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October 29, 2010

MVEIRB File Number: EA0809-002
Chuck Hubert
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P.O. BOX 938
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BY EMAIL: chubert@reviewboard.ca

Re: Canadian Zinc Prairie Creek Environmental Assessment Second Round Information Requests

Dear Mr. Hubert:

Indian and Northern Affairs Canada (INAC) is providing the following second round information requests (IR) for the Canadian Zinc Prairie Creek Mine Environmental Assessment. INAC believes that this information is necessary in assessing the potential impacts of the Prairie Creek mine.

INAC officials will contact the proponent directly to discuss these IRs and their associated rationale.

Thank you for the opportunity to provide information requests for the Canadian Zinc Prairie Creek Mine Environmental Assessment. If you have any questions about this request, please contact Krystal Thompson at 669-2595 or via email at krystal.thompson@inac-ainc.gc.ca.

Yours sincerely,

Teresa Joudrie
Director, Renewable Resources and Environment
Indian and Northern Affairs Canada

IR: INAC02-01

Subject: Effluent Discharge and Receiving Water Quality - Operations

Linkage: INAC-07, INAC-08, INAC-09, INAC-10, EC-14, EC-16, DFO-01, PC-39, PC-44, PC-45, Technical Session Day 1 and Day 2.

References:

DAR, CZN, March 2010.

Responses to Information Requests, Appendix J, CZN, September 2010.

Responses to Information Requests, Appendix K, CZN, September 2010.

Prairie Creek Mine, Outfall Designs – Preliminary Construction Details, Draft, Northwest Hydraulic Consultants, October 5, 2010.

Prairie Creek Mine, Outfall Performance – Downstream Mixing Analysis, Draft, Northwest Hydraulic Consultants, October 6, 2010.

Preamble:

Canadian Zinc's (CZN's) DAR identified five metals (cadmium, copper, lead, selenium and zinc) in their treated effluent that are considered likely to impact receiving water quality. Section 8.5 of the DAR identifies that chemicals of potential concern were identified by comparing information on treated minewater and process water against CCME, BC AQ and USEPA water quality guidelines, summarized in Table 8.7. Note that nutrient data was not included in the original assessment.

Additional parameters (antimony, arsenic, iron, mercury, silver, ammonia, nitrate, nitrite, phosphorous, sulphate and conductivity) were requested in IRs, and Appendix J of CZN's IR response document provides updated predictions of in-stream water quality concentrations for the following scenarios: mine drainage flows of 29 L/sec and 100 L/sec, at both average and high Prairie Creek flows, at both Harrison Creek and the Nahanni National Park Boundary.

The DAR and IR response did not include a comprehensive characterization of expected effluent quality including: metals, major ions and nutrients. CZN has indicated they will provide this information in response to a request from Environment Canada at the Technical Session.

Appendix K of CZN's IR response identifies that a diffuser (as proposed in the DAR) is no longer proposed, and effluent discharge to Prairie Creek will be through a simple pipe outlet. A draft report providing a mixing analysis was provided on Oct 7, during the Technical Session. The mixing analysis considered cadmium, copper, lead, selenium and zinc under the following scenarios: high and low mine flows, and 7Q10, open water mean and ice covered mean Prairie Creek flows. CZN indicated at the Technical Session that they would include mercury and ammonia in an updated mixing analysis.

In-stream water quality predictions provided in Appendix J exceed proposed site specific water quality objectives for copper, lead, selenium, antimony, arsenic, mercury, ammonia, nitrate, phosphorous and sulphate under one or more prediction scenarios during site operations. The draft mixing analysis identifies parameter specific mixing zones ranging from 38 m to 1380 m in length, but does not provide information on plume size, concentration gradients within the plume or a comparison of the size of dilution zone achieved using the simple pipe outfall against what could be achieved with a diffuser.

While much information has been presented, uncertainty remains regarding the extent of potential receiving water impacts resulting from effluent discharges at Prairie Creek, and INAC requires additional information to assess potential impacts.

Note: Any assessment of a range of conditions should include all combinations of the following flow scenarios as a minimum: the average Prairie Creek flows expected during typical operations, worst case Prairie Creek low flows and worst case Prairie Creek high flows; the monthly average inflows expected during typical operations and worst case high mine inflows (assuming worst case connectivity to the PCAA and HCAA). Worst case mine site scenarios should also consider the implications on catchment pond storage capacity and required discharge flow rates due to high or worst case mine inflow volumes occurring in combination with surface flood events, as this combination may require higher discharge volumes. CZN is to identify the selected typical ranges and worst case conditions.

Requests:

1. In addition to the table(s) on expected effluent quality as requested by Environment Canada during the Technical Session, provide associated rationale and background on how these values were derived.
2. Provide an assessment of the potential impacts associated with mine effluent, and identify acceptable in-stream parameter concentrations. Provide a rationale for removing all potential contaminants or stressors, present in the mine's effluent, from consideration during the assessment. As an example Table J.6 identifies that arsenic concentrations will increase by 4 times. This increased concentration remains below CCME standards, but the magnitude of the increase may still be significant for Prairie Creek.

