ALASKA POLLUTANT DISCHARGE ELIMINATION SYSTEM

PERMIT FACT SHEET

Permit Number: AK0038652

Teck Alaska, Incorporated

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Wastewater Discharge Authorization Program

555 Cordova Street

Anchorage, AK 99501

Public Comment Periods: April 25, 2011 through May 25, 2011 and
July 25, 2011 through August 26, 2011

Public Hearing: August 26, 2011 in Kivalina, Alaska

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An Alaska Pollutant Discharge Elimination System (APDES) permit is issued to

TECK ALASKA, INCORPORATED

For wastewater discharges from

Red Dog Mine into
Red Dog Creek,
82 miles north of Kotzebue, Alaska in the foothills of the DeLong Mountains
Latitude 68° 04'17" N, Longitude 162° 52' 05" W

The Alaska Department of Environmental Conservation (Department or DEC) issues an APDES individual permit (permit) to Teck Alaska, Incorporated (Teck). The permit authorizes and sets conditions on the discharge of pollutants from this facility to waters of the United States. In order to ensure protection of water quality and human health, the permit places limits on the types and amounts of pollutants that can be discharged from the facility and outlines best management practices to which the facility must adhere.

This fact sheet explains the nature of potential discharges from the Red Dog Mine and the development of the permit including:

- information on public comment, public hearing, and appeal procedures,
- a listing of effluent limits and other conditions,
- technical material supporting the conditions in the permit, and
- monitoring requirements in the permit.

Appeals Process

The Department will transmit the final fact sheet, permit, and Response to Comments to anyone who provided comments during the public comment period or who requested to be notified of the Department's final decision.

The Department has both an informal review process and a formal administrative appeal process for final APDES permit decisions. An informal review request must be delivered within 15 days after receiving the Department's decision to the Director of the Division of Water at the following address:

Director, Division of Water
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501

Interested persons can review 18 AAC 15.185 for the procedures and substantive requirements regarding a request for an informal Department review.

See http://www.dec.state.ak.us/commish/InformalReviews.htm for information regarding informal reviews of Department decisions.

An adjudicatory hearing request must be delivered to the Commissioner of the Department within 30 days of the permit decision or a decision issued under the informal review process. An adjudicatory hearing will be conducted by an administrative law judge in the Office of Administrative Hearings within the Department of Administration. A written request for an adjudicatory hearing shall be delivered to the Commissioner at the following address:

Commissioner
Alaska Department of Environmental Conservation
410 Willoughby Street, Suite 303
Juneau AK, 99811

Interested persons can review 18 AAC 15.200 for the procedures and substantive requirements regarding a request for an adjudicatory hearing. See http://www.dec.state.ak.us/commish/ReviewGuidance.htm for information regarding appeals of Department decisions.

Documents are Available

The permit, fact sheet, and other information are located on the Department's Wastewater Discharge Authorization Program website: http://www.dec.state.ak.us/water/wwdp/index.htm.

The permit, fact sheet, response to comments, and related documents can also be obtained by visiting or contacting DEC between 8:00 a.m. and 4:30 p.m. Monday through Friday at the addresses below.

Wastewater Discharge Authorization Program, Division of Water Alaska Department of Environmental Conservation 610 University Avenue Fairbanks, AK 99709 (907) 451-2136
Wastewater Discharge Authorization Program, Division of Water Alaska Department of Environmental Conservation 555 Cordova Street Anchorage, AK 99501 (907) 269-6285
Wastewater Discharge Authorization Program, Division of Water Alaska Department of Environmental Conservation 410 Willoughby Avenue, Suite 310 Juneau, AK 99801 (907) 465-5180

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TECHNICAL INFORMATION

I. APPLICANT

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Red Dog Operations
3105 Lakeshore Dr., Bldg A, Suite 101
Anchorage, AK 99507

Facility Contact: Robert Napier (907) 426-9145
Facility Location: foothills of the DeLong Mountains near Kotzebue, Alaska

II. FACILITY ACTIVITY

Teck Alaska, Incorporated (Teck), in partnership with the NANA Regional Corporation, operates the Red Dog zinc/lead mine in the Northwest Arctic Borough (NWAB) of Alaska, 82 miles north of Kotzebue and 47 miles inland from the coast of the Chukchi Sea. The mine site is located on a ridge between the Middle and South Forks of Red Dog Creek, in the DeLong Mountains of the Western Brooks Range. Red Dog is the world's largest zinc mine. NANA Management Services, Inc. provides camp management, housekeeping, catering and other services; and NANA/Lynden LLC, operates trucks carrying mineral concentrates from the mine to the Alaska Industrial Development and Export Authority's (AIDEA's) Delong Mountain Transportation System port facility.

The Red Dog deposit consists of metal sulfides in Mississippian shale. The orebody lies within the drainage basin of the Middle Fork of Red Dog Creek. Facilities at the mine site include an open pit zinc/lead mine, concentrator, tailings impoundment, concentrate storage building, maintenance facilities, power generation plant and an accommodations complex. The open pit mine is established on both sides of the valley of the Middle Fork of Red Dog Creek.

Mine production at the Red Dog Mine involves the stripping and stockpiling of ore, waste (i.e., rock with sub-economic value), and overburden/topsoil. Mill production involves crushing, grinding and processing to produce mineral concentrates. The Red Dog Mine main pit remained in production until 2012. The mine produces approximately 9,000 tones of ore per day. Teck is currently in mining a second pit, Aqqaluk, which would allow for continued mining through 2031.

The mill is located on a graded pad adjacent to, and northeast of, the tailings dam and requires a consistent feed of homogeneous ore material to optimize recovery. To accommodate this requirement, layered stockpiles, typically holding 280,000 tonnes, are built to combine the various types and grades of ore. The operation includes two crushing plants and grinding, flotation, reagent and dewatering facilities. Stockpiled ore is rehandled to a gyratory crusher where it is reduced to a size of less than six inches in one pass. Crushed ore is conveyed to an enclosed, coarse ore stockpile. The building is capable of holding about 15,000 tonnes of mill feed in one large pile. Coarsely crushed ore is withdrawn from underneath the stockpile to feed three Semi-Autogenous Grinding (SAG) mills. The grinding circuit overflow is delivered to the preflotation circuit. Froth flotation processes separate materials into floating (particles attached to bubbles) and sinking components, which produce concentrate and tailings, respectively.

Final lead and zinc concentrates are thickened and dewatered to a cake. These filtered concentrates are stored in the mill site concentrate storage building. From there, the concentrate is transferred by truck to the port site for shipment.

The concentrator tailings are pumped from the mill to the tailings facility and deposited either sub-aqueously or sub-aerially. The facility includes a rock fill dam and impoundment, a seepage collection and pumping system, a tailings discharge system (pumps and pipeline), and a water reclamation system.

The current dam crest is at elevation 970 feet. The pond elevation is at 963 feet. Upstream (south) of the dam, the impoundment is 8,000 feet long and 2,600 feet wide at its widest point. It is bounded on the south end by the Overburden Stockpile built on the divide between the South Fork of Red Dog Creek and Bons Creek. The impoundment has an ultimate capacity of approximately 39.3 million cubic yards (cy) of tailings, assuming that the tailings remain covered by water.

III. BACKGROUND

In the early 1980s, Teck submitted several applications for federal authorizations for the project. The surface water discharge was a new source which required EPA to prepare an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA). The EIS was issued in 1984 and the first NPDES permit was issued in 1985 and expired in 1990.

The permit was administratively extended and reissued in 1998. EPA proposed to modify the permit in 2003 but the conditions were appealed and the changed conditions did not go into effect. Teck re-applied for the NPDES permit in a timely manner so the permit has been administratively extended until it is reissued.

EPA reissued the NPDES permit in March 2007. The renewed permit was again appealed and EPA withdrew the reissued permit on September 27, 2007, citing the need to conduct additional NEPA analysis. On December 2, 2009, EPA issued an SEIS for permit reissuance which includes Teck's request to develop the Aqqaluk Pit.

