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Obed Mountain Mine
Environmental Protection Order No. EPO-2013/34-CR
2015 Remediation Sub Plans

Executive Summary

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1.0 BACKGROUND

On November 19, 2013, Alberta Environment and Sustainable Resource Development (ESRD) issued Environmental Protection Order No. EP0-2013/34-CR, as amended, (the "EPO") to Coal Valley Resources Inc. (CVRI). Clause 11 of the EPO sets out the requirements and details for the submission of an Impact Assessment Plan. The Impact Assessment Plan was submitted January 2014 with approval received April 24, 2014. Clause 15 of the EPO requires that all data collected under the Impact Assessment Plan be submitted in a report titled "Impacts Report". The final Impacts Reports was submitted to the AER May 29, 2015.

The 2014 Impact Assessment Report, submitted May 29, 2015, concluded that the 2013 Obed Incident floodwater caused damage to standing timber, surficial soils and to the bed and banks of Apetowun Creek. As it moved down slope, the water and solids picked up additional naturally occurring materials from the creeks and surrounding terrain. The heavier particles of solids settled within the headwaters of the Apetowun Creek while finer particles were carried onward to Plante Creek and the Athabasca River. Measures to remediate the impact of the incident have been undertaken including: the construction of four sediment traps along Apetowun Creek; the recovery of deposited sediment; the management of downed timber; the rehabilitation of damaged sections of Apetowun Creek; the installation of erosion control materials; and the revegetation of damaged areas.

The assessment of terrestrial resources affected by the incident has indicated that the most significant impact is found within the upper 5 km of Apetowun Creek. It is predicted that the soil remaining in place within the upper 5 km of Apetowun Creek will provide a suitable growing medium for the establishment of vegetation and subsequent restoration of wildlife habitat. Re-vegetation and weed control measures will assist vegetation recovery and natural succession of native plant species to communities comparable to pre-disturbance conditions. Wildlife surveys undertaken to date have confirmed the presence of local populations of large mammals, medium sized carnivores, hares and rodents in the area impacted by the incident.

Studies of aquatic environments indicated incident related impacts on fish and fish habitat (including substrates, periphyton and invertebrate communities) in upper Apetowun Creek, and measurable but more minor effects on fish and fish habitat in lower Plante Creek. Stabilization and partial recovery of fish habitat characteristics were evident in these creeks between spring and fall 2014. Effects of the release on the upper Athabasca River were less clearly indicated, although sentinel-species monitoring suggested reduced food availability or energy storage by small-bodied fish downstream of Plante Creek, which could be related to effects of the release. No residual, measurable effects of the release on water quality or sediment quality (judged by the frequency and distribution of exceedances of environmental quality guidelines) were indicated in Obed area creeks or the Athabasca River, including in far-field areas of the Athabasca River.

In order to accurately determine appropriate and necessary reclamation and remediation plans as set out in Clause 29 of the EPO, the Impact Assessment Report needs to be accepted and approved.

Clause 29 of the EPO details the content of the required Remediation sub-plans.

29. The Remediation Plan shall contain sub-plans to address remediation and restoration of the following impacted areas from the release:

a. waterbodies/aquatic environment of Apetowun Creek, Plante Creek, the Athabasca River and any other affected waterbodies,

b. riparian and fisheries habitat of Apetowun Creek and Plante Creek,

c. riparian and fisheries habitat of the portions of the Athabasca River that have been directly impacted by the release of mine wastewater, and

d. all impacted terrestrial habitats, including any wetlands, along or adjacent to Apetowun Creek and Plante Creek.

(collectively, these will be hereinafter referred to as the "Sub-Plans")

2.0 INTENT

As the EPO Clause 29 requires the submission of four individual sub-plans, the intent of this summary submission is to provide a framework for the future submissions of the detailed work plans. The sub plans will be based upon the agreement of the findings of the Impact Report and assessment work as outlined in the Long Term Sampling and Monitoring Program (the "LTSMP").

3.0 SUB-PLAN A, WATERBODIES/AQUATIC AFFECTED WATERBODIES

3.1 Effect Determination

Water quality data collected during the near field (Apetowun/Plante Creeks) and far field (Athabasca River) programs were evaluated by comparing concentrations against Alberta and federal surface water quality guidelines for the protection of aquatic life, available historical baseline data, and immediate post-incident data collected in November and December 2013. Concentrations and temporal trends for most variables showed predictable seasonal changes, with concentrations of particulates (TSS) and various particulate-associated total metals lowest during winter and highest during freshet.