3. Provide additional information on the mixing analysis including: mixing analysis for additional parameters (ammonia and mercury), the model used to generate the predictions, any site specific modifying factors included in the modelling exercise (e.g. attenuation factors) and expected concentration gradients within the plume.
4. Provide information (i.e. dimensions) for a set mixing/dilution zone that will be applicable to all effluent parameters under all flow conditions. In-stream water quality objectives will be met at the edges of the dilution zone.
5. Provide a comparative assessment between the use of a simple pipe outfall versus use of a diffuser. Specifically, with respect to the size of the predicted dilution zone and the ability of each option to minimize potential long-term impacts on the receiving environment. In addition, provide an assessment of any increased impacts to the left bank of Prairie Creek during moderate to high flow as a result of the pipe outfall design.
6. If in-stream water quality objectives will not be met at the edge of the proposed mixing zone, what mitigation measures will be used to reduce contaminant concentrations to acceptable levels. Any mitigation measures that rely upon decreasing effluent discharge volumes must include calculations demonstrating that the site's water management structures will be capable of storing any un-discharged water under a range of mine inflows including low, expected and high mine flows. The demonstration should also include several scenarios including reducing discharge for consecutive months and over the entire winter.

IR: INAC02-02

Subject: Downstream Mixing Analysis

Linkage: INAC -06, Technical Session Day 1 and 2.

References:

Prairie Creek Mine, Outfall Performance – Downstream Mixing Analysis, Draft, Northwest Hydraulic Consultants, October 6, 2010.

Preamble:

Mixing analysis was conducted using information collected at the Cadillac mine using data from 1974 to 1990. Mixing analysis is important from an environmental monitoring program perspective because it sets the geographic scale for measuring concentration–related, but not necessarily loading-related, possible effects. It is important to understand extreme conditions so that monitoring locations may be situated such that the agreed upon mixing zone, nearfield and farfield areas may be adequately monitored.

Typically in the NWT, the edge of the “mixing zone” or end of pipe measurements comprise stations that fall within the SNP (Surveillance Network Program) whereas other stations falling outside this area comprise AEMP (Aquatic Effects Monitoring Program) stations.

Adaptive management actions are driven by triggers that usually differ between SNP and AEMP locations. Thus it is important that the demarcation between the two areas be well estimated. INAC requests the following information to assess the downstream mixing analysis as provided by the proponent.

Requests:

1. Provide a rationalization why the within-period 7Q10 was chosen rather than another combination of low-flow period (the choice of 7-days) and recurrence interval (the choice of 10 years).
   - The recurrence interval (10 years) should reflect some fraction of the expected mine operating life that is greater than 1 to ensure a conservative temporal scale. The current choice of 7-days may reflect weekly patterns in mine operations but is not reflective of any natural temporal scales.

2. Discuss the temporal relevance of the Water Survey of Canada records for Cadillac Creek terminated at 1990 given the period of application is 20 years later.
   - Given that climate change is affecting precipitation patterns and timing of critical water-flow events such as freshet and ice-up; the relevance of a water quality record terminated 20 years ago should be discussed.

IR: INAC02-03

Subject: Receiving Water Quality – Post Closure

Linkage: PC 21, PC 22, PC 23, Technical Session Day 3

References:

DAR, CZN, March 2010.

Responses to Information Requests, Appendix J, CZN, September 2010.

Site Hydrogeology Report, Prairie Creek Mine Site, Northwest Territories, Canada – Rev 0, Robertson GeoConsultants Inc., February 2010.

Preamble:

Tables J13 and J14 in CZN's IR response Appendix J identify concentrations of cadmium, lead and zinc in excess of in-stream objectives in Prairie Creek both at Harrison Creek and at the NNPR boundary post closure. The tables identify that the estimated zinc concentrations will be of the same order as naturally occurring zinc concentrations under pre-mining conditions. However, post-closure cadmium concentration estimates are approximately three times higher than pre-mining cadmium concentration estimates and post-closure lead concentration estimates are approximately double pre-mining lead concentration estimates. Note, mercury concentration estimates are not provided in Tables J13 and J14.

Sections 5.3.4 and 5.3.5 of Robertson GeoConsultants Inc. February 2010 Site Hydrogeology report predict that early post-closure metals concentrations will be higher than long term post closure metals concentrations. Tables J13 and J14 do not indicate whether the predicted in-stream concentrations are for early or late post-closure conditions, but are assumed to be for long-term post closure.

Given the potential for exceedances of in-stream objectives, INAC requires additional information regarding post-closure water quality in Prairie Creek to assess potential long-term impacts from this operation.