On January 8, 2010, Region 10 reissued the NPDES Permit for the Red Dog Mine. On February 16, 2010, Trustees for Alaska and the Center on Race, Poverty and the Environment, representing regional environmental groups, local individuals and the Native Villages of Kivalina and Point Hope, filed a petition for review of the permit with EPA's Environmental Appeals Board (EAB). Among other things, the petition raised issues regarding antidegradation implementation procedures in the State of Alaska. By letter dated February 26, 2010, Region 10 identified five contested permit conditions that were stayed by the petition for review – effluent limits for lead (monthly average limit), selenium (daily maximum limit), zinc, weak acid dissociable (WAD) cyanide, and total dissolved solids (TDS). All remaining, uncontested permit conditions became fully effective and enforceable on March 31, 2010, in accordance with 40 CFR 124.16(a)(2) and 124.20(d). On March 17, 2010, EPA withdrew the five contested effluent limits and on April 30, 2010, the EAB dismissed as moot those portions of the petition for review related to the withdrawn limits.

On July 14, 2010, DEC issued a policy and procedure document setting forth *Interim Antidegradation Implementation* Methods. The legality of DEC's interim methods for conducting an antidegradation analysis was challenged in Alaska's Superior Court, case no.

3AN-11-07159CI. On September 4, 2012, the court found the Department's implementation of the interim methods legal and denied the challenge.

By letter dated September 8, 2010, Teck requested that EPA replace the withdrawn monthly average limitations for lead and zinc as well as the daily maximum limitations for selenium and zinc with the 1998 Permit limitations. The 1998 Permit limitations for these parameters are more stringent than those calculated for the 2010 Permit and are more stringent than necessary to protect the receiving water.

On November 8, 2010, the EAB denied review of the remaining issue in the petition related to monitoring requirements. This issue was further reviewed by United States Court of Appeals for the Ninth Circuit in Case No. 11-70776, *Native Village of Kivalina v. EPA*. On August 9, 2012, the court dismissed the complaint against EPA.

On December 8, 2010, Region 10 issued a final permit decision notifying the parties that, with the exception of the withdrawn limits identified above, all conditions in the 2010 Permit remained in effect. In addition, Region 10 stated that the following conditions in the 1998 NPDES Permit No. AK-003865-2 would remain in effect until further agency action:

- Part I.A.1 - effluent limitations for lead (monthly average limit), selenium (daily maximum limit), zinc, total dissolved solids, and total cyanide

On April 19, 2011, the validity of EPA's approval of the SSC for TDS in the Main Stem of Red Dog Creek was challenged in United States District Court. It was resolved on September 13, 2012, when the court upheld EPA's approval of the SSC and denied the challenge.

On April 25, 2011, EPA public noticed Statement of Basis (appendix F) for reinstating the permit limits that were withdrawn on March 17, 2010.

In November, 2012, EPA determined that all relevant appeals of the permit have been resolved and verbally notified DEC and Teck of the intent to transfer jurisdiction of the permit to DEC.

In a letter dated November 27, 2012, Teck requested that DEC not take action on the selenium daily maximum limit in light of Teck's continuing evaluation of recent discharge information. Based in part on Teck's request for no permit action on selenium, DEC takes no action on selenium (daily maximum), lead (monthly average), and zinc (monthly average and daily maximum) at this time. Unless DEC addresses selenium, lead, or zinc limits through a future permitting action, the corresponding limits from the 1998 permit remain in effect for selenium daily maximum (5.6 µg/L), lead monthly average (8.1 µg/L), zinc daily maximum (257.3 µg/L), and zinc monthly average (119.6 µg/L).

By letter sent on December 4, 2012, EPA formally transferred jurisdiction of this permit to DEC. The letter further stated that, "the Department may prepare the proposed final permit from an EPA-drafted permit and issue the permit, which would otherwise be prepared by EPA."

DEC addresses the five withdrawn limits as described in EPA's April 25, 2011 Statement of Basis (appendix F) and listed in the table below. DEC reinstates previously withdrawn 2010 Permit limits for TDS and WAD cyanide, and in taking no action on the withdrawn selenium, lead, and zinc limits, the 1998 Permit limits remain in effect for those parameters.

Parameter[1]	1998 Permit		2010 Permit		2013 Permit	
	Daily Maximum	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Monthly Average
Lead[2]	19.6	8.1	18.3	8.5	18.3	8.1
Selenium	5.6	4.9	7.2	4.4	5.6	4.4
Zinc[2]	257.3	119.6	269.2	155.9	257.3	119.6
Cyanide	9.0[3]	4.0[3]	22.2[4]	10.3[4]	22.2[4]	10.3[4]
TDS	196	170	1500 edge MZ		1500 edge MZ	

1. Units are µg/L.
2. Hardness-based metals criteria used a hardness of 260 mg/L $CaCO_3$.
3. Measured as total cyanide.
4. Measured as WAD cyanide.

IV. RECEIVING WATERS

A. Outfall Location. The facility discharges to the Middle Fork Red Dog Creek through outfall 001. Outfall 001, the discharge point for treated mine drainage and excess precipitation, is located at latitude 68º 04' 17" N, and longitude 162º 52' 05" W. Stormwater is also discharged through outfalls in the facility vicinity; and the outfall locations are defined in the Site Management Pollution Prevention Plan (SMPPP).

B. Water Quality Standards. The Alaska State Water Quality Standards (WQS) include use classifications, numeric and/or narrative water quality criteria, and the antidegradation policy. The use classification system designates the beneficial uses that each water body is expected to achieve (such as contact recreation, growth and propagation of fish, etc.). The criteria for each parameter are the criteria deemed necessary by the State to support the beneficial use classification of each water body.

The Middle Fork Red Dog Creek is protected in the WQS [18 AAC 70.230(e)(19)] for freshwater Class (1)(A)(iv) for industrial water supply use from the headwaters to the terminus of the Red Dog Mine Water Management System. Lower Middle Fork Red Dog Creek from the terminus of the Red Dog Mine Water Management System to the confluence with North Fork Red Dog Creek is protected in the WQS [18 AAC 70.230(e)(20)] for freshwater Classes (1)(A)(iv), (1)(B)(i) for contact recreation, wading only and (1)(B)(ii) for secondary recreation (except fishing). The main stem of Red Dog Creek from the confluence of the Middle and North Forks to Ikalukrok Creek is protected in the WQS [18 AAC 70.230(e)(18)] for freshwater Classes (1)(A)(iv), (1)(B)(i) for contact recreation, wading only, (1)(B)(ii) for secondary recreation, and (1)(C) for Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife. Ikalukrok Creek from its confluence with Red Dog Creek to the Wulik River is protected in the WQS [18 AAC 70.230(e)(8)] for freshwater Classes (1)(A)(iv), (1)(B)(i) for contact recreation, wading only, (1)(B)(ii) for secondary recreation, and (1)(C) for Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.

The water quality parameters that could be affected by the discharge from the facility include metals, solids, cyanide, and pH. These are common potential water quality parameters of concern in treated mine water discharges.

DEC has adopted, and EPA has approved, a site-specific criterion (SSC) for TDS that would result in effluent limitations different from those that would be required in the permit under the state-wide WQS.

The SSC for cadmium based on the natural condition is currently valid and has been approved by EPA. This type of SSC can be implemented in a permit and DEC and EPA used the SSC of 2 µg/L to develop permit limitations for cadmium.

V. DESCRIPTION OF DISCHARGE

The tailings pond at the Red Dog Mine receives water from a variety of sources. These sources potentially include: water associated with the tailings from the milling process which includes small amounts of the reagents used in the process; domestic wastewater, assay laboratory, filter press discharge, thickener overflows, and heavy equipment washing water carried by the gravity line from the mill/housing area; truck wash water; waste dump seepage; overburden pump back; SAG mill conveyor wet-scrubber, natural gas produced water; filter cloths which are buried with the tailings; soil cement used on the exposed tailings beach; seepage pumpback; blasting agents; secondary containment water; water used as dust suppressant that may contain small amounts of methanol; snow dump; mine sump water; sand filter backwash and sand deposited on the tailings beach; and Port wastewaters hauled to the mine site such as regeneration solution from the ion exchange treatment process at the Port. These contributions to the Tailings Impoundment are described in the re-application package.

