Environment Canada Environnement Canada

Environmental Stewardship Branch
Pacific and Yukon Region
201-401 Burrard Street
Vancouver, British Columbia V6C 3S5

July 25, 2013

Bill Ross
Chair, New Prosperity Federal Review Panel
160 Elgin Street, 22nd Floor, Place Bell Canada
Ottawa, Ontario K1A 0H3

Dear Mr. Ross:

Re: New Prosperity Gold-Copper Mine Project
Environment Canada Written Submission and Registration for Topic-Specific Sessions

Thank you for your June 21, 2013 letter inviting Environment Canada to participate in the public hearing for the proposed New Prosperity Gold-Copper Mine Project (the Project). Environment Canada continues to welcome the opportunity to contribute to the environmental assessment of the Project as a federal authority.

In keeping with the Department's review of the Environmental Impact Statement and supplemental information, our written submission attached is focussed on Environment Canada's expertise on two subjects as defined by the Panel for the topic-specific hearing sessions. In this regard, Environment Canada has already registered to make oral presentations based on our written submission at the following sessions:

- three presentations at the aquatic environment session on July 29th and 30th (i.e., surface water quality, surface water quantity, climate change); and
- one presentation at the terrestrial environment session on July 31st (i.e., wildlife in terms of migratory birds, species at risk, wetlands).

Environment Canada will be soon submitting an additional written submission that supports a presentation at the human environment session on August 1st (i.e., the assessment of alternatives for mine waste disposal).

We look forward to further opportunities to assist the Panel in its review of the Project.

Yours truly,

<original signed by>

Steven Wright
Regional Director
Environmental Protection Operations Directorate

cc: Caroline Caza

Attach

Environment Canada / Environnement Canada

New Prosperity Gold-Copper Mine Project

Environment Canada

Submission to Federal Review Panel for Topic-Specific Sessions

July 25, 2013

Table of Contents

1.0 Introduction

Environment Canada (the Department) is a federal authority in the ongoing panel review of the proposed New Prosperity Gold-Copper Mine Project (the Project) under the *Canadian Environmental Assessment Act*, 2012. In this capacity, Environment Canada continues to contribute specialist and expert information and knowledge (expertise) applicable to understanding and managing adverse environmental effects that could result from the Project.

Environment Canada participation is based on matters directly related to the Department's mandate. The Environment Canada mandate is determined by the statutes it administers including the *Department of the Environment Act,* R.S.C. 1985, c. E-10, the *Canadian Environmental Protection Act,* S.C. 1999, c. 33, the *Species at Risk Act,* S.C. 2002, c. 29, the *Migratory Birds Convention Act,* S.C. 1994, c. 22, and the pollution prevention provisions of the *Fisheries Act*, R.S.C. 1985, c. F-14. The applicability of these statutes and expertise has been considered in the review of the Environmental Impact Statement (the EIS) and supplemental information filed by the Proponent.

In its review, the Department identified three key subject areas which are the focus of this particular submission: wildlife, surface water quality, and surface water quantity including climate change considerations. Specific recommendations are offered for consideration including best management practices that could be pertinent to the Proponent's efforts to demonstrate due diligence in addressing regulatory requirements and minimizing potential adverse environmental effects.

2.0 Surface Water Quality

2.1 Context

Regulatory Context

Environment Canada has expertise on surface water quality. In terms of mining projects, this expertise relates principally to administration of the pollution prevention provisions (subsection 36(3)) of the *Fisheries Act* and the *Metal Mining Effluent Regulations* (MMER) under the Act. As set out in subsection 2(1), the MMER applies to mines that:

- *"at any time after June 6, 2002, exceed an effluent flow rate of 50 m^3 per day, based on effluent deposited from all the final discharge points of the mine; and*
- *deposit a deleterious substance in any water or place referred to in subsection 36(3) of the Act."*

On this basis, the requirement to comply with the MMER typically begins during mine construction, and continues throughout mine operations for a period of at least three years following the end of mine operations.

Effluent is defined in the MMER as follows:

> *"effluent" means an effluent — hydrometallurgical facility effluent, milling facility effluent, mine water effluent, tailings impoundment area effluent, treatment pond effluent, seepage and surface drainage, treatment facility effluent other than effluent from a sewage treatment facility — that contains a deleterious substance.*

The definition includes seepage from tailings and other mine waste disposal facilities. As a result, any seepage deposited into "water frequented by fish or in any place under any conditions where the deleterious substance …may enter any such water" (*Fisheries Act*, subsection 36(3)) would be subject to the monitoring and reporting requirements of the MMER. Accordingly, if seepage is deposited in a lake or stream that is fish-frequented, or deposited into surficial geological units (e.g., glacial till) or into underlying rock units which are hydraulically connected to nearby lakes or streams that are fish-frequented, then that seepage would be subject to the requirements of the MMER.

Approach to Review

Baseline data and water quality modelling is important to understanding potential adverse effects of a project. Baseline data characterizes current conditions and water quality modelling predicts the changes that could occur based on specific assumptions (e.g., contaminant loadings, water balance, mitigation effectiveness). The potential for adverse effects is presumed if water quality guidelines such as the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (the CWQG) could be exceeded. As a federal authority, Environment

Canada has considered whether baseline data is adequate, appropriate modelling methods applied, assumptions (including model inputs from geochemistry and groundwater hydrogeology modelling) are valid, and proposed mitigation measures are likely to be effective.

2.2 Analysis and Recommendations

Receiving waters impacted

Little Fish Lake would be within the proposed footprint of the tailings storage facility (TSF) for the Project. Otherwise, from a water quality perspective, four lakes could be adversely affected by the Project: Fish Lake, Wasp Lake, Little Onion Lake and Big Onion Lake.

Fish Lake is downstream of the proposed TSF, the milling facility and the overburden and low grade ore stockpiles. While outside of the Fish Lake drainage basin, Wasp Lake, Big Onion Lake, and Little Onion Lake could receive seepage from the TSF. Wasp Lake is less than 500 m from the south embankment of the TSF.

Stream systems which could be impacted by the Project include the following:

- tributaries of Fish Lake – Upper Fish Creek and Fish Lake Tributary 1 – as well as lower Fish Creek,
- Beece Creek, downstream from Wasp Lake, and
- the Taseko River, downstream from Beece Creek, Big Onion Lake and Fish Creek.

In general, Environment Canada believes that the Proponent has collected, analyzed, and reported baseline data in accordance with standard procedures using appropriate quality assurance and control methods. Sampling station coverage was reasonable, pertinent parameters were examined and detection limits were adequate.

The Proponent has predicted water quality in the potentially impacted lakes and streams for a period of 100 years, beginning in Year 1 of mine operations. Water quality is also predicted for several water bodies that would be constructed at the project site during mine operations or closure, including the tailings impoundment pond, the pit lake and seepage collection ponds.

Two different approaches to predicting impacts on water quality have been used by the Proponent. A stochastic approach has been taken to predicting impacts on Fish Lake and its tributaries as well as to the water bodies that would be constructed at the project site. A water balance based approach has been taken for Wasp Lake, Beece Creek, Little Onion Lake, Big Onion Lake and the Taseko River.

While the Proponent indicated that "complete details of the stochastic water quality model used to predict water quality in Fish Lake, Fish Creek Reach 8, Fish Lake Tributary 1, TSF Lake, and Pit Lake can be found in Appendix 2.7.2.1-I" (page 706 of the EIS, CEAR #129), those details could not be located. The cited appendix only includes modelling results for each water body, on a substance by substance basis, using graphs difficult to interpret in the absence of legends.

Further details are important to assessing the reliability of model predictions shown in Table 2.7.2.4B-14 of the EIS, CEAR #129.

Appendix 2.7.2.4B-G of the EIS (CEAR #129),provides water quality predictions for Wasp Lake, Beece Creek, Little Onion Lake, Big Onion Lake, the Taseko River, and Fish Creek downstream of the project area. The water-balance model used in these cases is supported by a detailed accounting of input assumptions, with modelling results presented in clear tabular and graphical formats.

Table 2.1 shows water quality baseline and prediction data for some of the potentially affected lakes. Discrepancies between data presented in the Table 2.7.2.4B-20 (CEAR #129) and in Appendix 2.7.2.4B-G Table A-4 (CEAR #129) are highlighted.

Table 2.1: Proponent's Water Quality Predictions for Lakes in the Project Area. Discrepancies of greater than 50% between data presented in the EIS, Table 2.7.2.4B-20 (CEAR #129) and in Appendix 2.7.2.4B-G Table A-4 (CEAR #129) are highlighted in yellow. Except as noted below, all data are from the EIS, Table 2.7.2.4B-20 (CEAR #129).

Big Onion Lake

	Baseline		Yrs 1-16	Yrs 17-20		Yrs 21-30		Yrs 31-47		Yrs 48-100		% change vs baseline
Aluminum	0.008	0.045	0.047	0.053	0.052	0.064	0.067	0.071	0.067	0.075	0.065	67%
Arsenic	0.0003	0.0003	0.00035	0.0006	0.00065	0.0009	0.00092	0.001	0.00092	0.0011	0.00091	267%
Copper	0.0008	0.0008	0.0008	0.0008	0.0008	0.0019	0.0021	0.0026	0.0021	0.0026	0.0021	225%
Iron	0.029	0.05	0.091	0.102	0.1	0.263	0.3	0.379	0.3	0.429	0.29	759%
Mercury	N/A	0.00001	0.000012	0.000012	0.000012	0.000013	0.000013	0.000594	0.000013	0.00089	0.000013	8800%
Selenium	N/A	0.00054	0.0006	0.0007	0.00066	0.0013	0.00148	0.0015	0.00148	0.0016	0.00146	196%
Sulphate	7.2	7.0	7.49	7.6	7.6	40.8	47.9	56.4	47.9	62.2	47.2	788%

Wasp Lake

	Baseline		Yrs 1-16	Yrs 17-20		Yrs 21-30		Yrs 31-47		Yrs 48-100		% change vs baseline
Aluminum	0.018	0.024	0.016	0.02	0.020	0.031	0.340	0.114	0.113	0.116	0.121	383%
Arsenic	0.0003	0.0004	0.0005	0.0007	0.00067	0.001	0.00903	0.0029	0.00291	0.003	0.00308	650%
Copper	N/A	0.0010	0.0015	0.0018	0.0018	0.0028	0.0320	0.0107	0.0106	0.0108	0.0112	980%
Iron	0.08	0.21	0.139	0.185	0.19	0.353	5.11	1.652	1.63	1.685	1.76	702%
Mercury	N/A	0.000010	0.000051	0.000019	0.000189	0.000332	0.000155	0.000090	0.000097	0.000447	0.000909	4370%
Selenium	0.0005	0.00050	0.0221	0.0263	0.00089	0.031	0.02060	0.0632	0.00668	0.062	0.00683	12300%
Sulphate	1.6	1.9	2.48	4.88	4.9	35.3	964.8	303	298.2	304	312.3	15900%