Requests:

1. Provide predicted in-stream parameter concentrations post-mine closure for 'all' parameters potentially affected by mining operations, including mercury.
2. What are predicted in-stream parameter concentrations during early post-closure? How long will the early post-closure conditions last?
3. Given that concentrations of several metals are predicted to exceed in-stream objectives after mine closure, identify potential mitigation measures that could be implemented to reduce the concentrations to below in-stream objectives.
4. Identify the assessment endpoints that will be used for monitoring post-closure water quality. Identify low, medium and high trigger levels that, when reached, will trigger a response during closure operations. (See INAC02-08 below)

IR: INAC02-04

Subject: Water Management and Treatment

Linkage: INAC 02, PC 40, PC 41, Technical Session Day 1 and 2.

References:

DAR, CZN, March 2010.

Responses to Information Requests, Appendix J, CZN, September 2010.

Table A9-1 Water Storage Pond Water Balance – corrected, October 8 2010.

Preamble:

Canadian Zinc will discharge a combination of treated minewater and process water to Prairie Creek. The proposed discharge strategy identifies that the final effluent composition will be determined by blending the treated process water and treated minewater streams in the Reactor Clarifier, prior to discharging to the Catchment Pond. The final blend will be modified as required to meet regulated limits. Canadian Zinc has identified that flow volumes in Prairie Creek will largely determine the effluent blend and flow volume. Treated process water will not be discharged during periods of low flow, i.e. winter, but will be discharged at a maximum rate of 0.020 m^3/s during higher flow periods, i.e. the summer months.

Tables in Appendix J identify that in-stream guidelines for metals and nutrients may be exceeded under several scenarios, but primarily during periods of low flow in Prairie Creek. CZN has indicated that effluent discharges will be reduced during periods of low Prairie Creek flow in order to meet in-stream objectives.

INAC is concerned that the ability of the site's water management system to handle consecutive months of low flow conditions in Prairie Creek has not been fully demonstrated. For example, assuming high mine inflows and low Prairie Creek flows as shown in Table J2, effluent discharge may have to be reduced by ½ in order to meet in-stream copper objectives for several consecutive months. Each month of reduced discharge will result in an extra 117,000 m^3 of water that must be managed. Two consecutive months of reduced discharge would require all the available operating storage capacity (not including free-board) in the WSP, assuming that maximum operating capacity was available when low Prairie Creek flows were first encountered.

Further, water inflows to the mine have been estimated to rise to 100 lps as a mean annual flow, (RGC report, referenced DAR page 211). The project water balance in App. 9 uses only 50 lps as the mean annual flow. Peak flows during snowmelt (DAR page 210 – CZN observations) may yield temporary flows which are much greater than 100 lps. During this period it will be necessary to have sufficient freeboard in the WSP to contain the water until it can be treated and discharged.

INAC is concerned that the water management strategy for the site must be flexible enough to handle the entire range of scenarios that could occur over the life-of-mine, therefore INAC requires additional information to evaluate the proposed water management strategy and to assess its ability to mitigate potential impacts. It is apparent from the tables and information presented in the DAR and IR responses to date that the receiving environment conditions will restrict and dictate effluent discharge and quality which in turn will influence the on-site water balance and management. Appropriate contingencies and storage capacity is required to handle the potential volumes of water from operations.

Note: Any assessment of a range of conditions should include all combinations of the following flow scenarios as a minimum: the average Prairie Creek flows expected during typical operations, worst case Prairie Creek low flows and worst case Prairie Creek high flows; the monthly average inflows expected during typical operations and worst case high mine inflows (assuming worst case connectivity to the PCAA and HCAA). Worst case mine site scenarios should also consider the implications on catchment pond storage capacity and required discharge flow rates due to high or worst case mine inflow volumes occurring in combination with surface flood events, as this combination may require higher discharge volumes. CZN is to identify the selected typical ranges and worst case conditions.

Requests:

1. Demonstrate that the proposed water management strategy can handle a range of flow scenarios including consecutive periods of high mine inflows and low Prairie Creek flows requiring a reduction in discharge volumes. Please confirm input parameters and freshet surges to the water balance.
2. Identify mitigation methods that would be implemented to maintain the site water balance and in-stream water quality objectives during periods when discharge must be reduced.
3. If allowing the mine to re-flood is a proposed mitigation strategy, identify any water quality issues that may arise from re-flooding the mine considering: contact with paste backfill, groundwater outflow from the mine workings/HCAA and PCAA contacts and water quality upon re-starting mine operations.
4. Provide a range of water treatment projections, in conjunction with range of water balance evaluations, which show the potential range of water treatment and discharge scenarios.

IR: INAC02-05

Subject: Mining Method – Crown Pillars – Surface Water Inflow to Mine

Linkage: INAC02-07

References:

DAR, CZN, March 2010.

Preamble:

Mining of ore zone near to, or through to, ground surface has the potential to intercept surface runoff and route it through the mine workings. This could result in a significant increase in flow through mine during operations and after closure. INAC requests the following information to assess potential impacts associated with additional flows through the mine workings.

Request:

1. Please describe how stability of the ground surface will not be affected by mining, or, how additional flows may affect the water balance and metal flushing from the mine workings.