Tailings pond water, often called reclaim water, is pumped by floating barge pumps in the tailings pond to two different water treatment plants at the mill facility. Water treatment plant 1 (WTP-1) operates year-round at a nominal rate of 6,000 gallons per minute (gpm) and provides the mill with treated water for processing. Water treatment plant 2 (WTP-2) is seasonally operated and treats reclaim water for discharge at Outfall 001 at a maximum capacity of 14,500 gpm. WTP-2 also has the ability to provide water to the mill when needed.

At WTP-2, reclaim water is first treated in the pipeline with at least 6 mg/L of sodium sulfide and mixed in an in-line mixer. The sulfide reacts with the dissolved cadmium in the reclaim water to form insoluble cadmium sulfide, which is stable throughout the remainder of the treatment process. Reclaim water then flows into a 6,500 cubic-foot (ft^3) rapid mix tank where reacted lime and recycled solids are added to adjust the pH to approximately 10.3 standard units (s.u.). From the rapid mix tank the solution gravity flows into a 50,000 ft^3 lime reactor that provides a nominal 20 minute residence time for complete chemical reactions. Large amounts of compressed air are sparged in to the rapid mix tank to ensure full oxidation of all ions in solution.

The significant chemical reaction occurring in the lime reactor is precipitation, altering the form of an ion from a dissolved state to a solid state, from soluble metals to insoluble metal-hydroxides. Teck has proposed using barium hydroxide rather than calcium hydroxide for this treatment step. The precipitated solids are maintained in suspension and flocculent is added, coalescing the smaller particles into larger solids. The flocculent is allowed to react in the agitated floc mix tank. From the floc mix tank, the solution gravity flows into a 200 foot diameter circular clarifier where the solids are allowed to settle under gravity and separate from the water. Settled solids are removed through the “underflow” and the treated water leaves the clarifier through the “overflow”. The majority of the underflow solids are recycled back to the beginning to the treatment process to a 1,200 ft^3 lime/sludge mix tank where the solids are

mixed with lime. Product in the lime/sludge mix tank is then fed into the rapid mix tank with the raw reclaim water.

Clarifier overflow water then gravity flows to the sand filters operated in parallel. The sand filters remove any residual solids not settled out of solution in the clarifier. From the sand filters, automated pH and turbidity meters take final measurements. If the pH is within permit limits and the range established which ensures effective treatment and the turbidity is within an established range which indicates that effective suspended solids removal has been accomplished, the water is discharged to Red Dog Creek. If the pH and turbidity are not within the prescribed range, the filtered water is discharged back into the tailings impoundment.

Water treatment plant 3 (WTP-3) was constructed during the winter/spring of 2004/2005 and began operating in 2006. The plant treats seepage and runoff from the Main Waste Stockpile and Mine Sump before it enters the tailings impoundment. Over time, the operation of WTP-3 is intended to help control TDS and sulfate levels in the tailings impoundment. Like WTPs-1 and 2, WTP-3 uses a lime precipitation process for metals removal.

VI. PERMIT REQUIREMENTS

A. Applicable Laws and Regulations

The Clean Water Act requires that the effluent limits for a particular pollutant be the more stringent of either technology-based effluent limits or water quality-based limits. A technology-based effluent limit requires a minimum level of treatment for industrial point sources based on currently available treatment technologies. A water quality-based effluent limit is designed to ensure that the water quality standards of a waterbody are being met. For more information on deriving water quality-based effluent limits, see Appendix C.

B. Effluent Limitations

1. Wastewater from Outfall 001

An evaluation for the discharge from Outfall 001 was done comparing the technology-based limitations in 40 CFR Part 440 Subpart J (18 AAC 83.010(g)(3)), plus other parameters of concern, with the WQ-based limitations discussed in Appendix C. For most parameters, the WQ-based limitation is more restrictive.

a. The following table summarizes the effluent limitations that are in the permit as well as comparing the effluent limitations and monitoring requirements of the previous permit. The information for the previous permit is in parentheses. An N/A means that this parameter was either not limited or not monitored in the previous permit. Parameters limits from the 1998 permit, the preceding effective permit, are denoted with parentheses in Table 1.

TABLE 1 – Effluent Limitations and Monitoring Requirements for Outfall 001				
Parameter (in µg/L unless otherwise noted)	Daily Maximum	Monthly Average	Sample Frequency	Sample Type[1]
Barium[2]	---	---	1/month (N/A)	24 hour composite
Cadmium[2]	3.2 (3.4)[7]	1.7 (2.0)[7]	1/week	24 hour composite
Copper[2]	34.4 (43.7)[7]	12.6 (15.1)[7]	1/week	24 hour composite
Chromium[2]	---	---	1/week	24 hour composite
Cyanide, WAD[3]	22.2 (9.0)[7]	10.3 (4.0)[7]	1/week	24 hour composite
Lead[2]	18.3 (19.6)[7]	8.1 (8.1)[7]	1/month (week)	24 hour composite
Manganese[2]	---	---	1/week	24 hour composite
Mercury, total	0.02	0.01	1/month	24 hour composite
Nickel[2]	216.5 (N/A)[7]	80.0 (N/A)[7]	1/week	24 hour composite
Selenium[2]	5.6 (5.6)[7]	4.4 (4.9)	1/week	24 hour composite
Zinc[2]	257.3 (257.3)[7]	119.6 (119.6)[7]	1/month (week)	24 hour composite
Total Suspended Solids (TSS), mg/L	30.0	20.0	1/week	24 hour composite
Total Dissolved Solids (TDS), mg/L	See Permit Part I.A.7.		1/week	24 hour composite
TDS Anions and Cations[4]	---	---	1/month	24 hour composite
Aluminum[2]	157.0 (N/A)[7]	53.0 (N/A)[7]	1/week (month)	24 hour composite
Iron[2]	---	---	1/month	24 hour composite
Fecal Coliform, #/100 ml[5]	400	200	1/ 2 months	Grab
Total Residual Chlorine, mg/L	---	---	1/month	Grab
Biochemical Oxygen Demand (BOD_5), mg/L	---	---	1/month	24 hour composite
Total Ammonia as N, mg/L	8.8 (N/A)[7]	5.7 (N/A)[7]	1/week	24 hour composite
Organic Priority Pollutant Scan[6]	---	---	1/year (3/yr)	24 hour composite
Turbidity, NTU	---	---	1/month (week)	Grab
Temperature, ºC	---	---	Daily	Grab
Cumulative Volume, gallons	See Permit Part I.A.3.		Continuous	Recording
Whole Effluent Toxicity, TUc	12.2	9.7	1/month	See Permit Part I.H.
pH, standard units	6.5 to 10.5		1/week	Grab

1. Effluent samples collected shall be representative of the effluent discharged without dilution from or contact with any outside sources. Results of analyses conducted under Part I.A.1. of this permit shall be submitted monthly on the discharge monitoring report.
2. All metals shall be analyzed as total recoverable unless otherwise indicated.
3. Cyanide was previously measured as Total but the WQS is now WAD. DEC authorized a mixing zone for WAD cyanide where one had not been authorized for total cyanide.
4. This monitoring shall include carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. The carbonate analysis should be estimated based on direct measurement of alkalinity.
5. The previous permit contained a limit on fecal coliform of 400 for a weekly average but the WQS allows only a very limited number of samples to be more than 400 which would make it a maximum value rather than an average.
6. Volatile organics shall be monitored using EPA analytical method 624, semi-volatile organics shall be monitored using EPA analytical method 625.
7. Parameters with values denoted by parentheses represent effluent limits from the previous effective permit.

2. Whole Effluent Toxicity (WET) Requirements

Chronic WET testing is included in the permit on a monthly basis. The testing will occur at Outfall 001 so that the full effects of the discharge into the Middle Fork Red Dog Creek will be determined. See Appendix C for further discussion.

3. Stormwater Outfalls

The discharge of pollutants to waters of the United States via stormwater is controlled in this permit by the establishment of a Site Management Pollution Prevention Plan (SMPPP). The basis for the SMPPP is described in Part VI.D. of this Fact Sheet and the requirements are found in Permit Part I.H.