Sonde data indicated that dissolved oxygen concentrations at all sampling stations met guidelines for protection of aquatic life at all times. Surface waters of Apetowun Creek and Plante Creek were characterized by high conductivity, TDS, alkalinity and hardness. Concentrations of these variables decreased gradually towards the downstream stations including Athabasca River stations. Turbidity measured in the Athabasca River was similar through 2014 between stations upstream and downstream of Plante Creek; any re-suspension of release materials in near-field areas during higher 2014 flows was not evident in turbidity values.

A sediment yield model, developed for the Athabasca River for this assessment, found that effects of the release on TSS and sediment flux in 2014 were relatively small, despite the visible suspended sediment plume that moved downstream to the lower Athabasca River immediately following the breach. Flow-TSS relationships in 2014 were consistent with pre-incident conditions, even near the point of release. No release-related downstream increases in turbidity were noted in the 2014 freshet period.

TSS and metals concentrations typically were low in 2014 at all sampling locations (lowest in winter), but showed occasional spikes in concentrations that appeared related primarily to periods of increased runoff in creeks or in the Athabasca River. During spring freshet flows, TSS concentrations exceeded short-term water quality guidelines in approximately 20% of the total samples in creeks. Similar exceedances were noted at Athabasca River near-field stations with even higher exceedances recorded at Athabasca far-field stations, indicating other sources of suspended particulates in the downstream river. Mercury and selenium concentrations typically were below analytical detection limits in Apetowun Creek. Organic bound methyl-mercury concentrations were well below water quality guidelines for the protection of aquatic life.

Concentrations of organic compounds were generally below analytical detection limits in almost all samples. Exceptions included a few polycyclic aromatic hydrocarbons (PAHs, including anthracene, benz(a)anthracene, fluoranthene, fluorene, phenanthrene, acridine pyrene, and retene), recoverable hydrocarbons, and phenols, but spatial and temporal patterns in these data did not suggest an influence of Obed release material on these concentrations.

Toxicity tests indicated no adverse effects of water samples from any location tested on rainbow trout embryos or juveniles, green algae, or water fleas. Adverse effects sometimes were observed on water flea reproduction and algal growth, but these effects were similarly observed in water samples from reference and exposure locations, suggesting that Obed release materials were not the proximate cause of these results.

Comparison of 2014 data with the historical (pre-incident) range of data at ESRD LTRN stations along the Athabasca River indicated an increase in TSS and some TSS-related total metals at Town of Athabasca during the spring 2014 freshet that could have been related to Obed release materials being carried downstream. However, these and other concentrations remained within historical ranges at this location and other stations farther downstream at Fort McMurray and Old Fort, indicating no measurable effect of the Obed release on water quality at these downstream locations in 2014.

Screening of sediment quality data for the released material against sediment quality guidelines and upstream conditions indicated that arsenic was the only metal of potential concern contributing to the receiving environment from the release. The arsenic concentrations in release materials were generally higher than upstream reference sediments and occasionally exceeding the CCME *Interim Sediment Quality Guideline* (ISQG). The concentrations were typically near or below the ISQG and did not exceed the CCME Probable Effects Level (PEL) at any time at any location. The concentrations did not show any spatial or temporal patterns in Athabasca River samples suggesting there are no measurable incident-related influences. Several PAH compounds (including naphthalene, 2-methylnaphthalene, acenaphthene, fluoranthene, fluorene, phenanthrene and pyrene) were identified as compounds of potential concern (COPCs) in sediments because they were both occasionally higher in release materials than upstream reference sediments and exceeded published sediment quality guidelines (CCME ISQGs). However, concentrations of these compounds in reference, near-field and far-field sediments in 2014 were typically at or near detection limits (which exceeded ISQG thresholds for some PAHs), and did not show spatial or temporal patterns that indicated that the release was the source of these compounds in receiving environments or that the release had increased their concentrations above their pre-existing range of variability in these receiving environments.

Seasonal testing of sediment toxicity suggested no spill-related adverse effects on survival or growth of test organisms (the amphipod *H. azteca* and the chironomid *C. dilutus*) in sediments collected from affected areas.