Fish Lake

	Baseline		Yrs 1-16	Yrs 17-20		Yrs 21-30		Yrs 31-47		Yrs 48-100		% change vs baseline
Aluminum	0.091		0.098	0.089		0.083		0.087		0.088		-3%
Arsenic	0.0003		0.0006	0.0006		0.0005		0.0008		0.001		233%
Copper	0.0008		0.0025	0.0019		0.0012		0.0015		0.0028		250%
Iron	0.142		0.572	0.61		0.625		0.732		0.803		465%
Mercury	0.000041		0.000005	0.000003		0.000000		0.000001		0.000004		-91%
Selenium	0.00008		0.00058	0.0007		0.00074		0.00112		0.00313		3812%
Sulphate	1.5		25	30.1		24.4		44.8		107		7033%

Sources for Table 2.1:

- First baseline column is from Appendix 5-2-A of the original EIS (March 2009)
- Second baseline column from Appendix 2,7.2.4B-G, Tables A4 and A6
- First column for each time period is from EIS Table 2.7.2.4B-20 (Fish Lake from 2.7.2.4B-14)
- Second column for each time period is from Appendix 2.7.2.4B-G Table A-4; this appendix table does not show predicted values for Years 1-16

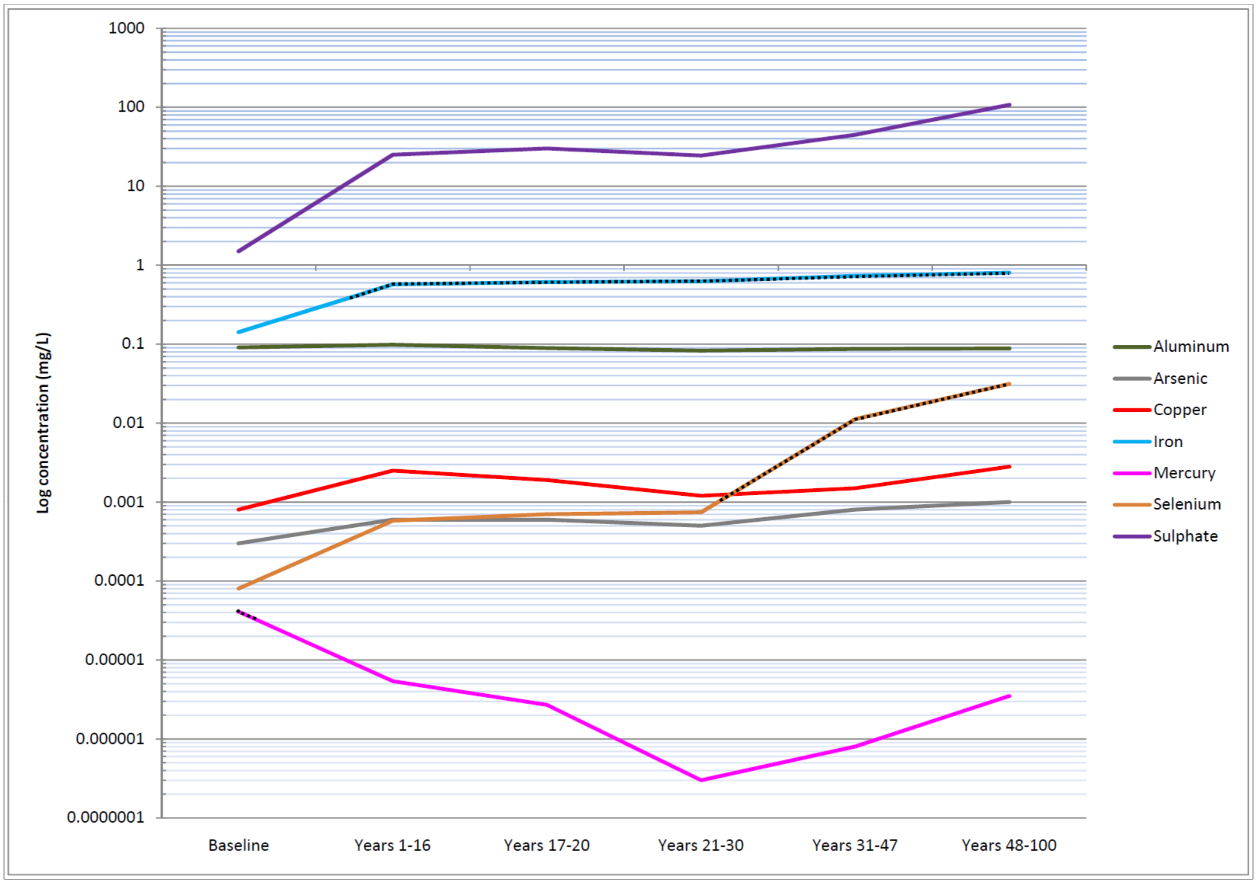
Recommendation 1: The Proponent should provide complete details on the stochastic model used and reconcile apparent discrepancies in the data provided if water quality impact predictions are to be relied upon.

Environment Canada has considered each of the aquatic systems potentially impacted by the Project, focussing on the lakes and Taseko River. The sensitivities of each system to potential impacts on water quality are noted and the implications of identified uncertainties highlighted. Specific recommendations are offered in cases where an improved understanding of potential impacts would assist in informing whether the mitigation measures and monitoring programs as proposed are adequately protective of water quality.

2.2.1 Fish Lake

In the EIS (CEAR #129), the Proponent asserts that the Project as proposed would preserve Fish Lake with nutrient, metal and sulphate concentrations in the lake considered as valued ecosystem components (Table 2.7.2.4B-4 of the EIS, CEAR #129). In this regard, predicted changes in these parameters are important determinants of impact significance and the need for mitigation and monitoring. The Proponent's water quality predictions for selected parameters (Table 2.7.2.4B-20 of the EIS and Appendix 2.7.2.4B-G Table A-4, CEAR #129) are presented in Figure 2.1.

Figure 2.1: Proponent's predictions for changes in water quality in Fish Lake. The dotted portions of the lines indicate time periods over which concentrations would be above the CWQG. For copper, for which the CWQG varies with the hardness of the water, a hardness of 100 mg/L was assumed. For sulphate, there is no CWQG, so the dotted portion indicates the time period over which concentrations would be above the BC water quality guideline.



The Proponent predicts that changes in concentrations of many parameters over a 100 year period will be relatively small, particularly compared to those predicted changes for Wasp Lake and Big Onion Lake. Predicted trends for selenium and sulphate are notable exceptions. Over the project life, the Proponent predicts that selenium concentrations in Fish Lake would increase by a greater percentage than increases in Wasp Lake and Big Onion Lake. While the predicted percent increases in sulphate would be smaller than those predicted in Wasp Lake and Big Onion Lake, they are much larger than the predicted percent increases for other parameters in Fish Lake. It is also notable that the Proponent predicts mercury to decrease during mine operations before increasing during closure but still remaining below baseline.

Overall, the Proponent's modelling suggests water quality in Fish Lake may be marginal for the protection of aquatic life, based on a comparison to the CWQG. Predicted copper, mercury, iron, and selenium concentrations are all similar to the CWQG. While receiving water quality guidelines incorporate a safety factor, additive or synergistic effects of compounds in a mixture are usually not considered. A situation in which several compounds are at or near guidelines presents some uncertainty regarding potential toxic effects.

While available information on the stochastic model used for predicting changes in Fish Lake water quality is limited, Environment Canada is concerned that the Proponent may have underestimated the potential impacts of the Project. This concern is based on three factors which introduce uncertainty to the Proponent's water quality predictions:

- the potential underestimation of seepage from the TSF by approximately one order of magnitude as identified by Natural Resources Canada (NRCan) in CEAR #587;
- potential for impacts on water quality associated with the Proponent's proposal to recirculate water within the Fish Lake / Upper Fish Creek system, including uncertainty regarding how this recirculation was taken into account in the modeling; and
- the Proponent's contingency plan for water treatment.

Potential Impacts of Lake Recirculation

The Proponent proposes to pump Fish Lake outflows back to the inlet channels of Upper Fish Creek, below the main embankment of the TSF. This process would begin during mine construction and continue through operations, closure and post-closure, for a period of at least 100 years (Table B4, Appendix 2.7.2.4A-B, CEAR #129). The main intent of this action is to preserve inlet flows for fish spawning and to prevent Fish Lake hydraulic residency time from becoming too long. A longer hydraulic residency time may have implications for lake stratification, temperature, dissolved oxygen, sedimentation and sediment quality, benthic invertebrate community changes, fish food web changes, and lake eutrophication.

The Proponent asserts that recirculation will effectively preserve Fish Lake water quality, but does not describe or cite case studies where mitigation of this kind has been successful. In SIR Response #15/19/25/49 (CEAR #494), specifically 49(d), the Proponent states it is not aware of any wilderness lakes that have been subjected to a recirculation process exactly like that being proposed for Fish Lake.

As there are few, if any, examples of lake recirculation at the scale proposed by the Proponent, Environment Canada has limited experience or knowledge on the subject. The Department undertook a literature review to gain a better understanding of this mitigation technique.

The Department's review revealed an extensive literature on recirculation in aquaculture systems, but very few of the systems described are lake-sized or start from natural conditions. This literature review also indicated that there are risks and uncertainties with lake recirculation technology.

In broad terms, Fish Lake recirculation as planned by the Proponent would replace lost up-gradient runoff by returning lake outflow to inlet streams. Some runoff from the (now smaller) Fish Lake catchment area, supplemented by clean water diverted from above the TSF, would provide new water to the system, but this only provides about 5% of the inputs for Fish Lake (almost 700,000 m^3/year compared to total inputs of over 12,000,000 m^3/year) and would be largely balanced against evaporation losses (almost 550,000 m^3/year) (Appendix A of Appendix 2.7.2.4A-B, CEAR #129). In comparison, almost 6,000,000 m^3/year of water from Fish Lake would be recirculated into Upper Fish Creek and Fish Lake Tributary 1.

The main goal of lake recirculation is to preserve spawning habitat in inlet streams, but the Proponent is anticipating the scheme will also protect water quality and biological productivity, especially that of Rainbow trout, in Fish Lake. In some respects, Fish Lake would be transformed into a recirculating aquaculture system.