4. Surface Water (Ambient) Monitoring

The following ambient monitoring shall be conducted:

TABLE 2 – Ambient Monitoring

Parameter[1]	Station 160[2]	Station 150	Station 151[2]	Station 12[2]	Station 140[2]
Aluminum	2/month	---	2/month	2/month	2/month
Cadmium	2/month	---	2/month	2/month	2/month
Chromium	2/month	---	2/month	2/month	2/month
Copper	2/month	---	2/month	2/month	2/month
Cyanide[3], WAD	---	---	2/month	---	---
Iron	2/month	---	2/month	2/month	2/month
Lead	2/month	---	2/month	2/month	2/month
Manganese	2/month	---	2/month	2/month	2/month
Mercury, total	2/month	---	2/month	2/month	2/month
Nickel	2/month	---	2/month	2/month	2/month
Selenium	2/month	---	2/month	2/month	2/month
Zinc	2/month	---	2/month	2/month	2/month
Total Ammonia as N, mg/L	2/month	---	2/month	2/month	2/month
Conductivity, umhos/cm	2/month	---	2/month	2/month	2/month
Hardness, mg/L $CaCO_3$	2/month	---	2/month	2/month	2/month
Temperature, ºCelsius	2/month	---	2/month	2/month	2/month
Total Dissolved Solids (TDS), mg/L	1/week	1/week	1/week	2/month	2/month

TABLE 2 – Ambient Monitoring					
Parameter[1]	Station 160[2]	Station 150	Station 151[2]	Station 12[2]	Station 140[2]
TDS Anions and Cations[4]	1/month	1/month	1/month	---	---
pH, standard units	2/month	---	2/month	2/month	2/month
Turbidity, NTU	---	---	---	2/month	2/month

1. Monitoring for metals shall be in µg/L and total recoverable unless otherwise noted. For additional monitoring requirements for aluminum, cadmium, chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, selenium, and zinc see section I.A.5.b.
2. The permittee shall spread out the sample collection dates so that the samples collected are representative of the calendar month. To the extent practicable, ambient monitoring shall coincide with effluent monitoring. If weather, safety, shipping, and other environmental constraints prevent the permittee from collecting representative samples, the permittee shall document the condition which prevented the representative samples from being collected on the discharge monitoring reports.
3. Since the permit includes limitations on WAD cyanide, the requirement for the permittee to notify the DEC and the ADF&G immediately by telephone should WAD cyanide concentrations exceed the detection limit is being removed from the permit.
4. This monitoring shall include a standard and complete suite of those cations and anions contributing to TDS including, but not limited to, carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. The carbonate analysis may be estimated based on direct measurement of alkalinity.
5. See Permit Part I.G. for additional testing requirements.

Ambient monitoring requirements at stations 2, 9, and 20 was discontinued because the monitoring is unnecessary to determine whether effluent treatment and the size of the mixing zones are adequate to protect all designated and existing uses in the receiving water.

C. Monitoring Requirements

40 CFR 122.48(b) (18 AAC 83.455) requires that the permit contain monitoring requirements. Self-monitoring of effluent parameters is necessary for the permittee to demonstrate compliance with effluent limitations, to assure that state water quality standards are met, and to provide information for future permitting actions. Monitoring frequencies are based on a determination of the minimum sampling frequency required to adequately monitor the facility's performance. Required sample types are based on a determination of the potential for effluent variability. These determinations take into consideration several factors, of which the most important are the type of pollutants of concern and the type of treatment system. The Limitation Table, above, includes the monitoring frequency and sample type proposed in the permit.

The monitoring frequency for zinc, mercury, and lead was reduced at Outfall 001. These parameters did not show a reasonable potential to violate the WQS and are included solely on the basis of their inclusion in the Effluent Limitation Guidelines. As such, the reduced the monitoring from weekly to monthly.

Reduced monitoring is also included for Organic Priority Pollutant Scans (OPPS). Monitoring results during the last permit cycle produced approximately 2000 non-detect results for the organic constituents in an OPPS. In addition, for all the OPPS conducted there have been two (2) values measured that were above the method reporting limits. Neither of these chemicals is used at Red Dog Mine, and they are both extremely common

laboratory cross-contaminants. Therefore, the monitoring frequency was reduced from 3 times per year to annually.

D. Best Management Practices

Section 304(e) of the CWA and 18 AAC 83.475 require DEC to include conditions in the APDES permit for developing a Best Management Practices (BMP) Plan and/or a Stormwater Pollution Prevention Plan (SWPPP) to control potential discharges such as runoff, spillage, and leaks. This permit requires a Site Management Pollution Prevention Plan (SMPPP) that combines general BMP Plan requirements with SWPPP requirements to control the discharge of toxics or hazardous pollutants by way of plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage at the mine site itself. Stormwater for the road and port site is covered under another permit. On a mine site, not all precipitation related drainage is considered stormwater for regulatory purposes. Drainage from the mine site is regulated as "mine drainage" rather than "storm water."

The SMPPP should recognize the hazardous nature of various substances used and produced by the facility and the way such substances may be accidentally dispersed. The intent of the SMPPP is to cover the facility and any ancillary activities that would need to control storm water discharges. The SMPPP should incorporate elements of pollution prevention as set forth in the Pollution Prevention Act of 1990, 42 U.S.C. 13101.

The SMPPP must be amended whenever there is a change in the facility or in the operation of the facility which materially increases the potential for an increased discharge of pollutants.

E. Quality Assurance Plan

The permit requires the permittee to review and modify the existing Quality Assurance Plan, as necessary, then implement the Plan. The purpose of the Quality Assurance Plan is to establish appropriate sampling, handling and analytical procedures for all effluent and ambient water samples taken.

F. Other Requirements or Changes from the current Permit

1. This permit prohibits the use of untreated mine water for road watering, even inside the mine pit. This provision is included in the permit to prevent the transport of pollutants contained in the untreated wastewater to sites that are not sloped toward the tailings impoundment.

2. Teck has indicated that they will not be discharging in the winter. This permit does not include any permit requirements that were related only to winter discharging.

3. The old permit contained biomonitoring prescribed by DEC in its 1998 CWA Section 401 Certification.

Table 3A – Current Bioassessment Monitoring	
Sample Site	Factors Measured
Middle Fork Red Dog Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance
North Fork Red Dog Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Main Stem Red Dog Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Ikalukrok Creek, stations 9, 7, and upstream and downstream of Dudd Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Ikalukrok Creek	Fall aerial survey of returning chum salmon
Wulik River	Metals concentrations in Dolly Varden gill, liver, muscle, and kidney. Fall aerial survey of overwintering Dolly Varden
Anxiety Ridge	Fish presence and use
Evaingiknuk Creek	Fish presence and use
Buddy Creek	Fish presence and use

The following table shows the monitoring that DEC included in this permit.

Table 3B – Proposed Bioassessment Monitoring	
Sample Site	Factors Measured
North Fork Red Dog Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Main Stem Red Dog Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Ikalukrok Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use

In the alternative, DEC included all biomonitoring in Waste Management Permit No.0132-BA002. This arrangement is supported by a court decision in *Native Village of Kivalina v. EPA.*

4. Teck requested Alternative Test Procedures (ATPs) for WAD cyanide, chlorides and metals. The ATPs for chlorides and metals were approved during the cycle of the old permit and are included in this permit. The ATP for WAD cyanide was approved by EPA in a letter dated November 16, 2005.

5. Teck requested that hardness be calculated rather than measured in the effluent. The monitoring for anions and cations in the permit makes this calculation possible.

6. Silver was monitored during the old permit cycle and has shown no reasonable potential to violate water quality criteria and has been removed from the permit.

7. The water balance modeling and water quality analysis in the SEIS provided information that indicated Teck will need to perform additional water treatment or source control to achieve TDS limits and discharge enough wastewater to maintain a safe water level behind the tailings impoundment dam. Teck has tested using barium hydroxide to lower TDS levels in the effluent and thereby increase the amount of wastewater that can be discharged. In order to ensure that Teck is able to meet the TDS limits and discharge sufficient wastewater, a new condition was added to the permit that requires Teck to develop and implement a TDS management plan. The TDS plan must describe the steps Teck will take to ensure that TDS limits are met and sufficient volumes of wastewater will be discharged. EPA and DEC will review the plan. In addition, Teck is required to report the water level behind the dam in comparison to freeboard. The TDS management plan is a mitigation measure that resulted from the SEIS analysis.

8. Teck may be using barium hydroxide rather than calcium hydroxide in water treatment during certain times of year. DEC determined that this will not require a change to the permit limits. However, monthly barium monitoring has been added to the permit. The only other constituent that could be elevated is manganese, and the permit already contains monitoring for this parameter.