3.2 Planned Remediation

Effects of the release incident on the Athabasca River were primarily associated with a rapid increase in turbidity and increases in suspended solids concentrations, which altered water chemistry. Second to the turbidity, the deposition of release material resulted in the smothering of naturally erosional substrates; no scouring impacts were observed in the Athabasca River (CVRI 2015). Sediment deposition surveys conducted in April 2014 (pre-freshet) and September 2014 (post-freshet) found that nearly all release material had been redistributed by the freshet and carried downstream to existing depositional areas of the lower Athabasca River.

Given the lack of physical long-term impacts to the Athabasca River, no remediation activities are proposed at this time. Monitoring of fish, fish habitat, benthic invertebrates, periphyton, water and sediment quality, as described in the LTSMP, will continue to on the Athabasca River. Should these programs identity the need for additional remediation activities in the Athabasca River, they will be identified and submitted to the AER with an addendum to the specified approved remediation sub plan, Clause 29 of the EPO.

4.0 SUB-PLAN B RIPARIAN/FISHERIES HABITAT APETOWUN/PLANTE CREEKS

4.1 Intent

This Sub-Plan is being produced as part of the EPO requirements for the Remediation Plan. The objective of the Remediation Plans is *"…the restoration of all impacted aquatic, riparian, and terrestrial habitats to an equivalent capability and condition as existed prior to the release of mine wastewater"* (ESRD 2013).

The objectives of this Sub-Plan are to:

1. Summarize the current capability and condition of the aquatic environment components;
2. Identify or reaffirm existing aquatic capability and condition endpoints.
3. Present the approach to achieve aquatic capability and condition endpoints.
4. Outline any potential habitat limitations and determine requirement(s) for remedial actions.
5. Provide detailed plans to be used as directives for any potential remedial activities to achieve endpoints.
6. Provide remediation monitoring requirements to assess the effectiveness of the remediation activities. All of the monitoring activities will be incorporated into the LTSMP of Apetowun and Plante Creeks to ensure consistency with ongoing monitoring programs.

4.2 Aquatic Environment

4.2.1 Release Pathway Drainages

The aquatic habitat specific to the release pathway is defined into two distinct parts: near-field and far-field. The near-field portion of the release pathway includes Apetowun Creek and Plante Creek, while the far-field portion of the release pathway is the Athabasca River. Apetowun Creek was the direct receiving body for the Obed material release (Hatfield 2014).

4.2.2 Aquatic Environment Components

Typically, the aquatic environment is divided into the following four inter-connected components:

- Water Quality;
- Benthic Invertebrates;
- Fish Communities/Populations; and
- Riparian Habitat.

For the purposes of the remediation planning, these four inter-connected components will be combined with channel conditions to be evaluated as a single element; fish habitat. The Sub-Plan will focus on fish habitat as the main component that may be enhanced or modified through remedial activities in order to progress towards meeting the "equivalent capability and condition" as stated in EPO-2013/34-CR.

4.2.3 Objective

Given the historic and current prevalence of ARTR within the Apetowun Creek and Plante Creek drainage, the "Threatened" and "Endangered" status of the ARTR, and the recovery strategy declared in the Alberta Athabasca Rainbow Trout Recovery Plan, remedial activity planning will focus on ARTR habitat.

4.3 Remediation Planning

The intent of the Sub-Plan is to describe the mechanisms that will be used to restore the impacted aquatic habitat to an *"equivalent capability and condition as existed prior to the release of mine wastewater."*

There will be two general pathways used to achieve the equivalent capability and condition: one through implementation of remedial actions (Active Remediation) and the other through the naturalization of the impacts to the release pathway (Passive Remediation).

- Active Remediation

  The application of mechanical means to achieve remediation objectives (*i.e.* building instream structures with heavy equipment). Active Remediation has the greatest capacity to alter/modify the existing fish habitat, but also presents the greatest potential to produce negative impacts on the existing fish habitat (*i.e.* the construction of access trails removing riparian vegetation and increasing stream access to recreational OHV operation).