IR: INAC02-06

Subject: Water Storage Pond – Diversion Ditch

Linkage: Technical Session Day 2

References:

DAR, CZN, March 2010.

Preamble:

Diversion of water around the Water Storage Pond is indicated as necessary for operation of the pond (page 210), and is purportedly described in more detail in App 12. The slope above the WSP is relatively steep, composed in part of clayey soils and there has been slope instability in this area. INAC requests the following information to better understand the mine development plan which will aid in the assessment of potential impacts.

Requests:

1. App. 12 does not provide any details as to the design or constructability of the diversion ditch. Information should be provided that is consistent with the design parameters of the WSP slope stabilization plans.

IR: INAC02-07

Subject: Hydrogeology – Potential Groundwater Inflows, Minewater Management

Linkage: INAC 01, INAC 03, Technical Session Day 1

References:

Site Hydrogeology Report, Prairie Creek Mine Site, Northwest Territories, Canada – Rev 0, Robertson GeoConsultants Inc., February 2010.

Preamble:

Section 4.4.3 of Robertson GeoConsultants Hydrogeology report identifies that the Vein Fault may intersect the Prairie Creek Valley, and could transmit significant quantities of groundwater flow to the deeper mine workings. Mine inflows could reach as high as 200 L/s if the MQV/Vein fault extends under Prairie Creek. At this point exploration drilling has not identified the presence of the MQV/Vein Fault under Prairie Creek, but the possibility of significantly higher mine in-flows remains.

CZN has indicated that higher flow rates will be managed by increasing treatment capacity and discharging more effluent. As noted in INAC02-04, the ability to increase effluent discharges may be limited by conditions in Prairie Creek (i.e. instream objectives, mixing zone characteristics and Prairie Creek flow conditions). INAC requests the following information to assess potential impacts of increased minewater flows.

Requests:

1. Identify mitigation measures that are available to handle significantly higher mine in-flows.
2. Demonstrate the likelihood of success of any proposed mitigation strategies.

IR: INAC02-08

Subject: Effluent Discharge and Monitoring

Linkage: INAC 06, INAC 11, Technical Session Day 2

References:

DAR, CZN, March 2010.

Responses to Information Requests, Appendix L, CZN, September 2010.

Aquatic Effects Monitoring Final Plan Canadian Zinc, Pugsley/Dube Consulting Inc., June 2, 2010.

Preamble:

CZN has proposed a variable discharge strategy whereby effluent discharge volumes and effluent contaminant concentrations would increase during periods of high flow in Prairie Creek. Impacts to Prairie Creek resulting from effluent discharges will be monitored using a combination of SNP, AEMP and MMER programs. A potential near field monitoring point located approximately 200 m downstream of Harrison Creek was identified in response to Parks Canada IR 39, but was not finalized pending receipt of an effluent mixing analysis. Appendix L in CZN's IR response document provides a general description of a monitoring program for the site, but includes few details regarding assessment locations, action trigger levels or response actions.

During the Technical Session CZN referred to the US EPA's use of total maximum daily loadings as a strategy for regulating discharges. This procedure is typically used when technology based effluent criteria have not been successful at protecting receiving water, and additional controls are required to provide an opportunity for the degraded receiving water to recover. However, Water Quality Based Effluent Limits are used in USEPA permits. Compliance with water licence conditions in the NWT is typically assessed using a combination of grab samples and 4 sample running averages (i.e. Maximum Average Concentration). Variable discharges and variable loadings will affect the ability of enforcement personnel to quickly and definitively assess whether effluent is in compliance with water licence conditions which may prove problematic for CZN as well as enforcement personnel.

INAC requires additional information to assess the proposed discharge and monitoring strategy.

Requests:

1. Identify downstream monitoring points (e.g. assessment boundaries and sample site locations) that will be used to track changes in the receiving environment related to effluent discharges.
2. Identify low, medium and high action effects levels for these boundaries that, when reached, will trigger a response. Note that a 'high action level' is generally considered to be a point that should not be reached and requires an immediate halt to discharge.
3. Identify appropriate adaptive management responses if the moderate level triggers at the most immediate downstream assessment boundary is reached. Include consideration of how proposed responses (reduced discharge volume or load) will impact site operations.
4. Identify a monitoring and reporting strategy that will permit effective enforcement of any water licence conditions respecting variable discharge criteria. Note this strategy will likely require a well defined water discharge

strategy (e.g. with flow and concentration numbers that are demonstrated to work with the facility's water balance under a range of scenarios including worst case and be consistent with a defined mixing/dilution zone).

IR: INAC02-09

Subject: AEMP

Linkage: INAC 06, INAC 11, Technical Session Day 2

References:

Aquatic Effects Monitoring Final Plan Canadian Zinc, Pugsley/Dube Consulting Inc., June 2, 2010.

Preamble:

In the NWT a tenet of the INAC (2009) AEMP guidance document is community consultation to develop monitoring questions and acceptable levels of change.