Environment Canada's literature review indicated that some techniques used in recirculating aquaculture systems are also used to restore degraded lakes or to manage highly eutrophic lakes. Very generally, the main issue that managers face in recirculating aquaculture systems is nutrient management, specifically nitrogen, phosphorus, and sulphur compounds. In particular, in recirculating aquatic food rearing systems, toxic nitrogen species (i.e., nitrite, unionized ammonia) may accumulate. Salts also accumulate in closed systems with evaporative losses.

The preliminary literature search suggests that the state of the art in managing recirculating aquaculture systems has advanced beyond simply recirculating water from outlet to inlet. Liu et al., (2010), for example, describe an ecologically engineered system of connected ponds and constructed under-flow wetlands designed to manage nutrient loadings. In Environment Canada's opinion, it does not appear that the Proponent has fully evaluated or described the most appropriate method of managing Fish Lake to minimize water quality impacts.

The Food and Agriculture Organization of the United Nations organized a workshop on "Building an ecosystem approach to aquaculture" at Universitat de les Illes Balears, Spain, in May of 2007 (Soto et al., 2008). Also, McQueen (1998) summarized freshwater food web biomanipulation as a tool for water quality improvement. These examples are cited to highlight the extensive literature on potential problems, issues, and management options regarding aquaculture systems as they may relate to the proposed recirculation system put forward by the Proponent.

In summary, Environment Canada is concerned that the recirculation mitigation measure proposed to manage water quality and the biological productivity of Fish Lake is unproven at this scale, and may require additional intervention to ensure success. The high level of uncertainty regarding the Proponent's proposed recirculation scheme is a particular concern given the stated goal of preserving Fish Lake.

> ***Recommendation 2: If the proposed recirculation scheme is to be considered further, the Proponent should first conduct peer-reviewed research into the potential implications of recirculating water within Fish Lake and its tributaries, using validated predictions of tailings storage facility seepage inputs. The research results should be carefully examined before recirculation is factored into management plans intended to ensure that the quality of water in Fish Lake and its tributaries is protected.***

Environment Canada understands that the written submission of the Department of Fisheries and Oceans includes an assessment of the proposed recirculation scheme. Environment Canada further understands that the Department of Fisheries and Oceans has identified risks associated with the effectiveness of the mitigation, and is of the view that there is substantial uncertainty in the long term regarding fish habitat values and ecosystem functioning.

Contingency Plan for Water Treatment

The Proponent acknowledges that its predictions for Fish Lake indicate water quality would be marginal and that mitigation is likely to be needed. In the Proponent's response to SIR 15/19/25/49b (CEAR #494), two technologies are proposed to achieve this: nano-filtration to control dissolved metal levels, and oxygenation to control epibenthic dissolved oxygen and phosphorus levels. The scale and cost of these mitigation schemes is of concern, particularly given the large volumes of water and the long timeframes involved.

Gupta and Gupta (2012) studied the effect of artificial de-stratification by hypolimnetic aeration on a eutrophic lake in India. While ultimately successful, they found that the whole water column became anoxic during the initial phase of aeration, and that the concentrations of ammonia-nitrogen, phosphate-phosphorus, and nitrite-nitrogen increased during seven months of aeration. In Environment Canada's opinion, shifts in dissolved oxygen and nutrient concentrations could have unforeseen effects in complex ecosystems.

With respect to alum treatment which is identified as a possible remedy or mitigation measure (pdf page 16 of Supplemental Information Request 15/19/25/49, CEAR #494), Nogaro et al., (2013) indicate that the ecological effects of alum on coupled metal and nutrient cycling are not well known. Their results suggest that alum treatment increased dissolved aluminium, sulphate, and nitrous oxide (N_2O) concentrations in surface and pore waters. They state that increased aluminium and sulphate may potentially feedback to alter benthic community dynamics. While these results pertain to the unintended ecological consequences of alum treatments in hypereutrophic freshwater ecosystems which they studied, the results suggest an element of risk and need for caution in alum treatments of less eutrophic systems such as a transformed Fish Lake. Further, de Vicente et al., (2008) caution that use of aluminium to remove phosphate from lake water is not a straight-forward process.

> ***Recommendation 3: If the proposed use of nano-filtration, oygenation and alum treatment technologies is to be considered further, the Proponent should first conduct peer-reviewed research into potential implications for local environmental conditions. The results of this research should be examined carefully before the potential role of these technologies is factored into project management plans to address water quality issues.***

2.2.2 Other Water Bodies

2.2.2.1 Lower Fish Creek

In the Department's review of the initial Prosperity project, it was concluded that there were unlikely to be deleterious effects on water quality downstream of Fish Lake if the Proponent implemented the waste and water management practices identified. This conclusion remains valid for the current proposal with the Proponent's continued commitment to install and operate a water treatment plant at the outlet of Pit Lake if water quality is not adequate for direct discharge to Fish Creek. The Proponent has committed to water treatment of Pit Lake and tailings storage facility water, if unsuitable for discharge, in its response to the Panel's IR 15a and 15c (CEAR #400, pages 15-2 and 15-4).

2.2.2.2 Little Onion Lake

The Proponent assumes (CEAR #129, Appendix 2.7.2.4B-G, page 7) that "TSF pore water does not contribute to groundwater base flow into Little Onion Lake." The Proponent states (CEAR #129, Appendix 2.7.2.4B-G, page 7) that "Most parameters change slightly at Year 20, when groundwater flow rates change, but do not cross any guideline thresholds." Yet, for most of the parameters listed in Table 2.7.2.4B-20 of CEAR #129 (i.e., arsenic, beryllium, cadmium, copper, fluoride, mercury, selenium, silver) there is no predicted change over the 100 years considered. Increases for aluminum, iron, and sulphate are extremely small.

Little Onion Lake is upstream of Big Onion Lake and only about 1500 m down-gradient of the proposed TSF west embankment. The headwaters of one of the tributary streams of Little Onion Lake are also very close to the proposed TSF west embankment. Given the proximity of Little Onion Lake to the proposed TSF location, the assumption that "TSF pore water does not contribute to groundwater base flow into Little Onion Lake" is questioned.

2.2.2.3 Big Onion Lake

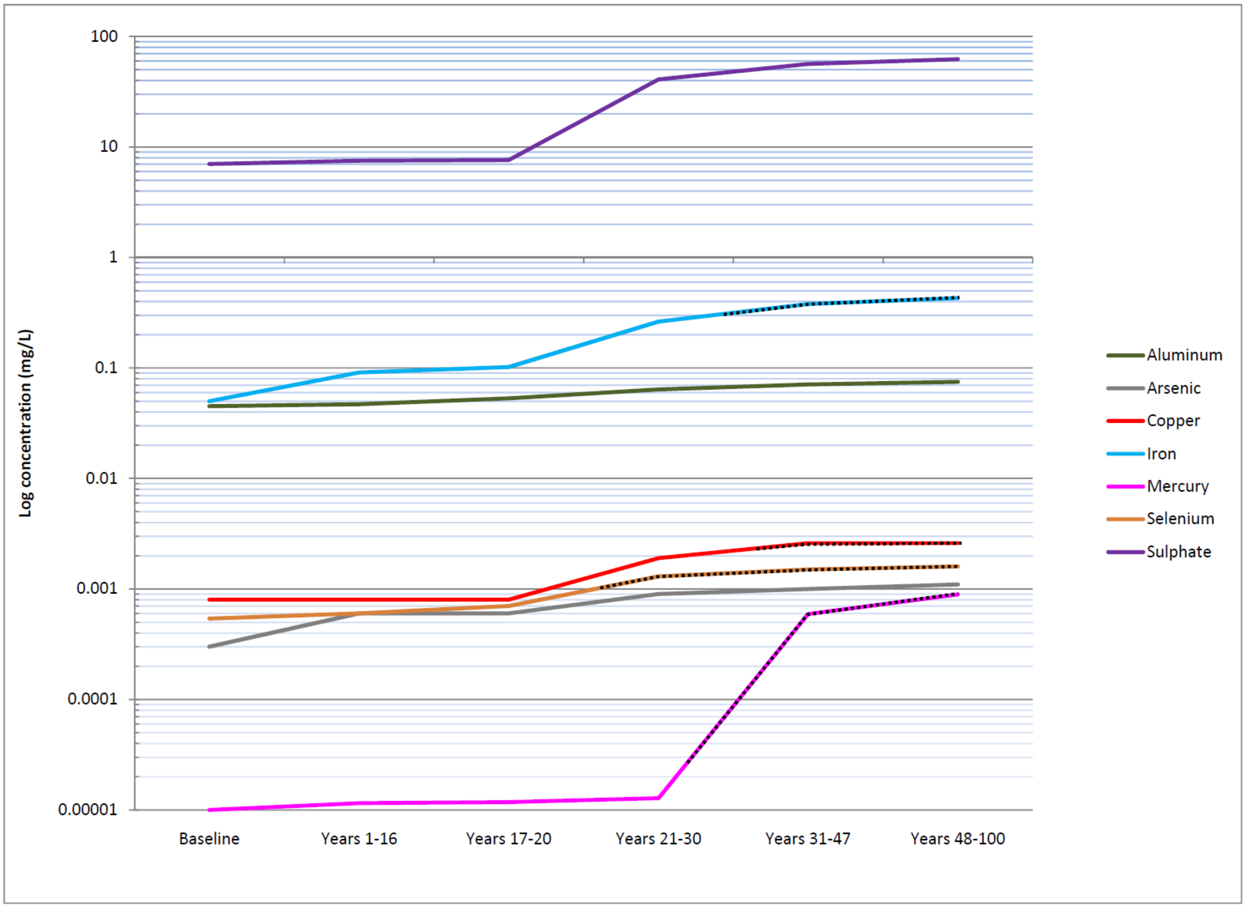
The potential for the Project to have impacts on the water quality in Big Onion Lake, particularly with respect to mercury and selenium, is a concern. The main source of contaminants, including selenium, would be seepage from the TSF.

While selenium is an essential micro-nutrient at trace levels, it may cause reproductive failure or serious birth defects leading to high mortality rates in offspring of female fish and some amphibians and waterfowl exposed to selenium in the environment and the food chain. The difference between essential concentrations and concentrations at which such effects can occur can be quite small, depending on the species and the exposure environment. Sensitivities to elevated selenium concentrations tend to be higher in confined water bodies (e.g., small lakes) than in flowing water bodies (e.g., rivers and creeks). Selenium cannot be effectively managed using conventional methods for the treatment of mine effluent, such as pH control. Newer, more innovative treatment methods are required, such as those described in the report authored by

BioteQ Environment Technologies, and submitted by the Proponent in response to SIR # 15/19/25/49 (CEAR #510).