- Passive Remediation

  The application of minor mechanical means and significant dependence on the naturalization of the release event impacts to achieve remediation objectives (*i.e.* allowing the development of riparian vegetation to stabilize banks and provide fish cover). Passive Remediation presents the least risk of impacting the existing fish habitat, but also has the least potential to immediately alter/improve fish habitat, resulting in a prolonged un-remediated state.

The approach to the remediation planning is laid in the following steps:

1. Once a set of feasible habitat limitations have been agreed upon via the approval of the Impact Report and required addendums, the sub-plan will delineate the (mechanical input) remedial

actions or if the habitat limitation(s) can be remedied through passive (minor mechanical input or naturalization) means; considering the risks associated with the probable additional impacts relating to active remedial remediation, and considering the risks associated with a prolonged timeline associated with passive remediation.

2. Site specific / location work plans will be produced to be used as directives for ground-level remedial activities.
3. Monitoring plans will be reviewed and additions to the LTSMP will be completed submitted via an addendum. Pending regulatory approval, the remediation planning team will implement the remediation actions prescribed in the Sub-Plan.

4.4 EndPoints

The measurable endpoint objectives of the Sub-Plan can be para-phrased as having comparable fish community performance metric values (total density, species richness, diversity, and assemblage tolerance index) to historic data or reference sites. However, it has been identified in the impact assessment report that given the relatively limited species diversity and fish capture numbers in the Apetowun Creek and Plante Creek drainage that not all performance metrics and statistical tools presented in the fish monitoring plan are required or practical to compare past and current aquatic habitat capability and condition (CVRI 2015).

As identified in the Impact Assessment Report, the most apparent difference between the past and current capability and condition of the Apetowun Creek and Plante Creek drainage was the absence of the ARTR in upper Apetowun Creek. Furthermore, as indicated in Section 3.2, there is a sharp difference in the physical habitat conditions of upper Apetowun Creek (the upper half of Zone 1) and the remainder of the drainage. The habitat conditions of upper Apetowun Creek likely require, and are suitable for Active Remediation. As such, unless other areas within the release pathway are identified as requiring remediation activities by the ongoing assessments presented in Section 4.1.3; the hard (measureable and quantitative) endpoint objective for remediation in Apetowun Creek and Plante Creek will be to achieve performance metric values comparable with the Obed Mountain Mine Fishery Monitoring Program data. The Obed Mountain Mine Fishery Monitoring Program data for Apetowun Creek provides the most robust recent historical reference data available for both upper Apetowun Creek and for the entire Apetowun Creek and Plante Creek drainage. The hard objective values are averages of the Obed Mountain Mine Fishery Monitoring Program data for Rainbow Trout population densities, and catch per unit effort.

The current hard objectives for the Sub-Plan are as follows:

- ARTR population density estimate values equal to or greater than 4.79 Rainbow Trout/100 m^2 within a section length exceeding 40 times the average channel width or not less than 150 m (Reynolds *et al.* 2003).
- ARTR catch per unit effort values equal to or greater than 0.46 Rainbow Trout/min.

Athabasca Rainbow Trout specific parameters that will be considered in the assessment are as follows:

Athabasca Rainbow Trout Gravel

Appropriately sized gravel substrates are critical for reproduction by salmonids including Athabasca Rainbow Trout. Stream resident Athabasca Rainbow Trout are generally smaller than their counterparts in more productive environments. Athabasca Rainbow Trout are known to attain considerable size in reclaimed lake habitats (Sonnenberg and Boorman 2014b, Sonnenberg 2011), but generally exist in relatively unproductive small mountain and foothills streams.

An optimal gravel size for Athabasca Rainbow Trout has been suggested at 10 mm (Alberta Athabasca Rainbow Trout Recovery Team 2014) which is smaller than what is considered optimal in Raleigh *et al.* 1984. As such, optimal spawning gravels for stream resident Athabasca Rainbow Trout will be considered to range from 5 mm to 30 mm for the purpose of this HSI inventory rather than 15 mm to 60 mm as is considered optimal by Raleigh *et al*. 1984.

Following habitat inventory and HSI analysis, any required remediation/enhancement efforts would attempt to provide gravels averaging 10 mm in diameter which are relatively free of fine sediment.