9. DEC requires Minimum Levels (MLs) for the permit. An ML is the level at which the laboratory knows with certainty that a parameter is present in a sample at the level reported. The permit requires that in effluent monitoring for limited parameters, the ML be below the effluent limitation. All proposed MLs are below the effluent limitations in the permit except for selenium. The Minimum Level for selenium will be designated as the compliance level in the permit.

   For parameters without limits, the permit requires MLs that will make it possible to assess compliance with the applicable WQS. The following table lists the proposed MLs:

Table 4 – Minimum Levels (MLs)

Parameter[1]	MLs (µg/L)
Barium	60
Chromium	10
Iron	125
Manganese	10
Selenium	5
TRC	100

1 All metals shall be measured in total recoverable unless otherwise noted.

G. Additional Permit Provisions

Sections II, III, and IV of the permit contain standard regulatory language that must be included in all APDES permits. Because they are regulations, they cannot be challenged in the context of an APDES permit action. The standard regulatory language covers

requirements such as monitoring, recording, reporting requirements, compliance responsibilities, and other general requirements.

VII. OTHER LEGAL REQUIREMENTS

A. Endangered Species Act

As a state agency, DEC is not required to consult with National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS) regarding permitting actions. However, DEC values input from the Services.

Section 7 of the Endangered Species Act (ESA) requires federal agencies to request a consultation with the NMFS and the USFWS regarding potential effects an action may have on listed endangered species. EPA sent letters to the Services on November 19, 2008, requesting updated species lists for the project area.

In a letter dated September 21, 2005, for the 2007 permit issuance, USFWS determined that the reissuance of the NPDES permit is not likely to adversely impact listed species so further consultation under Section 7 of the ESA is not necessary.

Also for the 2007 permit issuance, a letter dated September 28, 2005, from NMFS stated that there are no threatened or endangered species listed under their jurisdiction in the project area.

Unless an updated list includes unexpected information on the site, DEC has determined that the re-issuance of this permit will have no effect on threatened or endangered species.

B. Essential Fish Habitat

As a state agency, DEC is not required to consult with NMFS or USFWS regarding permitting actions. However, DEC values input from the Services.

Section 305(b) of the Magnuson-Stevens Act [16 USC 1855(b)] requires federal agencies to determine whether any activity proposed to be permitted, funded, or undertaken by a federal agency may have an adverse effect on designated Essential Fish Habitat (EFH) as defined by the Act. The EFH regulations define an adverse effect as any impact which reduces quality and/or quantity of EFH and may include direct (e.g. contamination or physical disruption), indirect (e.g. loss of prey, reduction in species' fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

DEC has determined that issuance of this permit is not likely to have an adverse effect on EFH in the vicinity of the discharge. Effluent limitations have been incorporated into the permit based on criteria considered to be protective of overall water quality in Red Dog Creek based on the designated uses of the creek. There is also a weir (rock gabion) barrier to fish passage that prevents fish from coming into contact with the discharge. Any recommendations received from NMFS regarding EFH will be considered prior to final issuance of this permit.

C. Antidegradation

The antidegradation analysis required by 18 AAC 70.015 is contained in the within the draft 401 Certification from DEC (appendix B) and remains unchanged from the version public noticed from April 25, 2011 to May 25, 2011 and July 25, 2011 to August 26, 2011. See page 34 of this Fact Sheet.

D. Permit Expiration

This permit will expire five years from the effective date of the permit. Permits may be administratively extended under 18 AAC 83.020 if all the requirements of that regulation are met.

VIII. REFERENCES

Application package dated February 25, 2003.

Red Dog Mine Extension Aqqaluk Project Supplemental Environmental Impact Statement. December 2009.

EPA 1991. *Technical Support Document for Water Quality-based Toxics Control*. Office of Water Enforcement and Permits, Office of Water Regulations and Standards. Washington, DC, March 1991. EPA/505/2-90-001.

EPA 1999. *1999 Update of Ambient Water Quality Criteria for Ammonia.* Office of Water, Washington, D.C., December 1999. EPA-822-R-99-014.

Water Quality Criteria; Notice of Availability; 1999 Update of Ambient Water Quality Criteria for Ammonia. 64 Federal Register 71974 – 71980, December 22, 1999.

18 AAC 70, the Alaska Department of Environmental Conservation's Water Quality Standards.

18 AAC 72, the Alaska Department of Environmental Conservation's regulations for Wastewater Disposal.

1998 Permit Package including the final permit, response to comments and 401 Certification.

2003 Permit Modification Package including the final permit, response to comments, fact sheet, Environmental Assessment, and 401 Certification.

2007 Permit Package including the fact sheet, final permit (withdrawn), response to comments and 401 certification.

Letter dated November 16, 2005, from William Riley, EPA, to R.G. Scott, TCAK, regarding Alternative Test Procedures (ATPs).

Letter dated June 16, 2005, from DNR/OPMP to TCAK regarding the ACMP review.

Letter dated December 10, 2005, from R.G. Scott, TCAK, to Luke Boles, DEC, requesting that the SSC for zinc not be re-certified.

"WET Limit with Consideration to Updated Site-side Water Balance" submitted by TCAK to EPA on November 21, 2005.

EPA Water Quality Criteria for Water [63 FR 68354-68364, December 10, 1998].

Letter dated March 26, 2006, from John B. Knapp, TCAK, to Michael F. Gearheard, EPA, providing an addendum to the renewal application.

Letter dated April 18, 2008, from John B. Knapp, TCAK, to Michael F. Gearheard, EPA, proposing an alternative wastewater treatment technology.

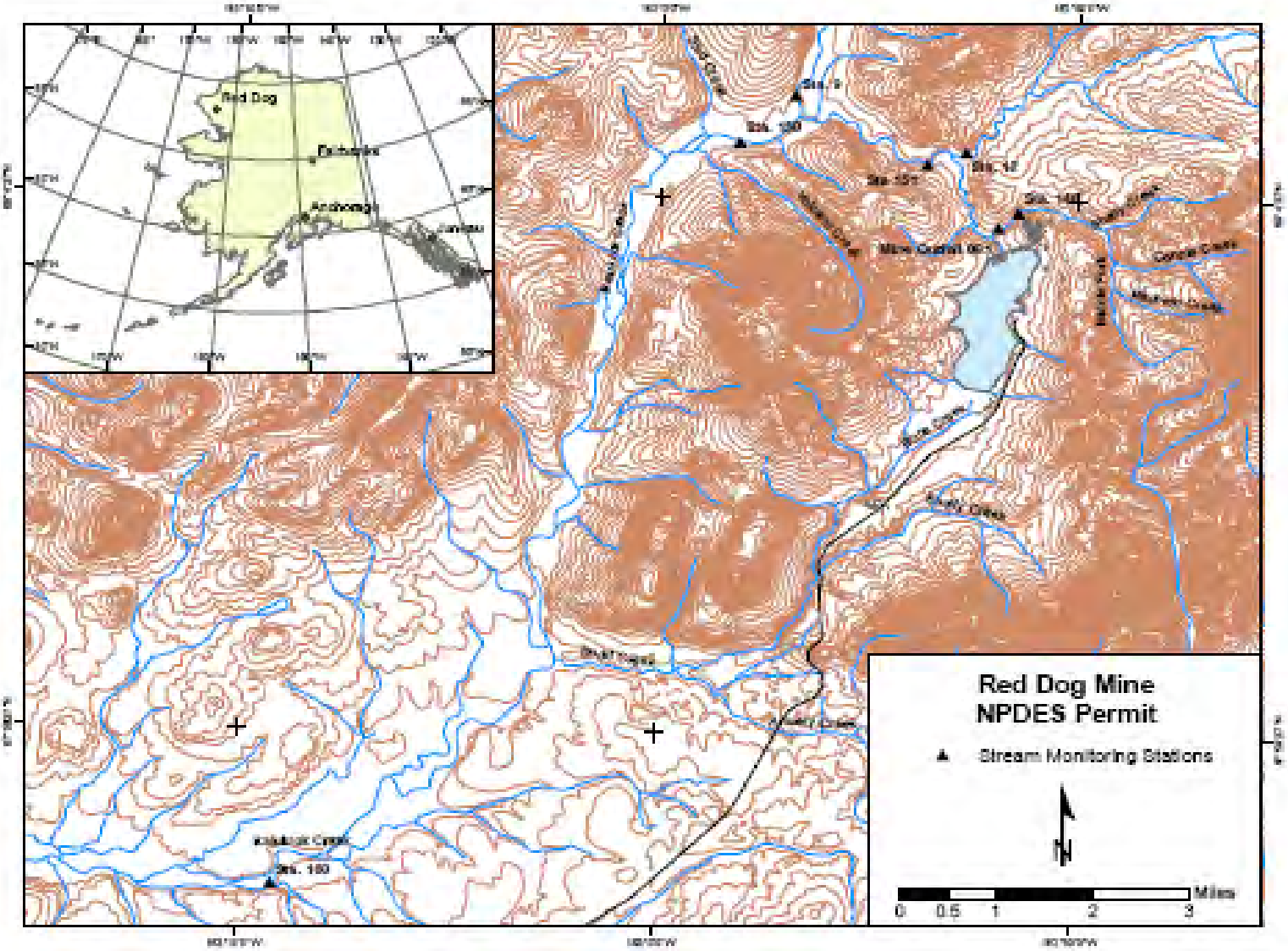
Native Village of Kivalina v. EPA, Case No. 11-70776, United States Court of Appeals for the Ninth Circuit, August 9, 2012.