The Proponent's water quality predictions for selected parameters (Table 2.7.2.4B-20 in the EIS, CEAR #129) are presented in Figure 2.2.

Figure 2.2: Proponent's predictions for changes in water quality in Big Onion Lake. The dotted portions of the lines indicate the time period over which concentrations would be above the CWQG. For copper, for which the CWQG varies with the hardness of the water, a hardness of 100 mg/L was assumed.



The Proponent predicts that concentrations of most parameters would increase, often by orders of magnitude, if the Project proceeds. Most of these parameters would remain below the CWQG.

While mercury would remain below the CWQG of 0.0000026 mg/L during the operational period, it would begin exceeding the CWQG by an order of magnitude during closure, reaching a level about 33 times higher. Environment Canada is concerned that methyl mercury concentrations may be similarly elevated and may bioaccumulate in fish.

Selenium would begin exceeding the CWQG of 0.001 mg/L by a small amount during operations and would continue to increase post-closure. The Proponent does not predict that concentrations in Big Onion Lake would exceed the British Columbia Water Quality Objective for selenium of 0.002 mg/L. Environment Canada is concerned that increased concentrations of selenium in the water column may result in increased concentrations of selenium in the food chain. Big Onion Lake is a small water body, and therefore, an increase in selenium in the food chain could lead to reproductive effects on the fish, amphibians and waterfowl found in that environment.

Environment Canada notes that the Proponent's predictions are based on the following assumptions (Appendix 2.7.2.4B-G, page 14, CEAR #129):

- Big Onion Lake would be affected by the Project at Year 20, when groundwater flow rates would change as a result of closure activities;
- surface water discharge from the south seepage pond would enter the lake at Year 21; and
- at Year 50, TSF pore water groundwater would reach the lake.

These assumptions appear to be inconsistent with Appendix A of Appendix 2.7.2.4 A-B (CEAR #129) which states the approximate inputs to Big Onion Lake of seepage from the TSF would be the following:

- Year 1 - 1%
- Year 5 - 7.5%
- Year 10 - 15%
- Year 16 - 22%
- Year 20 - 16%
- Years 30, 46 & 66 - 14%

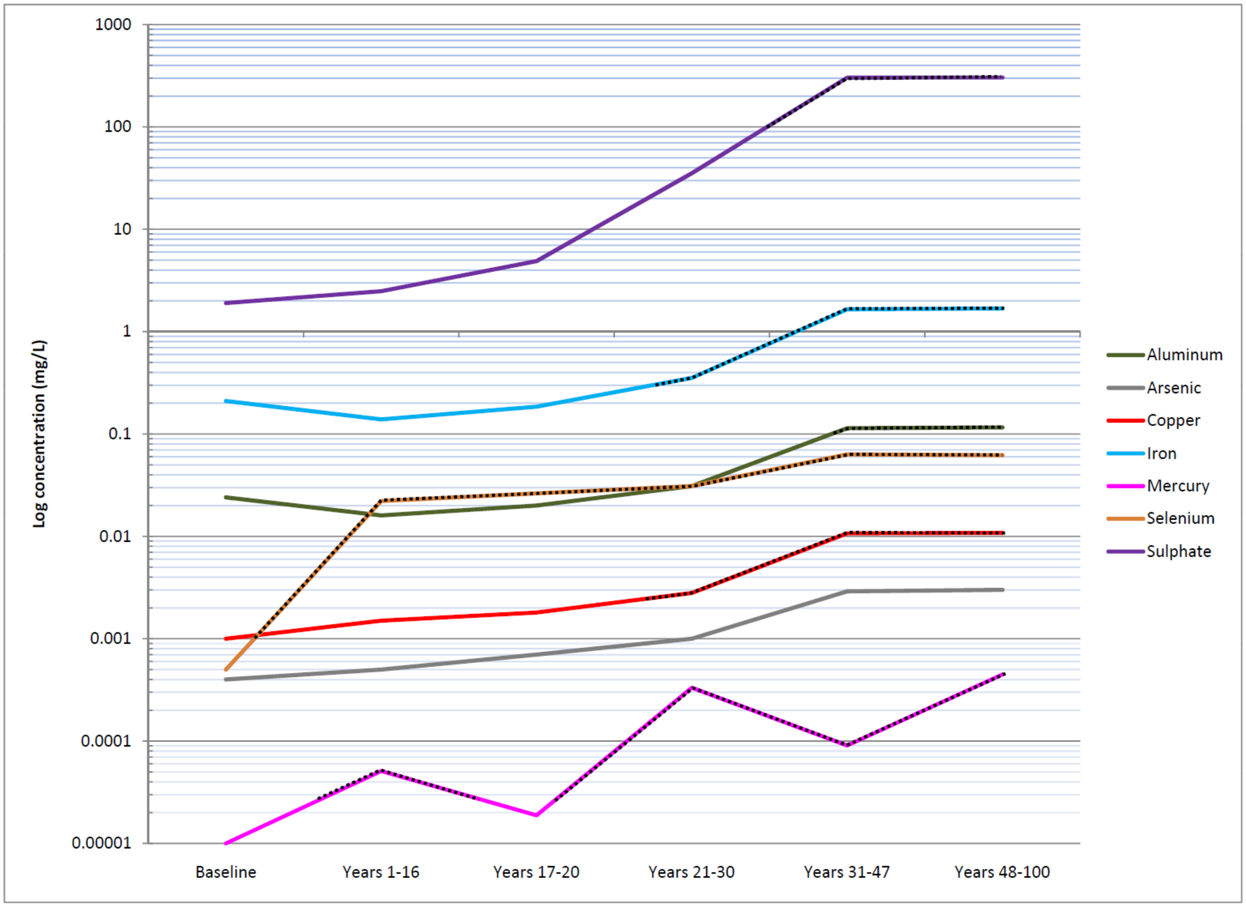
This apparent discrepancy diminishes confidence in the Proponent's predictions regarding Big Onion Lake water quality. Environment Canada is concerned that the Proponent may be underestimating the potential impacts.

Environment Canada also notes NRCan statements regarding the Proponent's estimates of TSF seepage quantities (CEAR #587). NRCan believes that the Proponent may have underestimated the amount of seepage that would be released from the TSF by approximately one order of magnitude (CEAR #587). If the amount of seepage has been underestimated, then the amount of seepage from the TSF reaching Big Onion Lake could be much greater than the amount predicted by the Proponent in Appendix A of Appendix 2.7.2.4 A-B (CEAR #129), with a commensurate increase in contaminant loadings associated with the seepage.

2.2.2.4 Wasp Lake

The Project would locate the TSF much closer to Wasp Lake than the initial Prosperity proposal. In addition, the Project eliminates the earlier planned Prosperity Lake which would have likely acted as buffer for Wasp Lake water quality. The Proponent's water quality predictions for selected parameters in Wasp Lake (Table 2.7.2.4B-20 and Appendix 2.7.2.4B-G Table A-4, CEAR #129) are presented in Figure 2.3.

Figure 2.3: Proponent's predictions for changes in water quality in Wasp Lake. The dotted portions of the lines indicate time periods over which concentrations would be above the CWQG. For copper, for which the CWQG varies with the hardness of the water, a hardness of 100 mg/L was assumed. For sulphate, there is no CWQG, so the dotted portion indicates the time period over which concentrations would be above the BC water quality guideline.



The Proponent predicts that concentrations of most parameters would increase in Wasp Lake if the Project proceeds as proposed, and in many cases these increases would be by orders of magnitude (Table 2.7.2.4B-20, CEAR #129). In particular, selenium would increase by about two orders of magnitude and mercury would increase by almost as much. Elevated selenium levels in the order of 0.01 mg/L have been demonstrated to have eliminated fish species in some lakes (Skorupka, J.P. 1998).

The Proponent predicts that both mercury and selenium would begin exceeding the CWQG during early mine operations and would be more than one order of magnitude higher than the

CWQG post-closure. Sulphate, fluoride, cadmium, copper, iron, silver, aluminium, manganese, and thallium would all exceed the CWQG by Year 21. Concentrations of these parameters would decrease after Year 31, but remain over the CWQG and the British Columbia Water Quality Guidelines, except for thallium.

Environment Canada notes a discrepancy between the Proponent's inputs to the water quality model described in Appendix 2.7.2.4B-G (CEAR #129) and the predicted inputs to Wasp Lake from TSF seepage described in Appendix 2.7.2.4 A-B (Water Management Report, CEAR #129). This apparent discrepancy diminishes confidence in the Proponent's predictions regarding Wasp Lake water quality. In particular, since the Water Management Report states that seepage from the TSF would reach Wasp Lake sooner than assumed in the water quality model, and at higher proportions than assumed in the water quality model (except for the period from about 66 to 100 years), Environment Canada is concerned that the Proponent may be underestimating impacts.

In addition, NRCan believes that the Proponent has underestimated seepage quantities that would be released from the TSF by approximately one order of magnitude (CEAR #587). If the amount of seepage has been underestimated, then the amount of seepage (and contaminants in the seepage) that enters Wasp Lake could be greater than the amount predicted by the Proponent in its Water Management Report (Appendix 2.7.2.4 A-B, CEAR #129).

The Proponent states on page 693 of the EIS (CEAR #129) that "monitoring programs under MMER will not be required during the operations phase, given there are no plans for discharge of effluent until post-closure". However, the MMER definition of effluent includes seepage. In determining if a mine has exceeded the threshold specified in the MMER of depositing effluent at a rate exceeding 50 m^3/day, seepage must be taken into account.

As set out in Appendix A of Appendix 2.7.2.4A-B, the Proponent expects seepage from the TSF to Wasp Lake to be approximately 130 m^3/day by Year 5. Seepage from the TSF to Big Onion Lake would be approximately 340 m^3/day by Year 5. In fact, according to Appendix A, the combined seepage deposits into these lakes could exceed 50 m^3/day as soon as Year 1.

Thus, based on the information provided in Appendix 2.7.2.4A-B, if the Project is developed as proposed, then the mine would deposit effluent subject to the MMER during the mine operation phase, contrary to EIS claims.

Notwithstanding that the mine would deposit effluent subject to the MMER during the mine operation phase, Environment Canada also notes that deposits of substances not listed in Schedule 4 of the MMER, such as selenium and mercury, would be subject to subsection 36(3) of the *Fisheries Act* which prohibits the deposit of deleterious substances.