Athabasca Rainbow Trout Spawning Habitat Availability

Lack of adequate spawning habitat may be attributable to lower than expected Rainbow Trout densities in many streams. Though a comprehensive study of this parameter has not been undertaken, many stream reaches have been thoroughly studied within the range of native Athabasca Rainbows and allow some values to be tabulated. Large amounts of spawning habitat are not needed in order to support a substantial density of Athabasca Rainbow Trout, but it would appear as though minimal thresholds do need to be accommodated.

Table 1 Summary of Athabasca Rainbow Trout habitat characteristics from local streams.

Steam/ Study Area	Gravel Substrate Abundance (%)	Fines (%)	Spawning Habitat	Rainbow Trout Density (n/100m2)
Falls Creek 2008-2009[1]	6.4%	41.4%	0.5 (0.03% of area)	2.1 to 6.2
Sphinx Creek 2008-2009[1]	18.1%	2.4%	-	11.2 to 18.1
ERT1[2]	26.5%	32.1%	23.0 m^2 (0.47% of area)	11.3 to 19.8
Bacon Creek[2]	16.7%	39.3%	14.6 m^2 (0.27% of area)	12.2
Chance Creek[3]	27.9%	26.8%	8.0 m^2 (0.16% of area)	11.1
Embarras River 2013-2014[4]	24.7%	17.6%	-	135.4 to 181.0
Embarras River 2013-2014[5]	18.2%	26.4%	-	10.4 to 44.9
Suggested Quality Ratings Based on all Sites	*Low (<10%)* *Mod (10-19%)* *High (20% +)*	*Low (40% +)* *Mod (10-39%)* *High (<10%)*	*Low (<0.2%)* *Mod (0.2-0.5%)* *High (0.5% +)*	*LowRisk[6] (>5.0)* *Moderate Risk[6] (2.0-5.0)* *High Risk[6] (<2.0)*

[1]Sonnenberg 2011
[2]Pisces 2012
[3]Pisces 2008
[4]Sonnenberg and Boorman 2015 in prep- natural channel downstream of fish exclusion device
[5]Sonnenberg and Boorman 2015 in prep – constructed channel upstream of Middle Embarras Lake
[6]Alberta Sustainable Resource Development and Alberta Conservation Association (2009)

Athabasca Rainbow Trout Water Quality

Rather than try to analyze water quality on a parameter by parameter basis for Athabasca Rainbow Trout, the water quality of the impacted streams will be compared to the Environmental Quality Guidelines for *Alberta Surface Waters for the Protection of Aquatic Life* (ESRD 2014). Water quality parameters should meet these guidelines or be comparable to non-impacted local streams. If certain parameters are found to be exceeded, mitigation strategies will be developed to determine if remedial actions are warranted.

Table 2 Water chemistry variables and water quality guidelines.

Variable	Units	Long-Term (Chronic)	Short-Term (Acute)	Source & Date	Notes
Physical Characteristics					
Conductivity	**µS/cm**				
Oxygen-dissolved	mg/L	6.5	5.0	AEP 1997	Oxygen values are minimum. See AEP 1997 for guidance when natural conditions do not meet guidelines. Long-term is 7 d mean, short-term is instantaneous value.
		8.3			For mid-May to end June, to protect Mayfly emergence.
		9.5			For areas and times where larval fish develop within gravel beds.
pH		6.5-9.0		USEPA 1996	Not to be altered by more than 0.5 units from background
Solids - total dissolved	mg/L				
Solids - total suspended	mg/L	Narrative	Narrative	CCME 1999	During clear flows or for clear waters: Maximum increase of 25 mg/L from background for any short-term exposure (*e.g.* 24-h period). Maximum average increase of 5 mg/L from background levels for longer termexposures (>24 h) During high flow or for turbid waters: Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥250 mg/L
Temperature	ºC	Narrative	Narrative	CCME 1987	Thermal additions should not alter thermal stratification or turnover dates, exceed maximum weekly average temperatures, nor exceed maximum short-term temperatures
Ions					
Alkalinity (as $CaCO_3$)	mg/L	20		USEPA 1986	A minimum value; unless natural conditions are less
Bicarbonate	mg/L				
Carbonate	mg/L				

Table 2 Water chemistry variables and water quality guidelines.