The AEMP functions as a "safety net" with respect to those concerns addressed through consultation, because even with discrete discharge limits based on a combination of concentrations and/or loadings in place, synergistic and unanticipated effects may occur. In order to perform this role, from an ecological perspective, the measurement endpoints should be sensitive to the contaminants being released and with a known relationship between observed changes and cascading effects in the ecosystem of the receiving environment. Note that other pragmatic considerations such as impact of sampling in a low-productivity system, etc. also apply.

In order to function as a "safety net", from a practical perspective the AEMP and particularly SNP decision points should actionable in a timely manner. INAC requests the following information to assess the appropriateness of the AEMP as provided by the proponent to identify potential downstream effects.

Requests:

1. The proponent should describe the community consultation with respect to measurement endpoints and levels of acceptable changes for the proposed AEMP, which is equivalent to the experimental design outlined in the Spencer et al (2008) study.
2. Provide a discussion of the ecological importance of epilithon in the local receiving environment and the sensitivity of the local epilithon to the expected contaminants being discharged.

3. It is possible that increased water storage capacity can obviate the requirement for seasonally varying effluent quality criteria and the attendant regulatory and monitoring complexity. Provide an assessment of the feasibility of increasing water storage capacity sufficient to use fixed effluent quality criteria prior to considering seasonally varying effluent quality criteria.
4. Section 4.1 suggests that effluent quality criteria should vary with season due to a large range in creek flows. A detailed description of the proposed "different regulatory approach" that would accommodate seasonally varying effluent quality criteria is requested. (See also INAC02-08.)

IR: INAC02-10

Subject: Effluent Discharge

Linkage: INAC 07, Technical Session Day 1 and 2.

References:

Responses to Information Requests, Appendix L, CZN, September 2010.

Preamble:

Appendix L describes a proposed discharge strategy whereby continuous flow monitoring data would be collected for Prairie Creek, and used in conjunction with background concentrations to calculate allowable discharge loads. Simultaneously, water treatment plant rates and recent treated water quality data would be used to calculate treated water loads. Treated loads would be adjusted by varying the volumes of mine and mill water entering the treatment plant. The calculations could be automated.

Although it is common to optimize and automate water treatment systems, it is not that common that the water treatment scheme and discharge strategy would change based on instantaneous conditions in the receiving environment. The potential exists for accidents, malfunctions and/or operator error resulting in discharges of unacceptable quality. Potential operational issues that may affect treated water quality include:

- fluctuations in influent water quality (as may occur from metallurgical process),
- process rate fluctuations (as may be needed to match discharge volume in Prairie Creek),
- regular sludge removal from the clarifier and process rate being too high for continuous effective settling of fine flocculent (in a plant operated without a large polishing pond)

- seasonal temperature effects (as it pertains to speed &/or efficiency of chemical reactions in the treatment plant).

Table 6-7 DAR has WQ data, which suggests that arsenic may be in the range of 0.10 mg/l (dissolved) and 0.75 mg/l total in the process water depending upon the ore source. Based upon the water balance schematics (provided in CZN DAR Addendum May 2010), 50% of the mine water becomes process water on an annual basis. The treatability testing in App. 2, was done on influent of 0.0009 mg/l, or about 1/10th the potential concentration of the average combined mine water and process water.

INAC requires additional information and detail to assess the ability of the proposed treatment and discharge strategy to mitigate potential environmental impacts.

Requests:

1. Detail the mitigation measures to minimize the risk of unacceptable discharges due to accident, malfunction or operator error.
2. Provide a range of water treatment projections, in conjunction with range of water balance evaluations, which show the potential range of water treatment and discharge scenarios (see also INAC02-03).
3. Demonstrate that the site's water management system provides sufficient capacity to accommodate site water under a worst case plant malfunction.
4. Please describe the suitability of the preferred treatment strategy for water with elevated arsenic content.

IR: INAC02-11

Subject: Spill Control Measures

Linkage: INAC 04 – IR response, Technical Session

References:

DAR, CZN, March 2010.

DAR, Appendix 28, CZN, March 2010.

Responses to Information Requests, INAC04, CZN, September 2010.

Outfall Design – Preliminary Construction Details, Northwest Hydraulic Consultants, Oct 5, 2010.

Preamble:

CZN's response to IR INAC 04 identifies that the surface water run-off ditch system on site is expected to only contain clean run-off. However, the Fuel Spill Contingency Plan identifies the main site drainage channel as a secondary control point for spills from several locations on site. The site surface drainage system discharges to the catchment pond. Traditionally, surface water is managed on site just as any other water, such as process water and mine water, as there is a potential for leaching and contamination of surface runoff as a result of operations at the mine (fuel spills, chemical spills, runoff and leaching from laydown areas, general contamination from construction areas or industrial operations, etc.).

Preliminary outfall design calls for a gravity outflow from the Catchment Pond to Prairie Creek. Figures 6-18 and 6-19 in the DAR identify a Catchment Pond Safety Return linking the Catchment Pond with the Water Storage Pond.