2.2.2.5 Taseko River

The Taseko River is about 6 km downstream from Wasp Lake by way of Beece Creek, and less than 1 km downstream from Big Onion Lake. The Proponent has predicted the water quality in the Taseko River at points downstream from its confluences with Beece Creek (the creek which drains Big Onion Lake) and Fish Creek. For the points downstream from Beece Creek and Big

Onion Lake, the Proponent predicts (CEAR #209, Appendix 2.7.2.4B-G, page 16) that mercury concentrations would increase due to seepage into Wasp Lake, but would not exceed the CWQG.

Environment Canada is concerned that the Proponent may have underestimated the potential impacts of the Project on water quality in Wasp Lake, Little Onion Lake and Big Onion Lake. Given that these lakes drain to the Taseko River, Environment Canada is also concerned that the Proponent may have underestimated impacts on water quality in the Taseko River.

> ***Recommendation 4: The Proponent should reaffirm predicted impacts on all water bodies influenced by the Project to ensure adequacy of mitigation and monitoring measures. Particular attention should be given to selenium and mercury concentrations, any discrepancies in water quality modelling inputs (for Big Onion Lake and Wasp Lake), tailings storage facility seepage rates and likely application of the Metal Mining Effluent Regulations.***

References:

de Vicente, I., Jensen, H. S., & Andersen, F. Ø. 2008. Factors affecting phosphate adsorption to aluminum in lake water: Implications for lake restoration. *Science of the total environment*, *389*(1), 29-36.

Gupta, R., & Gupta, P. K. 2012. The effect of artificial de-stratification on the water quality of a freshwater high altitude lake. *Journal of Ecophysiology & Occupational Health*, *12*(3and4), 27-41.

Liu, X., Liu, Z., Xu, H., Gu, Z., & Zhu, H. 2010. Ecological engineering water recirculating ponds aquaculture system. *Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering, 26*(11), 237-244.

McQueen, D. J. 1998. Freshwater food web biomanipulation: a powerful tool for water quality improvement, but maintenance is required. *Lakes & Reservoirs: Research & Management*, *3*(2), 83-94.

Nogaro, G., Burgin, A. J., Schoepfer, V. A., Konkler, M. J., Bowman, K. L., & Hammerschmidt, C. R. 2013. Aluminum sulfate (alum) application interactions with coupled metal and nutrient cycling in a hypereutrophic lake ecosystem. *Environmental Pollution*, *176*, 267-274.

Skorupka, J.P. 1998 Selenium poisoning of fish and wildlife in nature: Lessons from twelve real world examples. In Frankenberger, W.T. and R.A. Engberg, editors. Environmental Chemistry of Selenium. New York, NY (US): Marcel Dekker. P315-418

Soto, D., Aguilar-Manjarrez, J., & Hishamunda, N. 2008. Building an Ecosystem Approach to Aquaculture. FAO/Universitat de les Illes Balears Expert Workshop, 7–11 May 2007, Palma de Mallorca, Spain. *FAO Fisheries and Aquaculture Proceeding, No. 14*.

3.0 Surface Water Quantity

3.1 Water Balance Assessment

3.1.1 Context

Environment Canada has expertise on hydrological conditions, and specifically, water balance considerations, which are applicable to the Project. Water balance is a model based on the principles of conservation of mass. This type of model is used to track flow rates, storage volumes, and flow regimes at a mine. Proper characterization of hydrological conditions at the project site merits particular attention given implications for the management of possible water shortages and excess water during the operating life of the mine. Such water deficits and surpluses could have potential adverse environmental effects. The anticipated ability of the tailing storage facility (TSF) to remain saturated during post-closure is also tied to hydrological conditions.

3.1.2 Analysis and Recommendations

Water Balance Assessment and Use of Hydrometeorological Parameters

The water balance assessment is an essential part of water management plan development. It is used to establish the normal operating TSF pond volume (i.e., the maximum and minimum pond levels to be maintained), to assess the risk of having excess water or a shortage of water in the TSF during the mine operating period, and to assess the self-sustainability of a post-closure plan.

Precipitation is an important source of freshwater considered in the water balance assessment at the mine site and is characterized as 1) direct precipitation over lakes and other wet areas and 2) runoff resulting from precipitation over land surfaces. Estimating long-term mean annual precipitation and runoff values as well as characterizing their variability is important in adequately quantifying the amount of water anticipated at the mine site through all project phases.

Uncertainty in estimating hydrometeorological parameters representative of local conditions was recognized by the Proponent in planning the initial Prosperity project (August 2, 2009 letter from Knight Piesold to Taseko Mines Limited, CEAR #1078) based on two categories of factors. The first category of uncertainty related to the scarcity of regional data, challenging site data collection conditions, and localized climatic influences such as orographic effects (i.e., rapidly rising air forced up by mountains and creating precipitation). These uncertainty factors were addressed by the Proponent for the initial Prosperity project by conducting the operational water balance for different scenarios using upper and lower bounds of mean hydrometeorological parameter estimates.

The second category of uncertainty factors was related to the natural climate variability from year to year and month to month. To account for the temporal climatic variability, the operational water balance for the initial Prosperity project was conducted using statistical distribution of hydrometeorological parameters and Monte Carlo simulations which enabled possible combinations of conditions. In the supplementary information phase of the initial Prosperity project review (November 6, 2009 letter from Knight Piesold to Taseko Mines Limited, CEAR # 1311), the Proponent used coefficients of variation derived from Water Survey of Canada regional stations which reflected the variability observed locally over a 5 year period. The water balance assessment conducted for the New Prosperity project uses the same statistical approach and variability parameters which had been used for the initial Prosperity project. Environment Canada views this approach as reasonable.

In relation to the first category of uncertainty factors, however, the EIS for the New Prosperity project (CEAR #129) and supporting appendices describe a simplified operational water balance method. In this simplified method, the previously used water balance scenarios involving upper and lower bound estimates of mean precipitation and runoff parameters appear to have been abandoned. The EIS includes little discussion on uncertainty associated with challenges in estimating the long-term means of these hydrometeorological parameters. Instead, the Proponent has adopted a new calibrated baseline watershed model (Appendix 2.6.1.4B-A, CEAR #129), which is used to develop an understanding of hydrologic processes within the Fish Creek watershed. The Proponent claims this model will <u>confirm</u> [emphasis added] the estimates of mean annual precipitation for the Project (CEAR #129, Page 271, Section 2.6, Existing Environment – Overview of Baseline Conditions). Environment Canada questions this claim and believes that the watershed model information provided in the EIS does not provide evidence that would reduce uncertainty associated with estimates of long-term mean annual precipitation and mean annual unit runoff. Environment Canada views the development of a hydrological model as a good practice to understand hydrological processes within a watershed and such a model is a useful tool to characterize hydrological conditions and fluxes needed to inform water management infrastructure design. However, in Environment Canada's opinion the use of the model is not a substitute for a sensitivity analysis.

In addition to the challenges related to accurately estimating long-term mean hydrometeorological conditions at the site, other sources of uncertainty are also at play. Climate change could affect mean hydrologic response as well as its variability particularly during the post-closure period. The Mountain Pine Beetle epidemic, which tends to increase water yield in a watershed, is another example of how assessing hydrologic response based on past observations may not appropriately predict future conditions.

The Proponent has considered scenarios of extreme water availability conditions including excessive water conditions in the TSF (CEAR #129, Section 2.7.6. Accidents and Malfunctions, page 1360) and the extreme dry conditions (CEAR #129, page 1393) but is not clear on the probability of occurrence of such events. In the context of uncertainties described above and not knowing whether the water balance results (such as the probability of having water shortages or excess water in the TSF during operations) are sensitive to the input hydrometeorological parameters, it would be prudent to view the potential occurrence of scenarios involving extreme water availability conditions during all Project phases as being possible.

Water Balance Assessment during Project Operational Phase and On-site Monitoring of Hydrometeorological Parameters

The Proponent states that during the mine operational phase there is "a wide water surplus" (CEAR #129, Appendix 2.2.4-D - TSF Design, Section 6.2, page 22), with the TSF anticipated to function with a water surplus under average conditions. The potential for excessive water in the TSF to result in contaminated water being discharged to the environment has been considered by the Proponent. One of the mitigative measures proposed is reported in the EIS (CEAR #129, Section 2.7, page 1360) as "conducting annual reviews by an accredited consultant of tailings hydrological model, operation/construction of the tailings complex, and water balances based on site collected meteorological data". Environment Canada views this measure as important to minimize the risk of excessive water in the TSF but notes that the monitoring program for surface water and hydrogeology proposed in the EIS (Section 2.8.3, page 1495, 2nd paragraph, CEAR #129) has no hydrometeorological component.

The proposed monitoring plan should include provisions for gathering meteorological information such as precipitation, temperature and other parameters needed to estimate evaporation. The monitoring plan should also include provisions for measuring streamflows, as well as lake and pond levels. Such a plan should facilitate verification of predicted environmental conditions and help ensure the TSF is managed to minimize the risk of adverse environmental effects.

> ***Recommendation 5: The Proponent should measure hydrometeorological conditions onsite, as well as review the watershed model periodically to ensure the water management plan continues to reflect the best available information. Environment Canada specifically recommends estimating evaporation using the Penman equation, which would require the measurement of net radiation (over the water), air temperature, wind speed, vapour pressure, and water column temperature.***

Water Balance at Post-Closure Phase

Maintaining the potentially acid generating (PAG) waste submerged in the TSF in perpetuity is among the Proponent's proposed measures for preventing acid rock drainage. In the EIS (CEAR #129, page 618), the Proponent states that the PAG waste rock will become completely submerged at closure and post-closure as illustrated by Figure 2.7.2.4A-12. The Proponent asserts that the water balance results presented in the EIS represent a reasonably large range of anticipated climatic conditions. On page 1444 of the EIS (CEAR #129), the Proponent estimates an annual post-closure water surplus of 6.6 Mm^3.

The Proponent states that loss of water through TSF seepage will vary throughout the life of the Project, and is predicted to be 0 L/s at Year 80, or 60 years after mine closure (page 36, Appendix 2.7.2.4 A-B, CEAR #129). Environment Canada relies on the expertise of NRCan to verify this seepage rate. In a NRCan submission to the Panel (pdf page 41 of CEAR #648), seepage rates are estimated as being as high as 8,650 m^3/day (100 L/s). This represents an annual loss of 3.2 Mm^3 or approximately half of the annual water surplus estimated by the Proponent. It is likely that if the seepage rate was higher during post-closure, drier years would result in a net water deficit. However, the Proponent is proposing a design that includes a substantial supernatant pond with storage capacity of up to 54 Mm^3 (page 30, Appendix 2.7.2.4 A-B, CEAR #129), which should withstand water deficits in the drier years.