Variable	Units	Long-Term (Chronic)	Short-Term (Acute)	Source & Date	Notes
Chloride	mg/L	120	640	CCME 2011	
Hardness	mg/L				
Hydroxide	mg/L				
Ionic Balance	%				
Oil & Grease	mg/L	Narrative	Narrative	ESRD 2014	Oil and grease attributable to human activities should not be present in amounts that: - cause visible sheens, films, or discolourization; - can be detected by odour; - cause tainting of edible aquatic biota; and - form deposits on shores or bottom material that are detectable by sight or odour, or are deleterious to resident biota.
Sulfate	mg/L	Varies		BC 2013	Varies with hardness. See Table 1.7. Averaging period is 30 d.
Sulfide	µg/L	1.9			As S, but can be applied to undissociated H_2S if concerns arise. Averaging period is 4 d.
Trace Organic					
Benzene	µg/L	40		BC 2007	Interim. Applies to maximum concentration.
Toluene	µg/L	0.5		BC 2007	Maximum concentration should not exceed.
Ethylbenzene	µg/L	90		CCME 1996	
Xylene	µg/L	30		BC 2007	Applies to sum of all isomers. Maximum concentration should not exceed.
Phenol	µg/L	4		CCME 1999	
Nutrients					
Nitrate	mg/L	3.0	124	CCME 2012	As N. For protection from toxicity. Does not consider eutrophication.

Table 2 Water chemistry variables and water quality guidelines.

Variable	Units	Long-Term (Chronic)	Short-Term (Acute)	Source & Date	Notes
Nitrite	mg/L	Varies	Varies	BC 2001	As N. Varies with chloride. See Table 1.4. Averaging period is 30-d for long-term and instantaneous maximum for short-term
Nitrogen - total (inorganic & organic)	mg/L	Narrative		ESRD 2014	For Lakes: No increase in nitrogen (total) over existing conditions. Where nitrogen have increased due to human activity, develop lake-specific nutrient objectives and management plans where warranted.
Phosphorus	mg/L	Narrative		ESRD 2014	For Lakes: No increase in phosphorus (total) over existing conditions. Where phosphorus have increased due to human activity, develop lake-specific nutrient objectives and management plans where warranted.
Chlorophyll-a	µg/L				
***Metals**					
Arsenic	µg/L	5		CCME 1997	
Antimony	mg/L				
Aluminium	µg/L	50 or equation if pH <6.5	100 or equation if pH <6.5	BC 2001	For pH<6.5, see Table 1.1. For long-term, use 30-d mean (based on median pH). For short-term, use instantaneous maximum (and instantaneous pH)
Barium	mg/L				
Beryllium	mg/L				
Bismuth	mg/L				
Boron	mg/L	1.5	29	CCME 2009	
Cadmium	µg/L	Equation		CCME 2014	Varies with hardness. See Table 1.3
Calcium	mg/L				
Chromium	µg/L				In this context, total refers to analysis of unfiltered samples and not forms.
Cobalt	µg/L	2.5		EnvCan 2013	
Copper	µg/L	7	Equation	AEP 1996b	The long-term guideline only applies to waters of hardness ≥50 mg/L $CaCO_3$. The short-term guideline varies with hardness- see Table 1.3.

Table 2 Water chemistry variables and water quality guidelines.

Variable	Units	Long-Term (Chronic)	Short-Term (Acute)	Source & Date	Notes
Iron	µg/L	300		CCME 1987	
Lead	µg/L	Equation		CCME 1987	Varies with hardness. See Table 1.3.
Lithium	mg/L				
Magnesium	mg/L				
Manganese	mg/L				
Mercury	µg/L	0.005	0.013	AEP 1998	Averaging period is 4 d for long-term and 1 hr for short-term.
Molybdenum	µg/L	73		CCME 1999	Interim
Nickel	µg/L	Equation	Equation	USEPA 1995	Varies with hardness. See Table 1.3. Averaging period is 4 d for long-term and 1 hr for short-term.
Potassium	mg/L				
Selenium	µg/L	1		CCME 1987	
Silicon	µg/L				
Silver	µg/L	0.1		CCME 1987	
Sodium	mg/L				
Strontium	µg/L				
Sulfur	µg/L				
Thallium	µg/L	0.8		CCME 1998	
Tin	µg/L				
Titanium	µg/L				
Uranium	µg/L	15	33	CCME 2011	Refers to toxicity only and not radioactivity
Vanadium	µg/L				
Zinc	µg/L	30		CCME 1987	