It appears that spills on the site could enter the Catchment Pond through the surface water drainage system, and then enter Prairie Creek. INAC requires additional information on spill control at the site to fully assess potential impacts.

Requests:

1. How will gravity flow through the outfall line be stopped if a spill or other on-site contaminants comingle, leach or directly discharge to surface runoff, which according to the current site plan would report to the catchment pond and then Prairie Creek?
2. Describe mitigation measures that would manage surface runoff at the site in the event of a spill or other degradation of on-site surface water quality.
3. If potential mitigation measures include restricting flow from the catchment pond or diverting water from the catchment pond back to the WSP, demonstrate that the site water containment structures are capable of containing any water accumulated during restricted discharge, during a spill response or high flow/loading event.

IR: INAC02-12

Subject: Current Groundwater Conditions

Linkage: Technical Session Day 3

References:

Site Hydrogeology Report, Prairie Creek Mine Site, Northwest Territories, Canada – Rev 0, Robertson GeoConsultants Inc., February 2010.

Preamble:

One or more dissolved metal groundwater plumes exist as a result of mining activities that occurred pre-2007. The plume(s) extend from the mine workings to Harrison Creek and to Prairie Creek.

Metals concentrations (including cadmium, zinc and/or lead) exceeding the proposed in-stream criteria by several times have been identified in site groundwater (MW08-01, July 2009, DAR Appendix 1A, Table 3-5), Harrison Creek (HC3, July 2009, DAR Appendix 1A, Table 3-5) and Prairie Creek (PC-2, Sept. 2008, DAR, Appendix 1A, Table 3-4).

Currently, the following items are unknown: the southern extent of the MQV/Vein Fault in the vicinity of the Prairie Creek valley, the delineation of the plume(s) throughout the full depth and width of the PCAA and HCAA along the entire flow paths, the migration characteristics of the plume(s), and the potential long term impacts the plume(s) will have on water quality in Prairie Creek and in Harrison Creek.

INAC requests the following information to assess the current and future conditions and impacts from the existing groundwater plumes' discharge to Prairie Creek and Harrison Creek.

Requests:

1. The following is stated in the DAR, Appendix 1A: p.6, "Exploration drilling suggests that the Vein Fault strikes along the lower part of Harrison Creek valley and extends into the larger Prairie Creek valley.";p.28, "The Vein Fault is inferred to extend into Harrison Creek valley and crosses the Prairie Creek valley (near MW08-02)." INAC requests that Canadian Zinc confirm the extent of the Vein Fault in the vicinity of Prairie Creek valley and describe the implications of the vein fault being connected to Prairie Creek on flow within the creek itself, and on mine inflows. Under this connection scenario, what would be the required effluent discharge rate and predicted in-stream water quality concentrations?
2. Provide additional information on the existing dissolved metal groundwater plume(s) throughout the full vertical extent of all of the hydrostratigraphic units, as well as along the width and length of the plume flow paths. Hydrostratigraphic units of concern include Prairie Creek Alluvial Aquifer (>45m, deepest monitoring well is 5.8 m deep), Harrison Creek Alluvial Aquifer (20 m thick, deepest monitoring well is 12.7 m deep), MQV/Vein Fault, and shallow and deep bedrock units. CZN should explain how the characterization of groundwater flow and connectivity within the PCAA and HCAA is determined with confidence given that the existing monitoring wells do not

penetrate the full depth of the aquifer.

3. Information on any aquifer hydraulic testing within the hydrostratigraphic units of the PCAA, HCAA, MQV/Vein Fault, Shallow Bedrock and Deep Bedrock conducted by CZN. If no information has been collected, describe how groundwater movement in these zones has been predicted and provide the level of confidence that exists in the assessment of groundwater flow rates and plume migration rates.
4. Additional information on changes to groundwater seepage rates into Prairie Creek and Harrison Creek during low and high flow conditions.

IR: INAC02-13

Subject: Groundwater Conditions during Active Mining

Linkage: Technical Session Day 3

References:

Site Hydrogeology Report, Prairie Creek Mine Site, Northwest Territories, Canada – Rev 0, Robertson GeoConsultants Inc., February 2010.

Preamble:

The presence of impacted groundwater adjacent to Prairie Creek and impacted surface water in Prairie Creek suggests that Prairie Creek Alluvial Aquifer (PCAA) and Prairie Creek are hydraulically connected to the underground mining area and specifically the MQV/Vein Fault directly or through the Harrison Creek Alluvial Aquifer (HCAA).

When mine dewatering occurs, groundwater flow directions will reverse and groundwater from the HCAA, Harrison Creek, the PCAA, and possibly from Prairie Creek will be captured and flow toward the mine openings to eventually become mine inflows. The measured hydraulic conductivities of the hydrostratigraphic units and the extent of the Vein Fault that daylights beneath HCAA and possibly beneath PCAA greatly influence the capture zone created by mine dewatering.