Environment Canada views the supernatant pond in post-closure as a reasonable approach to supplementing water to the TSF in times of deficit, but cannot infer conclusions about the state of saturation of the material underlying the TSF. Environment Canada advises that good practice would entail reviewing the proposed supernatant pond size at the detailed design phase. At that point, the Proponent would likely have an improved understanding of hydrologic conditions based on monitoring during mine operations and an increased knowledge of potential climate change effects.

> ***Recommendation 6: The Proponent should take steps to ensure detailed design of the supernatant pond reflects a consideration of the best available understanding of hydrological conditions on the site based on operational phase monitoring programs and up-to-date climate change projections.***

3.2 Climate Change

3.2.1 Context

Environment Canada has expertise in climate and climate change science. Climate change considerations are relevant to the Project because future climate over the closure and post-closure period has been projected to be different from the current and past climate for the area; implications of this change in climate on the Project should be considered.

3.2.2 Analysis and Recommendations

Environment Canada has reviewed the climate change information presented in Appendix 2.7.2.4 A-D (CEAR 129 "Climate Change Assessment") and relevant sections of the EIS (CEAR #129) as well as IR 18 (CEAR #400) and SIR 18 (CEAR #494) which relate to the consideration of impacts of potential future climate change on lake productivity.

Environment Canada agrees with the Proponent's assessment that the range of climate due to natural variability in the observed climate record will likely be sufficient to characterize the range of climate over the construction and operational phases of the Project (~next 20 years). However, Environment Canada has identified several concerns with (1) the Proponent's assessment of future climate change (i.e., beyond mine operations), and (2) the Proponent's evaluation of the observed climate record which is highlighted in the Proponent's response to IR18a (page 18-3, CEAR #400) as cited below:

- "A review of historical climate data for the past 100 years would indicate that there is no basis for assuming any material change in temperature and precipitation in the region within the time frame of project development and closure".
- "Based on an analysis of regional temperature, precipitation and streamflow data, trends of regional stations indicate that changes in precipitation and temperature will not cause substantial changes to surface water streamflow volumes outside the natural variability of systems in British Columbia".
- "Climate change could potentially have effects to the surface water stream flow with an increase in variability. However, these potential effects have already been accounted for in the estimates associated with surface water stream flow volumes by including the variability that has been seen over the past several decades."

(1) Assessment of Future Climate Changes

In the Climate Change Appendix (CEAR #129, Appendix 2.7.2.4 A-D), the Proponent provides an assessment of past trends in precipitation and temperature data[1] from the Barkerville climate station and a streamflow record from the Chilko River. The Proponent reports a limited number of statistically significant trends in some of the climate variables it examined and indicates that, where significant, the trends are not very strong. The Proponent concludes that climate in the region has been "consistent" and that there is no clear evidence of climate change effects on the streamflow records examined.

In the first two referenced quotations above, the Proponent appears to use trends and variations in the observed climate record as a basis to make inferences about future climate change in the region following mine operations. In general, however, observed changes in the past cannot be used to project climate in the future without clear scientific evidence. The Appendix does not

[1] It is not clear if the climate records used are the most suitable for use in trend analysis. Climate records that have been homogenized to remove non-climate related changes are available from Environment Canada.

demonstrate convincingly that changes in precipitation and temperature will not alter surface water streamflow volumes in the future (i.e. beyond mine operations). Future climate over the closure and post-closure periods would likely be beyond the range of variability observed over the past few decades. Projections indicate that changes in the frequency and magnitude of extremes are likely for North America over the closure and post-closure period; these include an intensification of warm extremes and extreme precipitation events and a moderation of cold extremes (IPCC, 2012).

In its responses to IR 18 (CEAR #400, page 18-7) taking into account the Proponent's responses to IR 18b) and SIR 18 (CEAR #494, Table 1 on page 18-12 and related text on page 18-9), the Proponent appears to have extended linear trends in observed temperature records (from Barkerville and Williams Lake) to project future temperature changes for the area. There is no scientific basis to support the simple extrapolation of a linear trend from an observed record to 'predict' future climate. The climate system is not necessarily linear and trends and variations in past climate records reflect both natural variability and human influences; the changes due to natural variability are not predictable beyond the short term.

In response to both of these issues, Environment Canada recommended that an ensemble of Climate Model projections (different models for a range of scenarios) be examined to assess the possible range of future climate change for the region. Information on potential future climate can be provided only from climate model simulations. In response to the Panel's request in SIR 18 (CEAR #494), the Proponent provided projections of annual and seasonal temperature and precipitation. The projections provided in Table 1 of SIR 18 (CEAR #494) are acceptable to Environment Canada. However, the consideration of possible impacts of climate change should be based on the range of possible changes from the ensemble of projections not the ensemble mean. This approach ensures that the range of possible impacts and the uncertainty in projections is more adequately considered.

> ***Recommendation 7: The Proponent is encouraged to base the evaluation of possible impacts of climate change on the range of possible changes rather than the mean of the ensemble of Climate Model projections.***

Environment Canada notes that the Proponent could have provided more readily transparent documentation of the characteristics of the "climate change scenario" data used in the impacts table (Table 18-A1, SIR 18, CEAR #494) including information on the source (e.g., methods and data used) and time period of the climate change scenarios. For example, the Proponent documents an "Increased ice-free period for the lake" in Table 18A-1 but the literature cited indicates that values were based on available data from all northern rivers and lakes over the past 150 years rather than projected changes for Fish Lake as the Table captions suggest. This is not immediately apparent from Table 18A-1 and it should be recognized that the literature cited is based on historical trends rather than future climate change. Similarly, the projected values used from Dawson et al., (2008) in Table 1 (page 18-12) are not specified. Dawson et al., (2008) presented ensemble results for 15 models (2 scenarios) and a separate analysis using the Canadian Regional Climate Model with boundary conditions driven by CGCM3-A2, run 4. Documentation of such details is important to the value of impact predictions in supporting the development of project management plans and monitoring programs.

(2) Assessment of Regional Climate

It is Environment Canada's opinion that the Proponent does not demonstrate that the climate and hydrological trend analyses presented in Appendix 2.7.2.4 A-D (CEAR #129) and IR18 (CEAR #400) are representative of regional conditions. There is substantial variability in climate, particularly precipitation, in mountainous environments. All of the available long-term climate records are for locations some distance from the Project; the one or two records selected may or may not represent either the regional signal or variability at the site. Better assessment of trends in observed climate and hydroclimate variables could have been achieved by synthesizing the peer reviewed literature and/or reports. Regional records for this area do show considerable warming particularly in minimum temperatures in the winter and spring over the 20th century (e.g., Zhang et al., 2000; Dawson et al., 2008). The published literature also indicates that significant changes in hydrology have occurred in this region and further changes are projected for the future. These changes include earlier snowpack-driven peak discharge and decreased streamflow volume during summer months; e.g., Shrestha et al., 2012).

> ***Recommendation 8: The Proponent is encouraged to synthesize the peer-reviewed literature and/or reports to achieve a better assessment of trends in observed climate and hydroclimate variables.***

References:

Dawson, R., Werner, A.T. and Murdock, T.Q. 2008. *Preliminary Analysis of Climate Change in the Cariboo-Chilcotin Area of British Columbia. Pacific Climate Impacts Consortium*, University of Victoria, Victoria BC, 49 pp.

IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

Shrestha, R.R., Schnorbus, M.A., Werner, A.T. and Berland, A.J. 2012. Modelling spatial and temporal variability of hydrologic impacts of climate change in the Fraser River basin, British Columbia, Canada. *Hydrological Processes*, 26: 1840-1860.

Zhang, X., Vincent, L.A., Hogg, W.D. and Niitsoo, A. 2000. Temperature and precipitation trends in Canada during the 20th century. *Atmosphere-Ocean*, 38(3): 395-429.

4.0 Wildlife

4.1 Context

Environment Canada's mandate includes the protection of migratory birds and their habitat. Regulations made under the *Migratory Birds Convention Act, 1994* (MBCA) provide, *inter alia*, for the conservation of migratory birds and the protection of their nests and eggs. Section 6 of the *Migratory Birds Regulations* sets out prohibitions including those related to the disturbance, destruction, or taking of a nest, egg or nest shelter of a migratory bird. Prohibitions under section 6 also include the possession of a migratory bird, nest or egg, except under the authority of a permit for that purpose. Subsection 5.1 of the Act sets out prohibitions that include the deposition by a person or vessel of substances harmful to migratory birds in waters or areas frequented by migratory birds or in a place from which the substance may enter such waters or such an area.

In cooperation with the Department of Fisheries and Oceans and the Parks Canada Agency, Environment Canada is responsible for administering the *Species at Risk Act* (SARA). The purposes of the SARA are to prevent wildlife species from becoming extinct or extirpated, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened.

Section 79 of SARA pertains to situations where a person is required by a federal Act to ensure that an assessment of the environmental effects of a project is conducted. Subsection 79(1) requires every such person to notify the competent Minister(s) without delay if the project is likely to affect a listed wildlife species or its critical habitat. Subsection 79(2) of SARA requires that person to identify the adverse effects of the project on the listed wildlife species and its critical habitat; and, if the project is carried out, to ensure that measures are taken to avoid or lessen those adverse effects and to monitor them, and to ensure that such measures are taken in a way that is consistent with any applicable recovery strategy and action plans. Subsection 79(3) defines 'person' as including an association or organization, and an authority as defined in subsection 2(1) of the *Canadian Environmental Assessment Act, 2012*, and anybody that is set out in Schedule 3 to that Act.

The *Federal Policy on Wetland Conservation* (the Wetland Policy) is a government-wide policy that was approved by federal Cabinet and adopted in 1991. It was developed as a federal response to wetland decline in Canada and is driven by interdepartmental, intergovernmental and widespread public support for and interest in the conservation of Canadian wetlands. The ecological importance and economic value of wetlands stem from their ability to perform key ecological (hydrological, biochemical, habitat and climate) functions. Environment Canada has a lead role in providing technical advice to other federal entities responsible for implementing the Wetland Policy. See Appendix 1 for a summary brief of the Wetland Policy.