**Metals as total

Athabasca Rainbow Trout Temperature

Raleigh *et al*. 1984 suggests an overall optimal temperature range of 12 to 18 0C for Rainbow Trout with optimal spawning temperatures ranging from 7 to 12 0C. The Alberta Athabasca Rainbow Trout Recovery Team (2014) suggests optimal spawning temperatures ranging between 6 to 10 0C with optimal overall temperatures ranging from 4 to 15 0C. As remediation objectives can only be indirectly influenced to change temperatures, the optimal temperature values as presented by Raleigh *et al*. 1984 were utilized to calculate HSI scores. Sonnenberg (2011) found increased stream temperatures resulting from end-pit lakes resulted in increased reproductive success by Athabasca Rainbow Trout as compared to success under natural temperature regimes. In the event that temperature can be influenced on the remediated landscape, values as provided by Alberta Athabasca Rainbow Trout Recovery Team (2014) should be considered as optimal.

4.5 Monitoring

This section will discuss the proposed addendum to the Long Term Sampling and Monitoring Program required to assess the progress, success and issues with the Aquatic Remediation Sub-Plan Corrective Actions

5.0 SUB-PLAN C RIPARIAN/FISHERIES HABITAT ATHABASCA

5.1 Effect Determination

Fish communities in the upper Athabasca River were surveyed in spring and fall 2014, in multiple reaches from upstream of Plante Creek to near Whitecourt. Adult, large-bodied fish in the upper Athabasca River were generally similar in community composition and morphometric characteristics (*i.e.*, age, condition, external health *etc.*) among all sampling reaches, with results similar to previous EEM studies in the river undertaken in the late 1990s. Total catch and catch-per-unit-effort for mountain whitefish and longnose suckers generally decreased with downstream distance in both spring and fall, independent of the location of the Obed release and consistent with the findings of historical EEM studies. Spring surveys were restricted by high freshet flows limiting the ability to draw meaningful conclusions from their results.

A sentinel-species program was undertaken in the upper Athabasca River upstream and downstream of Plante Creek using spoonhead sculpin. Sculpin condition, relative liver weight and relative gonad weight were significantly lower in the exposure area than in the reference area, suggesting reduced energy storage or food availability in the near-field area potentially related to habitat impacts of the Obed release.

A subset of adult fish were sacrificed for analysis of metals and PAHs in fish tissues. Overall, concentrations of metals in fish tissues were low in all species and areas sampled, with the exception of selenium in mountain whitefish (predominantly eggs), which frequently exceeded relevant tissue-quality guidelines (related to fish health, not health of human consumers). This finding is not considered related to the incident, given selenium concentrations in release-associated water and suspended materials were very low and that concentrations of selenium in mountain whitefish tissues were similar in both reference and exposure areas. Mean selenium concentrations in mountain whitefish were similar to those found in mountain whitefish collected from the upper McLeod and Smokey River systems, suggesting an independent regional source of this selenium. Mercury concentrations in some longnose suckers collected from both reference and exposure areas exceeded the CCME tissue-residue guideline for protection of piscivorous wildlife (such as mink and loons). However, concentrations were similar to those reported by others for fish collected from various uncontaminated lakes throughout BC and Alberta. The Obed release is not likely a source of this mercury, given mercury and methyl-mercury concentrations in release materials and receiving environments monitored throughout 2014 were very low.

5.2 Planned Remediation

Effects of the release incident on the Athabasca River were largely associated with a rapid increase in turbidity and increases in suspended solids concentrations that altered water chemistry, followed by the deposition and smothering of naturally erosional substrates; no scouring impacts were observed in the Athabasca River (CVRI 2015). Sediment deposition surveys conducted in April 2014 (pre-freshet) and September 2014 (post-freshet) found that nearly all release material had been re-suspended by the freshet and was carried downstream to more naturally depositional areas of the lower Athabasca River. In addition, in November and December of 2013, clean-up crews removed approximately 127 m^3 of release material from the Plante Creek/ Athabasca confluence. Given the lack physical impacts to the Athabasca River, no remediation activities are proposed at this time. The ongoing monitoring of fish, fish habitat, benthic invertebrates, periphyton, water and sediment quality, as described in the LTSMP, will continue to monitor potential long-term effects of the release incident on the Athabasca River. Should these programs identity the need for additional remediation activates in the Athabasca River, they will be identified in the annual impact assessment report.