Native Village of Point Hope v. EPA, Case No. 3:11-cv-00200-TMB, United States District Court for Alaska, September 13, 2012.

Alaska Center for the Environment v. DEC, Case No. 3AN-11-07159CI, Superior Court for the State of Alaska, September 4, 2012.

APPENDIX A

Red Dog Mine Location



APPENDIX B

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CERTIFICATE OF REASONABLE ASSURANCE

A Certificate of Reasonable Assurance, as required by Section 401 of the Clean Water Act (CWA), has been requested by Teck Alaska Incorporated (Teck) for National Pollutant Discharge Elimination System (NPDES) Permit AK-003865-2 to discharge treated wastewater and storm water from Red Dog Mine.

Public notice of the application for this certification was conducted according to 18 Alaska Administrative Code (AAC) 15.140.

A Water Quality Certification is required because the activity is authorized by a U.S. Environmental Protection Agency (EPA) permit identified as NPDES Permit AK-003865-2 and discharges will result from the activity.

The department certified AK-003865-2 on December 15, 2009, and the permit became effective on March 1, 2010. On March 17, 2010, the permit limits for lead, selenium, total dissolved solids (TDS), weak acid dissociable (WAD) cyanide, and zinc were withdrawn, and they were replaced with the limits for those substances contained in the 1998 permit. With the exception of the withdrawn limits, the permit remained effective. This permit action merely reinstates the withdrawn permit limits for TDS and WAD cyanide, compares the daily maximum and monthly average limits in the 1998 and 2010 permits for lead, selenium, and zinc, and imposes the more restrictive limit. For lead, the resulting limits combine the daily maximum from the 2010 permit with the monthly average from the 1998 permit; as for selenium, the daily maximum came from the 1998 permit and the monthly average from the 2010 permit; and both zinc limits were carried forward from the 1998 permit. For the sake of continuity, this Certificate supersedes the department's December 15, 2009 version. It covers the 2010 NPDES Permit AK-003865-2 and replaced limits in their entirety.

This NPDES Permit certification covers wastewater disposal from the following discharges:

1. Outfall 001 – discharge of treated wastewater and excess precipitation to the Lower Middle Fork of Red Dog Creek (Lower Middle Fork) located at latitude 68° 04'17" N and longitude 162° 52' 05" W and

2. Discharge of snowmelt and rainfall runoff from the site as indicated in the Stormwater Pollution Prevention Plan.

Under 18 AAC 70.235(b), the most recent EPA-approved regulation for Alaska site-specific criteria (SSC), the cadmium natural condition-based site-specific criterion (NCBSSC) in the Main Stem and Ikalukrok Creek, is 2.0 micrograms per liter (µg/L) derived from total recoverable metal concentrations. This value is representative of the natural condition and will protect all designated and existing uses.

The department reviewed the application, 2010 NPDES Permit, and this certification with respect to the water quality standard (WQS) antidegradation policy and finds the reduction in water quality to be in compliance with the requirements of 18 AAC 70.015, provided that the terms and conditions of this certification are made part of the final NPDES Permit. See Appendix A for the antidegradation analysis of decisions contained in this certification.
This Section 401 Certification applies to the 2010 NPDES Permit AK-003865-2. The department reviewed the discharges with respect to the Alaska Costal Management Program (ACMP) under 11 AAC 110. In a letter dated June 16, 2005, the ACMP stated that this version of NPDES Permit AK-003865-2 does not require a consistency review, because this is a continuation of an ongoing project and proposes no modifications to effluent concentrations or volumes when compared to the previous, ACMP-consistent permit. Therefore, pursuant to 11 AAC 110.820(k)(4) and11 AAC 110.830, consistency review is not required for this permit reissue.

Having reviewed the permit, the department certifies that there is reasonable assurance that the proposed activity and any resulting discharge complies with the requirements of CWA Section 401, which includes WQS (18 AAC 70). Through this certification, in accordance with 18 AAC 15.120, ADOPTION OF NPDES PERMITS, the NPDES Permit will constitute the permit required under Alaska Statutes (AS) 46.03.100 Waste Disposal Permit, provided that the terms and conditions of this certification are made part of the final NPDES Permit. The department is specifying the following permit terms and conditions under authority of AS 46.03.110(d).

1. This certification authorizes the following three mixing zones (NPDES Permit parts I.A.1, I.A.7a, and I.C.1), which have been numbered for the sake of reference.

   First, mixing zone 1 in the Lower Middle Fork extends from Outfall 001 downstream to the confluence with the North Fork of Red Dog Creek (North Fork). The Lower Middle Fork mixing zone is approximately 7,000 feet long, authorized for pH, and shall be monitored at Station 151.

   Second, mixing zone 2 in the Main Stem of Red Dog Creek (Main Stem) extends from the confluence of the Lower Middle Fork with the North Fork to Station 151. The Main Stem mixing zone is approximately 1,930 feet long and provides mixing in the ratio of 1.5 parts receiving flow to 1 part effluent inflow for a dilution multiplier of 2.5. This mixing zone is authorized for the following parameters: TDS, ammonia, and cyanide measured as WAD cyanide.

   Third, mixing zone 3 in Ikalukrok Creek extends downstream from the confluence of the Main Stem and Ikalukrok Creek to Station 150. The mixing zone is approximately 3,420 feet long and provides mixing in the ratio of 1 part receiving flow to1 part Main Stem inflow for a dilution multiplier of 2. The Ikalukrok Creek mixing zone is authorized for TDS.

   See the map and schematic diagram in Attachments A and B, respectively.

Rationale: In accordance with State Regulations 18 AAC 70.240 to 18 AAC 70.270 (June 26, 2003), which are the most recent mixing zone regulations approved by EPA for issuance and certification of NPDES Permits, the department has authority to authorize mixing zones in permits or certifications.

a) 18 AAC 70.240(a)(1). The applicable requirements of 18 AAC 70 will be met.

The proposed mixing zones meet the requirements of the State water quality regulations at 18 AAC 70. In addition, the requirements of 18 AAC 70 will be met at all points outside of the mixing zones.

b) 18 AAC 70.245(a). Existing uses of the waterbody outside the mixing zone will be maintained and fully protected, such that existing uses outside the mixing zone are neither partially nor completely eliminated, and the overall biological integrity of the waterbody is not impaired.

In considering whether the mixing zones should be authorized, the department determined that designated and existing uses of the receiving waters will be maintained and fully protected.

The department's review of effluent monitoring data and studies conducted by the Alaska Department of Fish and Game (ADF&G) indicate that designated and existing uses will be maintained and fully protected in areas outside the mixing zones, including in the Main Stem, North Fork, and Ikalukrok Creek.