4.2 Analysis and Recommendations

Migratory Birds

Minimizing Risk

The inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs is known as incidental take. Currently, the *Migratory Birds Regulations* do not provide for authorizations or permits for the incidental take of migratory birds or their nests or eggs in the course of industrial or other activities. Searches for active migratory bird nests for the purpose of protecting such nests from project activities in complex habitats such as those the Project would overlap carries an associated risk of harm and is generally discouraged. Additional guidance and information regarding the issue of incidental take can be accessed at Environment Canada's website at http://www.ec.gc.ca/nature/default.asp?lang=En&n=2D16D723-1

> ***Recommendation 9: The Proponent is advised to avoid engaging in potentially destructive or disruptive activities. In order to achieve that objective, the Proponent is advised to develop and implement a management plan that effectively avoids or minimizes the risk of detrimental effects to migratory birds, their nests and eggs.***

Cumulative Effects

The Proponent presented a cumulative effects study (SIR 1, CEAR #494) that includes an assessment of potential effects on wildlife values such as migratory birds. For the Panel's consideration, Environment Canada offers the following observations on the Proponent's accounting of various stress sources such as forest harvesting that would act cumulatively with the Project.

> *Cumulative Effects and Forest Harvesting*
> On page 1-7 of SIR 1 (CEAR #494), the Proponent states that, '*forest harvesting have* [sic] *minimal effect on other non-timbered values*'. Environment Canada is of the view that there is quantifiable scientific evidence that forest harvesting and ranching can and does impact wildlife resources, including migratory birds and species at risk. For example, as noted in the Northern Rockies Bird Conservation Region Plan[2], the '*Loss and degradation of forest habitats (coniferous, mixed and riparian habitat classes) through logging and forest harvesting was identified as the most severe threat to priority bird species in this Bird Conservation Region. Impacted species are many, but include among the priority species Northern Saw-whet Owl, Barrow's Goldeneye, and Golden-crowned Kinglet'*. Similarly, from the same Plan, it is worth noting that the '*Threats from agricultural practices were also significant, stemming from loss or degradation of habitat*

[2] CW66-316/4-2012E-PDF

due to agricultural conversion or intensification (affecting Horned Lark, Short-eared Owl) or degradation due to overgrazing (affecting Sharp-tailed Grouse, Northern Harrier)'. Environment Canada raises this point to the Panel for information purposes.

Cumulative Effects and Mountain Pine Beetle (MPB)
On page 1-7 of SIR 1 (CEAR #494), the Proponent states that, '*MPB is a natural occurrence, the environmental effects of which should not be considered a result of human activities and development'*. Environment Canada is of the view that while MPB outbreaks are natural occurrences on the forest landscape, the scale of the current epidemic is unprecedented, due in large part to the volume of susceptible pine (of suitable age class) that arose from past forest management practices in combination with climate change. Environment Canada raises this point to the Panel for information purposes.

Cumulative Effects and Riparian Ecosystems
On page 1-14 of SIR 1 (CEAR #494), the Proponent states that, *'Future forest harvesting activities are not expected to have substantive cumulative interactions with riparian ecosystems, as provisions in the Forest Planning and Practices Regulation under the Forest and Range Practices Act are designed to avoid ecosystem loss and minimize indirect environmental effects to riparian areas'*. It is important to note that there is quantifiable evidence that ranching has and does impact riparian systems and associated migratory bird communities. Environment Canada raises this point to the Panel for information purposes.

Cumulative Effects and Grassland Ecosystems
On page 1-14 of SIR 1 (CEAR #494), the Proponent has not accounted for historical and ongoing impacts of ranching on grassland communities. While research to date has focused primarily on prairie habitats, some research has been, and is being, conducted on interior grasslands such as in the Chilcotin. To date, research suggests the effect of grazing on grassland birds have mixed outcomes. To generalize: low to moderate levels of grazing may not be overly detrimental, whereas overgrazing can have measurable effects. More broadly, it appears that the Proponent has not fully considered the combination of invasive weeds (e.g., spread by heavy machinery, ATVs), poor grazing and forest management practices, increased road networks (e.g., road density), and traffic volumes (e.g., mortality caused by vehicle collisions potentially have important impacts on birds and other wildlife, particularly if the species are at risk), acting in combination with the Project.

<u>Species at Risk</u>

In managing a project in the context of SARA-listed species, proponents are advised to identify and evaluate likely species occurrences (e.g., conduct baseline surveys), assess environmental effects, and develop mitigation strategies and follow-up monitoring plans. Since the Project was submitted for review, Environment Canada has provided updates on changes to the status of wildlife and plant species under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and SARA. The Proponent should update its accounting of species at risk in the project area (CEAR #400, response to IR28a, Table 28-1) to take the following changes into account accordingly.

- In 2012, Whitebark Pine was added to Schedule I of the SARA as 'Endangered', and a recovery planning process, including identification of critical habitat, is currently underway. There is a potential for Whitebark Pine to occur within the project area.

- The status of the Lewis' Woodpecker cited on page 1-25 of SIR 1 (CEAR #494), has been up-listed to 'Threatened' on Schedule I of SARA. Any adverse effects of the Project on this species or its habitat have the potential to be significant.

There may be updates to COSEWIC assessments and SARA listings, as well as to recovery planning processes currently, or soon to be, underway for species known to occur in or proximate to the project area. In particular, there is the strong possibility that critical habitat for several SARA-listed species will be identified in the region in which the Project is located. All critical habitat on non-federal lands identified under SARA must be effectively protected.

> ***Recommendation 10: The Proponent should continue to track the status of species as assessed by the Committee on the Status of Endangered Wildlife in Canada and listed under the Species at Risk Act, and refine project management plans to ensure appropriate protective measures are taken. In this regard, the Proponent should consult with the appropriate jurisdictions involved in Species at Risk Act recovery planning processes relevant to the Project, including the identification of critical habitat.***

<u>Wetlands</u>

As with the initial Prosperity project, the potential effects on wetlands and associated riparian habitat that support migratory birds and species at risk are a key concern of Environment Canada. Wetlands, including fens, swamps, and shrub-carrs, within the footprint of the pit and the TSF would be permanently lost. These losses include wetlands located north of Fish Lake, between Fish Lake and Little Fish Lake, and in and around Little Fish Lake. The Proponent has quantified losses in the amount of 311 ha (post-closure)[3]. Additionally, the structure, composition and function of wetlands outside of the pit and TSF footprints would also likely be affected due to proposed water management strategies for the mine site. Such effects could manifest in the longer term, during operations, closure and post-closure phases of the Project. Environment Canada understands that these water management strategies could potentially affect 69 ha of wetlands, based on review of the draft Habitat Compensation Plan (IR 32, CEAR #400). A monitoring program that evaluates impacts to wetlands due to changes in hydrology would be one important component of the draft Habitat Compensation plan (HCP). The draft

[3] Note the Draft Habitat Compensation Plan (February 28, 2013, CEAR #400) indicates wetland losses would be 258 ha whereas the EIS indicates wetland losses would be 311 ha. This difference needs to be reconciled.

HCP makes reference to undertaking such a program but it will be important to develop the temporal and spatial scope of the monitoring program prior to the construction phase of the Project, should it proceed.

Fen wetlands predominate in the area of the pit and TSF. In relation to IR 37a (CEAR # 400), the Proponent advises that, '*wetlands and riparian areas within the white area are limited in extent and diversity'*. In terms of migratory birds, these fens do not appear to function as productive waterfowl breeding habitat relative to other wetlands in the Project area, but do nonetheless support a breeding landbird community. Additionally, the fens and other wetlands likely provide other functions, such as forage and security opportunities for birds in migration. Further, these wetlands undoubtedly perform biochemical functions to downstream habitats, and in this regard, it is important that the ecological interconnections between upstream and downstream habitats be thoroughly understood in assessing potential impacts and appropriate mitigation and/or compensation. For example, organic/nutrients inputs from the Little Fish Lake, Wasp Lake, and the fens, swamps, marshes, and shrub-carrs associated with, and downstream of, these water bodies undoubtedly contribute to the habitat productivity of Fish Lake and wetlands downstream of Fish Lake.

The Canadian Wildlife Service of Environment Canada relies upon the Proponent's evaluations that proposed water management strategies in relation to the pit, TSF and other mine facilities would affect or diminish the water quality of flows to Fish Lake, Wasp Lake or upstream or downstream wetlands and thereby affect the migratory birds and/or species at risk that utilize those habitats. In this regard, Environment Canada notes that in its July 4, 2013 letter to the Panel (CEAR #587), NRCan believes that the Proponent may have underestimated the amount of seepage that would be released from the TSF by approximately one order of magnitude. If the amount of seepage has been underestimated, then the volumes of seepage reaching surface water bodies could be much greater than predicted by the Proponent with associated impacts for migratory birds and/or species at risk. Environment Canada has a regulatory role in upholding provisions of the *Fisheries Act* and MBCA as they pertain to maintenance of water quality and the protection of waters frequented by fish and migratory birds. Therefore, any water quality impacts arising from the Project could not be considered for habitat/functions compensation under the HCP.

In its review of the EIS, Environment Canada offered advice regarding development of a HCP. In response, the Proponent provided a draft HCP (CEAR # 400, IR 32). The Proponent's draft HCP provides an appropriate foundation for finalizing appropriate compensation details. The summary brief on the *Federal Policy on Wetland Conservation* (the Wetland Policy) in Appendix 1 includes information on its application to projects such as New Prosperity. In the context of the Wetland Policy, Environment Canada recommends that losses and degradation of wetland functions that would or potentially would arise from the following project activities be addressed as components of the HCP:

i. Development, operation and reclamation of the pit and TSF;
ii. Water management strategies; and

iii. Zones of influence effects arising from noise, light and other such effects.

A monitoring and mitigation strategy is recommended for (ii) and (iii).

Environment Canada notes that the Proponent does not intend to use TSF reclamation measures as credit for habitat compensation to address residual effects to wetland functions (page 32-13, IR 32). For completeness, Environment Canada advises that it would not support reclamation of the TSF as credit to meet the objectives of the Wetland Policy for the following reasons: (1) TSF wetland reclamation would occur at a minimum of 45-50 years after the functions had been lost; (2) there is no assurance that the functions lost could be effectively replaced through TSF reclamation; and (3) habitat compensation should be directed to sites where confounding factors, such as reduced water quality, are minimized so that probability of replacing lost functions is maximized.