If the capture zone reaches Prairie Creek, stream flow rates will be reduced. If the capture zone does not include Prairie Creek, the existing dissolved metal groundwater plume adjacent to Prairie Creek will continue to discharge into the creek. If Prairie Creek stream flow rates decrease or, alternatively, if the existing dissolved metal plume continues to discharge into Prairie Creek during active mining, then the allowable amount of effluent discharged to Prairie Creek will need to be further reduced, possibly halted, to control loadings into Prairie Creek so that the in-stream concentration criteria are met.

INAC requests the following information to assess potential impacts Prairie Creek and Harrison Creek.

Requests:

1. Assess and describe the potential magnitude of effects on Prairie Creek flows assuming worst case connectivity between Prairie Creek and the MQV/Vein Fault.
2. Assess the impacts from the dissolved metal groundwater plume(s) discharging into Harrison Creek and Prairie Creek, using the measured hydraulic and chemical properties of the flow systems and considering the seasonal fluctuations in stream flow rates and effluent discharge.
3. Assess potential impacts to the minewater discharge strategy and in-stream metals concentrations considering metal loadings to Prairie Creek from the existing dissolved metal plume, Also consider the impacts on the minewater discharge strategy considering a possible reduction in Prairie Creek flows due to mine dewatering. Evaluate any mitigation measures required in response to predicted impacts.

IR: INAC02-14

Subject: Post-Closure Groundwater Conditions

Linkage: Technical Session Day 3

References:

Site Hydrogeology Report, Prairie Creek Mine Site, Northwest Territories, Canada – Rev 0, Robertson GeoConsultants Inc., February 2010.

Responses to Information Requests, Appendix J, CZN, September 2010.

Preamble:

The level of groundwater characterization at the mine site presented in the DAR is insufficient to determine with certainty the source of the existing dissolved metal groundwater plume(s). The DAR states that the plume may have originated from either of the two following sources or both:

1. Mine water by-passing collection and treatment at the 870-level portal
2. Groundwater discharges from the Vein Fault into Harrison Creek Alluvial Aquifer and/or Prairie Creek Alluvial Aquifer

If the existing dissolved metal groundwater plume originates from the MQV/Vein Fault flow path, then the impacts from this existing plume will indicate what impacts might be expected post-closure.

In CZN's Responses to Information Requests, September 2010, in Appendix J, the following is stated:

"Revised predictions of pre-mine and post-closure main metals (in Prairie Creek) at Harrison Creek are contained in Table J13, and at the Park Boundary in Table J14. No site-specific criteria are exceeded during average flows. At low flows, cadmium, lead and zinc criteria are exceeded February to April. The cadmium and lead exceedances are marginal. Note that the predictions of in-stream water quality are arithmetic, and do *(not?)* include consideration of attenuation effects. While zinc is a relatively conservative metal, cadmium and lead are prone to attenuation, and therefore concentrations of these metals are likely to be well below the predicted values, and therefore impacts are not expected. The predicted zinc concentrations post-closure are less than pre-mine concentrations. "(INAC assumes that attenuation effects were "not" considered based on the wording of this paragraph. If this is not the case, INAC will revise this IR accordingly).

The data in Tables 3-4 and 3-5 of the DAR indicate:

1. Table 3-4 (Water Quality Data Sept/Oct 2008) shows in stream Zn concentrations of 27 ug/L in two samples collected in September 2008 from water sampling station PC-1, located in Prairie Creek downstream of the mill. The Zn concentrations of 27 ug/L are above the proposed site specific criteria of 22.65 ug/L. They are over two times the predicted pre-mine Zn concentration of 8.4 ug/L (Table J13 in Appendix J of CZN IR Replies). They are approximately three times the predicted post closure Zn concentration of 7.66 ug/L (Table J13 in Appendix J of CZN IR Replies). The samples were collected in September when the creek flow rate is moderate (6.4 m3/L), and not during low flow conditions, from February to April, when flows are typically less than 0.5 m^3/L.

2. Table 3-5 (Water Quality Data July 2009) shows the cadmium concentration being over four times the site specific criteria in monitoring well MW-08-01, located downgradient from Harrison Creek and adjacent to Prairie Creek. The presence of elevated cadmium in groundwater adjacent to Prairie Creek does not support CZN's position that natural attenuation will reduce cadmium concentrations to acceptable levels.

Due to the many hydrogeological uncertainties associated with the predictions of post-closure impacts to Prairie Creek presented in the DAR (i.e. aquifer hydraulic conductivities, percentage of groundwater flow provided by the MQV in the Vein Fault/MQV system, groundwater seepage rates into streams, extent of the Vein Fault, effect of existing groundwater plume), INAC requests the following information to assess post-closure impacts from the re-development of the mine.