In the case of TDS, the discharge concentrations have been authorized by the department under Compliance Orders by Consent (COBCs) for nearly a decade. During this time, discharge water quality and biological impacts have been extensively monitored and analyzed by the department, ADF&G, and EPA. Under the 2003 permit modification, TDS limits at the boundary of mixing zone 2 were 1,500 milligrams per liter (mg/L) during Arctic grayling non-spawning and 500 mg/L during grayling spawning periods and 1,000 mg/L at the boundary of mixing zone 3. During non-spawning periods, there has been only one instance when water quality within mixing zone 2 did not comply with the limits contained in the 2003 permit modification. Water quality within mixing zone 3 has never deviated from limits contained in the 2003 permit modification. Upon appeal of the 2003 permit modification, the 500 mg/L limit for grayling spawning was remanded to EPA by the Environmental Appeals Board (EAB) for further consideration. Subsequent to the 2004 EAB decision, the department developed, and EPA approved, a revised SSC for the Main Stem, which established a TDS WQS of 1,500 mg/L for both spawning and non-spawning periods. The department determined that these levels would fully protect designated and existing uses of the waterbody, as summarized in the department's January 27, 2006 decision document supporting the TDS SSC.

Aquatic monitoring has shown fish populations in Red Dog Creek increase and decrease with time. There are, however, no discernible differences between populations in areas exposed to discharges from mine operations and in the North Fork, which is not exposed to mining operations. There also have been no effects on fish populations in the North Fork compared to pre-mining conditions indicating that there have not been adverse impacts on fish passage through the watershed. Last, there have been no observable negative impacts on designated or existing uses, within the mixing zones or outside of them, since mining began. Over a decade of State of Alaska biological monitoring

reports[1] indicate that discharges of TDS have not impaired designated or existing uses, either within or outside the mixing zones, and there will be no impairment to the overall biological integrity of the waterbody.

For ammonia, there was no effluent limit in the 1998 permit. The actual discharge of ammonia is expected to be consistent with, or less than, historical levels and will not contribute to any impairment of designated or existing uses. Based on analysis of discharge data, concentrations of ammonia in the mixing zone are expected to be significantly below the acute WQS, such that chronic levels of ammonia would rarely occur in the mixing zone between the North Fork and Station 151. For these reasons, the department has determined that the water quality associated with the ammonia limit will be adequate to fully protect designated and existing uses.

For cyanide, the permit imposes a new limit based on weak acid dissociable (WAD) cyanide. The actual discharge of cyanide is expected to be consistent with historical levels and will not contribute to any impairment of designated or existing uses. Discharge data indicates that the median value of WAD cyanide concentration in the effluent is well below chronic levels. Considering dilution, chronic levels of cyanide are not anticipated to occur in the mixing zone between the North Fork and Station 151. Additionally, the maximum projected concentration for WAD cyanide at the point of discharge is below the acute WQS. Concentrations of WAD cyanide in the mixing zone are expected to be significantly below the acute and chronic WQS. For these reasons, the department has determined that the water quality associated with the WAD cyanide limit will be adequate to fully protect designated and existing uses.

The mixing zone for pH extends from Outfall 001 to the confluence of the North Fork. pH will be fully protective of the limited designated and existing uses within the mixing zone and of designated and existing uses at all points beyond. Based on water quality monitoring data, the baseline pH at the station just above Outfall 001 ranges from 5.8 to 6.7. An optimum wastewater treatment pH, approximately 9.5 to 10.5, precipitates metals from treated water before it is discharged through Outfall 001. Data collected in the discharge and in the receiving waters since mine operations began, indicate that pH stabilizes shortly after the discharge into Red Dog Creek. The pH is above 6.5 at Station 20 (upstream of the North Fork confluence) and is approximately 7 at the mouth of the Main Stem; i.e., the mixing of basic discharge waters with naturally acidic creek waters results in near neutral pH where fish occur, ensuring protection of designated and existing uses within the mixing zones and at all points beyond. Beyond the mixing zone, pH standard of 6.5- 8.5 applies to protect aquatic life. Past sampling indicates that pH will be within this range at all points downstream of the mixing zone.

Additionally, under 18 AAC 70.230(e), the Lower Middle Fork has the designated uses of contact recreation (wading only), industrial purposes, and secondary recreation (except fishing). As a result, the most restrictive pH standard that would otherwise apply in the absence of the mixing zone is 6.5 to 8.5, which are the criteria for contact recreation. Contact use of the Lower Middle Fork consists of mine and agency personnel conducting instream sampling or other necessary instream work performed by the permittee. These uses, and use of the Lower Middle Fork for industrial purposes

[1] See State's biological monitoring reports as cited in References section below.

and secondary recreation, will not be adversely affected by the authorized mixing zone and, additionally, the pH mixing zone will not affect uses further downstream.

Based on this information, the department finds that designated and existing uses outside of the mixing zones will be fully protected and maintained, and the mixing zones will not impair the overall biological integrity of the waterbody.

c) 18 AAC 70.240(a)(2). The mixing zones will be as small as practicable.

The department finds that the sizes of the mixing zones authorized for discharge in this certification are as small as practicable and consistent with the size limitations of 18 AAC 70.255(e)(3).

Under 18 AAC 70.255(e)(3), the length of a mixing zone established in a stream or other flowing fresh water may not extend downstream beyond the computed point where the variation in the concentration of a water quality parameter across a stream is predicted to be less than 5%, as determined using a standard river flow mixing model.

For mixing zone 1 (Outfall 001 to the North Fork), the size of the pH mixing zone, as discussed above, was based on extensive water quality sampling indicating that the basic, treated, mine wastewater mixes with the naturally acidic water of Red Dog Creek, reaching an overall pH of 6.5 to 7 by the confluence with the North Fork. Based on protection of the designated downstream uses, the department determined that the mixing zone is the smallest practicable size to ensure adequate mixing.

For mixing zone 2 from the confluence of the North Fork to Station 151, the size of the mixing zone was based on the smallest size to ensure adequate mixing. Flow and concentrations have been extensively monitored in Red Dog Creek. No significant dilution is achieved by contributions from side streams or sheetflow from upland sources or seeps. Conductivity is a field parameter that provides real time measurements of water composition, which were used to determine the point of complete mixing in the Main Stem. Transects of conductivity readings on multiple sampling dates were used to determine the length of the mixing zone. The point of complete mixing was determined to be where conductivity readings reached a stable value across the width of the channel. This method of determining complete mixing, based on measuring stable conductivity, is more accurate than mixing models often used by the department. For mixing zone 2, complete mixing occurs near a whirlpool feature, so stream geomorphology appears to control complete mixing. The department determined that this mixing zone, approximately 1,930 feet long, is the smallest practicable size to ensure adequate mixing.

For mixing zone 3 from Ikalukrok Creek to Station 150, the same approach was undertaken as for mixing zone 2. Complete mixing occurs near a whirlpool feature where a change in the river bank causes turbulence. The department determined that mixing zone 3, approximately 3,420 feet long, is the smallest practicable size to provide adequate mixing.

d) The maximum pollutant discharge limitations were calculated in compliance with 18 AAC 70.255(f).

18 AAC 70.255(f) governs calculation of the maximum pollutant discharge limitations in the context of establishing mixing zones. It allows the dilution calculations to be based on either actual flow data collected concurrent with the discharge or the low flow of the receiving water location.

In this case, the permittee requested mixing zones for ammonia and cyanide based on actual data comparing the ratio of the average daily flows at Station 10 in the Main Stem and the outfall from the tailings impoundment. The calculated dilution multiplier of 2.5 represents the 5th percentile of the ratios for the period from May 2003 through September 2005. Therefore, the dilution multiplier of 2.5 was used in calculating the maximum pollutant discharge limitations when authorizing the mixing zones.

For pH, data collected in the discharge and in the receiving waters since mine operations began indicate that pH stabilizes shortly after the discharge into Red Dog Creek. The pH is above 6.5 at Station 20 (upstream of the North Fork confluence) and is approximately 7 at the mouth of the Main Stem. Mixing of basic discharge waters with naturally acidic creek waters results in near neutral pH by the boundary of the mixing zone.

e) 18 AAC 70.240(a)(3). The effluent will be treated to remove, reduce, and disperse pollutants using methods found by the department to be the most effective and technologically and economically feasible, consistent with the highest statutory and regulatory treatment requirements.