Recommendation 11:

- ***a. In conjunction with pre-construction and operations wetland monitoring (to assess potential impacts to structure and composition), the Proponent should conduct migratory bird and species at risk pre-construction and operations monitoring to assess potential changes in function. The Proponent should consult with Environment Canada on the duration and frequency of monitoring in relation to migratory birds and species at risk.***
- ***b. Further to (a), any temporary or permanent changes in wetland structure and composition not relating to predicted losses associated with the pit and tailings storage facility, and defined as extending over and beyond an ecologically relevant period (in the order of five years), that change or impair functions supporting migratory birds and/or species at risk, be addressed in the Habitat Compensation Plan.***
- ***c. That submission of the final Habitat Compensation Plan be made a commitment under the Canadian Environmental Assessment Act, 2012.***
- ***d. That in completing the final Habitat Compensation Plan, the Proponent consult with Environment Canada in relation to migratory birds and species at risk.***
- ***e. That the final Habitat Compensation Plan be submitted no later than three months prior to construction, should the Project proceed, and that this be made a commitment under the Canadian Environmental Assessment Act, 2012.***

5.0 List of Recommendations

Surface Water Quality

Recommendation 1: The Proponent should provide complete details on the stochastic model used and reconcile apparent discrepancies in the data provided if water quality impact predictions are to be relied upon.

Recommendation 2: If the proposed recirculation scheme is to be considered further, the Proponent should first conduct peer-reviewed research into the potential implications of recirculating water within Fish Lake and its tributaries, using validated predictions of tailings storage facility seepage inputs. The research results should be carefully examined before recirculation is factored into management plans intended to ensure that the quality of water in Fish Lake and its tributaries is protected.

Recommendation 3: If the proposed use of nano-filtration, oygenation and alum treatment technologies is to be considered further, the Proponent should first conduct peer-reviewed research into potential implications for local environmental conditions. The results of this research should be examined carefully before the potential role of these technologies is factored into project management plans to address water quality issues.

Recommendation 4: The Proponent should reaffirm predicted impacts on all water bodies influenced by the Project to ensure adequacy of mitigation and monitoring measures. Particular attention should be given to selenium and mercury concentrations, any discrepancies in water quality modelling inputs (for Big Onion Lake and Wasp Lake), tailings storage facility seepage rates and likely application of the Metal Mining Effluent Regulations.

Surface Water Quantity – Water Balance Assessment

Recommendation 5: The Proponent should measure hydrometeorological conditions onsite, as well as review the watershed model periodically to ensure the water management plan continues to reflect the best available information. Environment Canada specifically recommends estimating evaporation using the Penman equation, which would require the measurement of net radiation (over the water), air temperature, wind speed, vapour pressure, and water column temperature.

Recommendation 6: The Proponent should take steps to ensure detailed design of the supernatant pond reflects a consideration of the best available understanding of hydrological conditions on the site based on operational phase monitoring programs and up-to-date climate change projections.

Surface Water Quantity – Climate Change

Recommendation 7: The Proponent is encouraged to base the evaluation of possible impacts of climate change on the range of possible changes rather than the mean of the ensemble of Climate Model projections.

***Recommendation 8: The Proponent is encouraged to synthesize the peer-reviewed literature and/or reports to achieve a better assessment of trends in observed climate and hydroclimate variables*.**

Wildlife

Recommendation 9: The Proponent is advised to avoid engaging in potentially destructive or disruptive activities. In order to achieve that objective, the Proponent is advised to develop and implement a management plan that effectively avoids or minimizes the risk of detrimental effects to migratory birds, their nests and eggs.

Recommendation 10: The Proponent should continue to track the status of species as assessed by the Committee on the Status of Endangered Wildlife in Canada and listed under the Species at Risk Act, and refine project management plans to ensure appropriate protective measures are taken. In this regard, the Proponent should consult with the appropriate jurisdictions involved in Species at Risk Act recovery planning processes relevant to the Project, including the identification of critical habitat.

Recommendation 11:

- ***a. In conjunction with pre-construction and operations wetland monitoring (to assess potential impacts to structure and composition), the Proponent should conduct migratory bird and species at risk pre-construction and operations monitoring to assess potential changes in function. The Proponent should consult with Environment Canada on the duration and frequency of monitoring in relation to migratory birds and species at risk.***
- ***b. Further to (a), any temporary or permanent changes in wetland structure and composition not relating to predicted losses associated with the pit and tailings storage facility, and defined as extending over and beyond an ecologically relevant period (in the order of five years), that change or impair functions supporting migratory birds and/or species at risk, be addressed in the Habitat Compensation Plan.***
- ***c. That submission of the final Habitat Compensation Plan be made a commitment under the Canadian Environmental Assessment Act 2012.***
- ***d. That in completing the final Habitat Compensation Plan, the Proponent consult with Environment Canada in relation to migratory birds and species at risk.***

e. ***That the final Habitat Compensation Plan be submitted no later than three months prior to construction, should the Project proceed, and that this be made a commitment under the Canadian Environmental Assessment Act 2012.***

Appendix 1 Federal Policy on Wetland Conservation – Environment Canada Advice

FEDERAL POLICY ON WETLAND CONSERVATION –

ENVIRONMENT CANADA ADVICE

(A) The key policy objectives of the Federal Policy on Wetland Conservation (the Wetland Policy) relevant to federal environmental assessment can be found in the section on 'strategy related to federal lands and water' and in the section on 'other federal programs'. These include:

> ***Commit all federal departments to the goal of no net loss of wetland functions (i) on federal lands and waters, (ii) in areas affected by the implementation of federal programs where the continuing loss or degradation of wetlands has reached critical levels, and (iii) where federal activities affect wetlands designated as ecologically or socio-economically important to a region. Due to local circumstances where wetland losses have been severe, in some areas no further loss of any remaining wetland area may be deemed essential*** **(Government of Canada 1991).**

(B) The Wetland Policy applies to federal departments addressing the potential loss of wetlands and wetland functions. Projects and activities of the Government of Canada are subject to the Wetland Policy, including those projects and activities considered under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). For projects on non-federal lands and waters, such losses are evaluated (1) in terms of the scope of any federal permits, licenses, authorizations and other instruments under federal jurisdiction which may be applicable, <u>and</u> (2) where the associated wetland functions support areas of federal jurisdiction (for Environment Canada, for example, these include migratory birds and species at risk). To be clear: the Policy does not apply to wetlands in the absence of either of these two above links to federal jurisdiction.

(C) The Wetland Policy is underpinned by a no-net-loss of wetland functions objective, and as such, necessitates a consideration of all wetland functions which could be impacted. For Environment Canada, functions of specific interest include those supporting migratory birds and species at risk. To inform the applicability of the Wetland Policy, Environment Canada recommends that proponents describe the natural processes of potentially impacted wetlands (physical and chemical) and perform an assessment of the potential impacts and mitigation.

Hanson et al. (2008) '*Wetland Ecological Functions Assessment: An Overview of Approaches*' (accessible at: Environment Canada - Nature - Publications) should be reviewed before undertaking a functions assessment.

(D) The Wetland Policy is applied on a regional basis to reflect current conditions. The Wetland Policy applies to natural, degraded, and artificial wetlands. In British Columbia, for example, the <u>geographic areas where continuing loss or degradation of wetlands has reached critical levels</u> are defined as:

- *Delivery Areas under the Pacific Coast Joint Venture;*
- *Delivery Areas under the Canadian Intermountain Joint Venture;*
- *Delivery Areas under the Prairie Habitat Joint Venture;*
- *Lower Mainland / Fraser River region;*
- *East Vancouver Island and Gulf Islands;*
- *Okanagan Valley; and,*
- *Portions of the Columbia Valley.*

In British Columbia, <u>ecologically or socio-economically wetlands important to a region</u> are defined as:

- *All marine coastal wetlands, saltmarshes, eelgrass (Zostera subspecies) beds; and,*
- *Red- and blue-listed wetland ecological communities.*

With respect to the two definitions provided above, Environment Canada's Canadian Wildlife Service (Pacific and Yukon) will provide more detailed guidance to project proponents as and when requested.

(E) Three mitigation strategies should be used to achieve a no-net-loss of wetland functions for the three situations identified above. In order of application, these strategies[4] are:

(1) Avoidance of impacts;
(2) Minimization of unavoidable impacts; and,
(3) Compensation for unavoidable impacts.

Due in part to the broader wetland policy objective of promoting the conservation of Canada's wetland functions, now and in the future, and given the important role that wetlands play in sustaining populations of migratory birds and *Species at Risk Act*-listed species, in addition to the foregoing no-net-loss considerations of the Wetland Policy, Environment Canada recommends that avoidance and minimization of impacts to ecological wetland functions be broadly considered in project design.

It is important to note that application of the Wetland Policy is separate and distinct from a significance evaluation under the CEAA 2012. The Wetland Policy is based on a no-net-loss of wetland functions, whereas the significance evaluation under the CEAA 2012 uses threshold-based criteria. The Wetland Policy applies to all wetland types, regardless of size; to all impact types, whether small or large, short duration or long, or direct or indirect. Specifically, the no-net-loss goal applies to the temporary loss of wetland functions. Monitoring programs need to be sufficiently robust to ensure effective implementation of mitigation measures and successful recovery of wetland functions.

(F) The Wetland Policy applies to CEAA 2012 to the extent of the application of federal jurisdiction as described under (B). With specific reference to section 5 of CEAA 2012 then, the relevant sections are sections 5(1)(a),5(1)(b) and 5(2)(a). With respect to section 5(1)(a), there must be link between areas of federal jurisdiction as described under (B).

Environment Canada's Canadian Wildlife Service recommends that a Wetland Compensation Plan be submitted with an Environmental Impact Statement for review in the environmental assessment process. Amongst other matters, the Wetland Compensation Plan should describe the wetland ecological communities and functions potentially impacted to which the Wetland Policy applies; application of the mitigation hierarchy; identification of residual effects; identification of a compensation ratio; identification of the location and timing of implementation of compensation projects (where feasible); and, the parties responsible for implementation (including monitoring) and review.

At a minimum, a compensation ratio of 2:1 is used; however, this ratio varies on a project-by-project basis. Consultation with the Canadian Wildlife Service is recommended to ensure the appropriate ratio is identified. In order of priority, the Canadian Wildlife service recommends wetland restoration over enhancement and enhancement over creation.

(G) In summary, Environment Canada advises proponents that the Wetland Policy applies to federal departments and agencies when addressing the loss of wetlands. It will be used to inform the environmental assessment process and will be considered by Environment Canada when assessing the appropriate measures to be taken to mitigate the adverse environmental effects of a project under CEAA 2012, the *Canadian Environmental Protection Act,* the *Migratory Birds Convention Act,* the *International River Improvements Act* and the *Species at Risk Act.*

[4] For more information on the mitigation hierarchy, refer for example to the Federal Policy on Wetland Conservation Policy Implementation Guide for Federal Land Managers (1996), available through the following web link: http://www.ec.gc.ca/nature/default.asp?lang=En&n=132ADBFC-1&parent=0C1743A2-4D49-4183-AC5F-1DE909D2FEB1