Since the total storage requirement over the full mine at is estimated to be 13.2million cubic meters of Coarse Rejects and Tailings Fines, this Plant waste stream cannot simply be dumped on the ground, waiting for pit backfill. How will Process Plant waste be managed?

Remember that there are “safe” construction waste rock criteria where the NPR is required to be greater than 2. This means that acid generating waste rock cannot be used for dam construction, except for the upstream dam face that will be “permanently” flooded (in all probability saturated), as is the legal Permit requirement at most mine sites.

The process plant waste stream, as a Bulk Sample taken by Manalta in 1997, showed for both **Coarse Rejects and Tailings Fines have tested as an NPR of .6**…highly acid generating. Note that there may be a range of NPR for Process Plant discharges and representative sampling may not have occurred in 1997, but the fact remains that Process Plant waste must immediately be stored under a water cover. Where would that storage take place except for a Tailings Impoundment?

GEOTECHNICAL ENGINEERING DESIGN AND AS-BUILT CONSTRUCTION

There have been few B.C. Environmental Assessment processes that have directly addressed geotechnical hazards as issues to be resolved. The detailed design and as-built construction have all been considered “permitting” issues.

At the Telkwa coal fields past Mine Plan proposals during BCEAA have not directly described geotechnical engineering, including the hazard of mudstone/claystone to either dam or waste rock dump construction. It is always assumed that these issues are detailed and so are relegated to Mines Act Permits and final engineering design. This is an error:

- Due to the dangerous waste rock types, such as Mudstone.
- The geology of sand and gravel lenses that could create exfiltration from ponds if these are foundation materials.
- The fault and fracture zones present.

These issues should be addressed during the BCEAA procedures. Differing mine components from the Tailings’ Dams to Waste Rock Dumps require:

- Construction utilizing “safe” NPR-confirmed waste rock, soils and till/clay, or quarry rocks.
- Construction that avoid use of Mudstone/claystone hazard.
- Design that contains all projected mine waste produced.
- Competent, see not permeable, foundation materials, no sand and gravel under the Tailings Impoundment, ponds or dams.
- Dry Cover construction that does not de-stabilize waste rock slopes in any deposition area.
- Water Covers that are designed to prevent ARD are permanent, to prevent oxidation and/or Wet/Dry cycles within waste rock and waste produced by the process plant.
- All engineered structures must be robust and ensure stable, effective containment under weather pattern variability, projected maximum storm events, climate change projections and operational shutdown episodes.

The not-yet-mentioned Tailings Impoundment Dams, @40meters height, represent a major hazard not only to the Telkwa and the Bulkley Rivers but to the town of Telkwa and the people who live there. Those dams must be managed (see water levels) and maintained, forever. Dam collapse or failure would create disaster for the entire lower watershed, from the Telkwa to Bulkey River flows because the Process Plant solid waste are PAG, both the Coarse Rejects and the Tailings Fines.

Is the Settling Pond described within the Allegiance mine plan actually the location for a Tailings Impoundment?

A critical feature of as-built (built to design criteria) construction for tailings impoundment dams will be ABA/NPR sampling data **to ensure that no PAG rock volumes are used for any construction**, including road ballast.

No mudstone can be used in any dam construction and should not be placed within waste rock dumps where slope stability must be maintained.

In the last few years there have been upgrades to the legally required standards for all dams and some collection ditch systems, due to climate change projections. These standards are a legal requirement, under Mines Act legislation. This includes a series of standards for Tailings Impoundment Dams. Be aware that a company cannot build a “Settling Pond” with a certain criteria for dam foundation materials and then turn that into a major Tailings Impoundment Dam….the foundation materials may not be adequate for the hydrostatic load.

Waste Rock Dumps, especially coal mine waste, should also be assessed for geotechnical stability. As already noted, the mudstone/claystone waste tonnage should not be placed within the Telkwa Mine waste rock dumps, but should be segregated and disposed of in a “secure” location.

Waste Coal tonnage will also require special handling and deposition areas.