6.0 SUB PLAN D TERRESTRIAL/WETLANDS APETOWUN AND PLANTE CREEK

6.1 Intent

The intent of the Sub-Plan is to address the remediation and restoration, to an equivalent land capability and condition as existed prior to the release of the mine wastewater, of all impacted terrestrial habitats, including any wetlands, along or adjacent to Apetowun Creek and Plante Creek in fulfillment of Environmental Protection Order No. EPO-2013/34-CR.

The objectives of the Sub-Plan include:

- Provide detailed plans for the proposed remediation and restoration activities of the impacted terrestrial habitats including details on active and passive remediation as well as methods, materials and equipment.

- Provide short-term and long-term goals towards establishing a terrestrial ecosystem equivalent in capability to the pre-disturbance ecosystem and details on how successful endpoints will be evaluated.

6.2 Current Conditions

This section will address impacted terrestrial conditions after the wastewater release as per the environmental assessment. A discussion on the current conditions of impacted terrestrial ecosystems, resulting from the initial release and the remediation efforts, will be summarized in the following sub sections. Methodologies for soil sampling, revegetation, soil stabilization, erosion control, monitoring, and any toxicity testing used to assess and/or remediate impacts on soils, vegetation and wildlife during the remedial work, will be presented.

6.3 Terrestrial Remediation Plan

This section will provide proposed activities for the remediation and restoration of impacted terrestrial habitats to an equivalent land capability and condition that existed prior to the release of the mine wastewater. A discussion on the implementation of methods, including Active and Passive Remediation pathways, to achieve equivalent capability, will be presented. Materials and equipment required for such process will be detailed.

6.3.1 Erosion Control

The section will discuss any additional erosion and sediment control required along Apetowun Creek. The proposed removal of erosion controls, such as silt curtains, will be presented once remediation goals are achieved.

6.3.2 Straw Bales

This section will detail an in situ disposal plan for the straw bales that were installed along parts of Apetowun Creek.

6.3.3 Bank Stabilization

The section will provide supportive documentation of any additional bank stabilization efforts required along the banks of Apetowun Creek that are presented in the Aquatic Sub Plan and the geomorphological assessment.

6.3.4 Woody Debris

This section will discuss any additional handling of woody debris piles that accumulated along the forest margins as a result of the mine wastewater release.

6.3.5 Mulch

This section will detail a disposal and/or redistribution plan for any areas along Apetowun Creek where mulch depths are found to be greater than 5 cm depth as per ESRD *Directive 2009-01*.

6.3.6 Infill Seeding

This section will discuss any areas along Apetowun Creek that require infill seeding with site specific, approved grass seed mixtures.

6.3.7 Infill Tree Planting

This section will discuss any areas along Apetowun Creek that require infill tree planting.

6.3.8 Noxious and Restricted Weed Control

This section will detail plans for ongoing noxious and restricted weed control through the use of cultural controls.

6.3.9 Reclamation of Temporary Access Roads

This section will provide detailed plans for the full reclamation of temporary access roads that were used during solids recovery and access to work areas along Apetowun Creek.

6.3.10 Reclamation of Sediment Traps and Associated Access Roads

The section will detail the short term, interim reclamation goals as well as the long term reclamation plans for of the three constructed sediment traps and their associated access roads.

6.3.11 Reclamation of Laydown Areas and Temporary Workspaces

This section will provide details on the reclamation plans for the laydown and temporary workspace areas that were required for the construction of the sediment traps and for solids recovery.

6.3.12 Wetlands

The section will discuss any required wetland reclamation and/or restoration in the zone of impact.

6.3.13 Wildlife

The section will discuss any future terrestrial wildlife habitat requirements and/or considerations along the zone of impact.

6.3.14 Geomorphic

The section will discuss any future geomorphic requirements.

6.4 Monitoring

This section will discuss the proposed addendum to the Long Term Sampling and Monitoring Program required to assess the progress, success and issues with the Terrestrial Remediation Sub-Plan Corrective Actions

6.5 Implementation Schedule

This section will outline the proposed schedule for terrestrial remediation activities until such time the impacted area are deemed to be on the appropriate trajectory towards achieving restoration end goals and equivalent land capability.