Requests:

1. Re-evaluate predictions of post closure groundwater impacts on Harrison Creek and Prairie Creek by incorporating the following:
   - Worst case scenario assumptions regarding connectivity (i.e. vein fault connects to Prairie Creek), mine water inflows and concentrations.
   - Re-evaluation using any new additional information regarding the mixing contributions of groundwater from the MQV within the Vein Fault/MQV system. As stated in the Prairie Creek Mine Responses to Information Requests, CZN, 2010, Appendix J, Annex J6, p.3, "At the present time, insufficient data is available to determine the natural zinc load contributing via the Vein Fault/MQV system with a high degree of accuracy. We recommend that our preliminary loading estimates be updated once additional monitoring data become available."
   - An evaluation of the aquifer's attenuative capacity for metals of concern.
   - Inclusion of antimony, arsenic, iron, mercury, and silver predictions of in-stream creek concentrations, in addition to cadmium, copper, lead, selenium, zinc, and sulphate.

IR: INAC02-15

Subject: Mine Waste Management – Tailings and Waste Rock Quantities and Volumes

Linkage: Technical Session Day 2 and Day 3

References:

DAR, CZN, March 2010.

Preamble:

The mine development plan for the Prairie Creek mine is to "have no tailings on surface after mine closure" (ref. Section 6.11, page 191). This objective forces a linkage between ore mined (in-situ density, volume of voids for backfilling), concentrate removed (% of ore, density, volume extracted from ore), swell factor from ore to tailings. INAC requests the following information to better understand the mine development plan which will aid in the assessment of potential impacts.

Requests:

1. With reference to Table 6-4 Life of Mine (Years 0 – 14) Waste Quantities, provide additional information to address the following:

   - Mill feed
     - Does the tonnage 4,995,000 refer to diluted ore fed to the mill?
     - If so, what percentage dilution is assumed?
     - What is the in-situ density of the ore and dilution rock

   - DMS rock
     - What is the bulk density of this material

   - Flotation tailings
     - What is the bulk density of this material

   - Concentrates
     - What is the bulk density of this material

   - Voids (stopes & development)
     - The volume of development waste rock to the Waste Rock Pile is 277,000 m^3 (page 196). Assuming an in-situ specific gravity of 2.7 and swelled specific gravity of 1.9, the volume of development voids in the mine will be approximately 195,000 m^3. If the total volume of voids is 1,799,720 m^3 (as per Table 6-4), this leaves approximately 1,600,000 m^3 of voids in stopes for backfill. Please confirm.
     - Backfilling of overhand cut-and-fill stopes is likely to result in a high percentage of the mined voids being backfilled. That said, 100% backfilling of mined voids is unlikely. What percentage of the voids is assumed to be backfilled in the Prairie Creek mine plan?

   - Placed Backfill
     - The tonnage of backfill is 3,401,470 at a density of 1.89 t/m^3. This gives a backfill volume of 1,800,000 m^3, which is greater than space available underground. Please confirm. (Note: In the CZN DAR Addendum May 2010, the tailings density in the WSP is imputed to be 1.6 t/m^3. If this lower density is achieved in the tailings backfill, then the volume of tailings to be managed is up to 2,177,000 m^3, or 576,000 m^3 more than the available space.)
     - Please confirm that CZN does not intend to develop a surface quarry of sand and gravel for use as a component of tailings backfill or in lieu of tailings backfill altogether.
     - Paste backfill is the only tailings management strategy that has been described for the site. Outline and evaluate alternate tailings management strategies that may be utilized if final feasibility and design eliminate the use of paste backfill as a tailings management approach.

IR: INAC02-16

Subject: Closure Plan – Waste Rock Storage

Linkage: Technical Session Day 3

References:

DAR, CZN, March 2010.

Preamble:

The Waste Rock Storage is designed for an outer slope of 2H:1V. This surface is to be covered, although cover details are not provided. It is intended that the cover will restrict infiltration as a means to limit flushing of metals. In general, it is difficult to conduct earthworks, such as cover construction, on a 2H:1V slope, and, such a steep slope is prone to erosion.

The proposed location of the Waste Rock Storage with lateral diversions is near the lower end of a tributary (likely ephemeral, but none-the-less subject to runoff during extreme precipitation events and freshet snow melt). After closure the diversions may fail and the creek flow will pass either through the rock pile (as a flow-through rock drain) or over top. In either case, the stability of the pile or the cover may be affected, resulting in increased flushing of metals. INAC requests the following information to assess potential post-closure impacts.

Request:

1. Provide further evaluations to demonstrate that flushing of metals from the Waste Rock Storage Area will not increase in the future.

IR: INAC02-17

Subject: Closure Plan – Backfilling of Portals

Linkage: Technical Session Day 3

References:

DAR, CZN, March 2010.

Preamble:

Backfilling of mine workings and portals is proposed as a means to restrict groundwater flow through any voids. Whereas it is correct that this will restrict groundwater flow, the extent to which it will is uncertain. No objectives for post-closure levels (concentration and/or load) of metal release are proposed. INAC requests the following information to assess potential post-closure impacts.

Request:

1. The proponent should provide objectives for post-closure metal release and an evaluation which suggests that those levels can be achieved.