Geotechnical capacity design and construction are dependent upon accurate Water Balance/Mass Balance calculations. These were never provided by Manalta Coal Ltd. In addition, Peak Flow and Maximum Predicted Precipitation events were also not provided but are necessary for design and construction of dams and dam spillways that are meant to last until the next glaciation.

Some Settling Pond dams can be decommissioned at Mine Closure, since process plant and open pit mining will be discontinued and over….but the Tailings Impoundment dam/s must remain functional and maintain structural integrity, forever. Tailings Dam/s' functions include maintaining a permanent water cover over plant PAG wastes estimated to Total 13.2million cubic meters.

THE MITIGATIONS OF WET COVERS AND DRY COVERS

As has already been written above, Water Covers to prevent ARD oxidation must be permanent, not just during the operational mine life but throughout Post Closure, forever. If water covers are not maintained, within the Tailings Impoundment or the backfilled Open Pits, Wet Dry cycles can accelerate ARD.

In addition, AP/acid producing sulphides are very patient; they will remain intact, waiting for conditions that initiate oxidation and flushing. NP/neutralizing potential as Ca CO3/calcium carbonate can be depleted while AP remains, waiting for dry cycle conditions of oxidation and then water flows.

In past mine site descriptions at Telkwa coal fields, Open Pits may not maintain flooded conditions, or, Open Pits may only maintain water cover in the "upper portion" of each pit. This represents a high risk for continuous Wet/Dry cycles and ARD.

Even within Manalta description: 1997-98 of the Tailings Impoundment "water/mass balance", the company stated that the water cover could not be maintained, during operations let alone in Post Closure….and would experience a "few months" with no water cover. This brings into focus the question; where is the process water coming to operate the scaled-up Process Plant? The suggestion was, take flow volumes from the Bulkley River during seasonal or Dry Year low flow periods at the mine site, Manalta 1998.

All BCEAO/Office documentation and reports thus far reflect an operational/geological inability to maintain permanent water covers over PAG mine wastes to be a major Certificate Approval issue for any Telkwa Coal Mine proposal. This failure of “prevention” of ARD, due to failed engineering decisions which in turn damage effective mitigation success, is important.

The soils and tills/clay “overburden” has been estimated to be 1.5million cubic meters within the entire mine footprint. These soils are usually stockpiled and retained for reclamation of the mine.

Allegiance now proposes to utilize this soil/till mix for use as Dry Cover/s on waste rock dumps, in-pit or out-of-pit. Simply placing soils/tills on waste rock does not prevent ARD. In addition, soil/till placement may represent a risk for stability of the waste dumps, as the upper waste lifts compact soil/till and create slip-zones.

So, re-contour for “safe” slope of waste rock piles is necessary, prior to Dry Cover placement.

Mitigation engineering should be “effective” and “long term” because these procedures and management practices cost money and time. Mitigation should not create additional hazard and risks.

ACID ROCK DRAINAGE OR METALS LEACHING TREATMENT

Passive Treatment: The first line-of-inquiry for companies facing extended ARD/ML treatment is to look at options for passive treatment systems, such as Wetland, anoxic lime drains, lime-drip-systems and/or in-pit lime additions. Considering the challenges at the Telkwa Coal open pits locations and the real questions regarding the ability to “mix” lime with any of the predicted ARD flows, such passive treatment system proposals would have to be carefully examined.

An ARD Treatment Plant, if required, is also a system:

- Guaranteed collection by ditch network and pumping array of all contaminated drainage (containment).

- Lime Treatment, which includes delivery of lime to mine site, for decades.
- Treatment sludge disposal on site: a hazardous waste.
- Discharge of “Treated” mine effluent, this will not be “clean water”.

An engineered building as a Lime Treatment Plant should only be considered when “(all) **Preventative methods have been examined and are determined to be technically or economically unfeasible**.” From Dr. William Price/Bill, 1997: “Status of Outstanding Issues”. This approach is due to the fact that Lime Treatment is an expense and that costs associated with ARD treatment, such as “hydro”, fuel and lime unit costs…. continue to increase over the long term.(See Liability, for the next hundred years…give or take.)

A Metals’ Leaching treatment plant is even more challenging, since Cadmium or Selenium will either require an injection system of ferrous Iron or some form of bacterial treatment cycle. In either case the treatment residue will be some form of metals’ contaminated waste that must be stored in a secure location, forever.

COMMUNITY CONSULTATION AND COMMUNICATION

For some time now government and the regulatory agencies of government have considered themselves “partners” with industry, any industry. This framework of cooperation, public and private, industrial development blurs the line for both “conflict of interest” and for any form of regulatory legal compliance. And now, on BNN/Business News Network we hear that industry wants further “fast-tracking” of all projects. Major project development affects people’s homes and Quality of Life and yet there does not seem to be recognition or respect for local and regional landowners and residents, not their values, not their comments in response to industrial development proposals.

What is “Social License”? This new phrase just seems to be an industry insistence for development, on their terms…. and a government endorsement of any communication approach that industry decides is in their interest. There is no dialogue; there is no agreement or public consensus, there is only the expectation of public "consent" to industry adverse impacts…..in the name of "benefits".

"We" are allowed in certain controlled situations to ask questions; "we" are not guaranteed answers to our questions.

Industry states their "plan" and we respond, as either directly affected residents or as regional stakeholders. However, a local concern such as "a major Haul Road through a residential neighborhood" is important; once raised as a major direct concern of local homeowners…. those adverse impacts should elicit an industry response that the company will build another access corridor for their coal haul trucks…not in three years, but as part of their Mine Development Plan initial phase.

When community members state their concerns and there is no government or industry response, what has become of the word "consultation"?

Door to door private conversations do not allow interests, values of lifestyle or concerns to be shared within the community, to be shared with the neighbors. And, since the Proponent will take note those private conversations as "consultation", there are no checks and balances for anything but an industry interpretation of those private comments.

Open House presentations that do not allow for a sit-down meeting format with question and answer session, fragments all issues-related conversations and prevents knowledge sharing and information transfer.

An Open House forum should supply:

- A map for each person attending of mine footprint, access corridor/s, hydro-lines corridor and all private property "in the vicinity" of the project.
- An accurate description of the Project Proposal, plus all known impacts, such as noise, coal dust, groundwater volume/flow affecting domestic wells (these should also be mapped) and surface hydrology.
- A Community Consultation Plan, plus timelines for engagement and direct conversation….a two-way exchange of information.

- A hard-copy page that allows each community member to write their concerns; not a question-list that ends with “Do you support this Project?”
- A meeting format where all present can ask questions, make comments and hear their neighbors’ concerns as well.
- A written record of all “consultation” comments should be kept, if not by the proponent, then by What Matters in our Valley members.

FINAL COMMENTS

For some people, this Handbook text is too “complicated” but you can pick and choose whatever issue that you think is important. Communication is hard.

Or, some readers might say that all of these hazards can be “prevented”. In fact, all of the hazards described exist now in the very geology and location of the Telkwa coalfields. I have not seen any company “plan” that begins to address those Mine Plan/Waste Handling Plan challenges.

For myself, the issues and the potential outcomes described here, plus the hazard and risks’ list, are a message and information package to government regarding the future potential liability of any Telkwa Coal Mine proposal. All of these hazards and risk factors have led to my decision to oppose Mine Development at the Telkwa coalfields. These concerns can be summarized into two factors:

- The proximity of the Telkwa coalfields to high value aquatic ecosystems and fisheries’ rivers, the Telkwa and Bulkey Rivers.
- The complications of interactive site conditions, namely, the geochemical hazard of Acid Rock Drainage, Hydrogeology and Geology, including fault and fracture zones that will prevent “containment” of ARD.

This text is also intended to allow local and regional stakeholders to learn the language of B.C. Environmental Assessment and of mine development proposals, to better organize their own comments for public consultation.

Glenda Ferris