The mine wastewater treatment plant treats water from the tailings impoundment and discharges to the Lower Middle Fork via Outfall 001 during the summer months, typically late May to early October. Metals, including lead, selenium and zinc, are removed using high density sludge (HDS) treatment process. For cadmium removal, sodium sulfide is added to the untreated feed water boosting the removal of this metal to levels below permit limits.

The HDS treatment process uses lime precipitation to treat for metals with their precipitation occurring in tanks equipped with agitators. Flocculent is then added and the precipitated solids are separated from the treated water in a clarifier. Clarifier underflow, containing the metals solids, is recycled back to the process inlet and is ultimately returned to the tailings impoundment while the clarifier overflow passes through sand filters before being discharged to Red Dog Creek. This process replaces the dissolved metals ions with calcium ions in the wastewater and results in a modest, up to ten percent, reduction of TDS concentration. However, TDS composition changes from sulfates of various metals to primarily calcium sulfate (gypsum).

Water treatment methods (distillation, membrane filtration, etc.) to significantly reduce TDS concentrations are not practicable or economic for the nature and volume of the effluent from the mine. The most effective and reasonable method for reduction of TDS in the mine's effluent is source control. The mine has implemented a TDS source control program to reduce the amount of TDS contained in the tailings pond water (the wastewater influent source). Source control measures include operation of a third water treatment plant to treat high TDS influent wastewater prior to entering the tailings pond and testing of waste rock and use of waste rock management practices to reduce the amount of TDS entering the tailings pond from waste rock runoff. Another source control measure currently being implemented includes the oxide-stockpile reclamation project, which will

reduce acid rock drainage to the tailings pond. This project was initiated in 2008 and construction of the cover is complete and monitoring of cover-performance is ongoing. Additionally, the proposed permit requires Teck to develop a TDS Management Plan (Section 1.A.7.f), which must be approved by EPA and the department providing information on actions Teck will take to enhance treatment and source control.

For cyanide, this pollutant is used in the lead extraction process as a pyrite (iron) depressant. The mine has investigated alternatives to the use of cyanide in the mill with unacceptable results. Small concentrations of WAD cyanide found in the effluent, less than 15 µg/L, are at levels that are not considered to be treatable with available water treatment technology. Unlike elemental pollutants, such as metals, cyanide is molecular and naturally attenuates in the tailings pond through oxidation. From August 1998 through September 2005, 97 WAD cyanide analyses were conducted on samples collected at Station 10. All 97 samples were reported at levels below the minimum level of quantification (ML) for the WAD cyanide analytical method, and 74 of the samples were reported as less than the method detection limit (MDL) for the WAD cyanide analytical method. Identical results have been documented in Ikalukrok Creek and the Wulik River. A combined 217 samples have been collected and analyzed by the WAD cyanide method at Stations 150, 160, and 2 since August 1998. Results from all samples were reported at levels below the minimum level of quantification (ML), and 189 of the samples were reported as less than the method detection limit (MDL) (EPA, 2006).

In addition, from August 2003 through October 2008, 64 WAD cyanide analyses were conducted on samples collected at Station 151 (located at the downstream boundary of the Main Stem mixing zone). Station 151 is upstream of Station 10 and provides a more conservative representation of WAD cyanide concentrations in the Main Stem, as Station 151 is less subject to influence by ambient runoff contribution (and resulting dilution) than is downstream Station 10. Again, all 64 Station 151 samples were reported at levels below the ML for the WAD cyanide analytical method, and 53 of the samples were reported as less than the MDL for the WAD cyanide analytical method.

As demonstrated by the monitoring results described above, the department finds that the treatment for WAD cyanide that occurs in the tailings pond is effective and reasonable for the concentrations present.

For ammonia, traditional water treatment methods for reducing the concentration in effluent (air stripping, biological treatment, chlorination, etc.) are not practicable at the mine, given the volumes and concentrations present. Source control is the most effective and reasonable method for reducing ammonia concentrations in the effluent. The primary source of ammonia in the effluent results from blasting with an ammonium nitrate and fuel oil mixture in wet blast holes in the mine pit. When placed in wet holes the ammonium nitrate dissolves into the groundwater in the vicinity of the blast hole. Mine drainage water, including the groundwater encountered in blast holes, is collected in the mine drainage sump, which is then pumped into the tailings pond. Since 1999 the mine has implemented the use of an emulsified blasting agent that results in minimal ammonium nitrate dissolving into the groundwater and subsequently entering the mine drainage sump. This source control technique has resulted in decreasing effluent ammonia concentrations since 1999. Condition 5 of this Section 401 Certification contains a specific best management practice (BMP) requirement carried forward to Section I.H.2.i.(vi) of the permit requiring the permittee to develop a BMP to

ensure that best blasting practices are used in any wet blast holes to minimize the amount of blasting agent that dissolves in the groundwater in the vicinity of the blast hole.

After review of the applicable statutory and regulatory requirements, including 18 AAC 70 and 18 AAC 72, the department finds that the treatment measures used by the discharger to remove, reduce, and disperse pollutants represent the most effective, technologically and economically feasible techniques for controlling the quality of the mine effluent, and that these treatment measures meet the highest applicable statutory and regulatory requirements.

2. The department authorizes the effluent limits and monitoring requirements contained in the NPDES Permit Part I.A.1 – Table 1.

Rationale: In accordance with State Regulations, 18 AAC 15.090, the department may attach terms and conditions to a permit, variance, or approval, including operating, monitoring, inspection, sampling, access to records, reporting requirements, and the posting of a performance bond or other surety, that it considers necessary to ensure all applicable criteria will be met. The effluent limits included in the permit provide assurance that WQS are being met.

3. NPDES Permit part I.A.7.a shall maintain the following language:

After the commencement of discharge, the permittee shall limit the TDS load discharged from Outfall 001 so as to maintain in-stream TDS concentrations at or below:

(1) 1500 mg/L at the boundary of the mixing zone in the Main Stem of Red Dog Creek,

(2) 1000 mg/L at the boundary of the mixing zone in Ikalukrok Creek throughout the discharge season, and

(3) 500 mg/L from July 25th through the end of the discharge season at Station 160.

Rationale: The TDS SSC allows TDS concentrations up to 1500 mg/L in the Main Stem without timing restrictions. The department finds that the in-stream TDS limits are required to ensure that designated and existing uses are protected.

Rationale: In 1999, the department changed the WQS under 18 AAC 70.020(b)(Note 12) for inorganic dissolved solids, regulated as TDS. This criterion is in effect in Ikalukrok Creek for the areas listed above:

> *Total Dissolved Solids (TDS) in concentrations up to 1000 mg/L in Ikalukrok Creek are in effect from the confluence of Ikalukrok Creek with the Main Stem to the Wulik River,* ***except*** *during chum salmon and/or Dolly Varden spawning in Ikalukrok Creek, when the aquatic life criterion of 500 mg/L will apply at Station 160.*

Rationale: In accordance with 18 AAC 70.020(b)(4) and Note 12, the TDS concentration at Station 160 shall remain at or below 500 mg/L from July 25th through the end of the discharge season to ensure no adverse effect.

In accordance with State Regulations 18 AAC 15.090, the department may attach terms and conditions to a permit, variance, or approval, including operating, monitoring, inspection, sampling, access to records and reporting requirements, and the posting of a performance bond or other surety, that it considers necessary to ensure that all applicable criteria will be met.

4. Permit part I.E – Bioassessment Program Requirements could be removed from the NPDES Permit. The bioassessment program in Red Dog Creek is part of a larger monitoring program that requires aquatic and biological monitoring in Red Dog Creek and Bons Creek drainages. To keep that larger program consistent and intact, the Bioassessment Program Requirements have been incorporated into the department's Waste Management Permit, and duplication here could lead to future inconsistencies. Nonetheless, the following table could be inserted into the NPDES Permit.

Bioassessment Sites	
Sample Site	**Factors Measured**
North Fork	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Main Stem	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use
Ikalukrok Creek	Periphyton (as chlorophyll-a concentrations) Aquatic invertebrates: taxonomic richness and abundance Fish presence and use

Rationale: In accordance with State Regulations 18 AAC 70.240, the department has authority to ensure that designated and existing uses of the waterbody outside the mixing zone are maintained and fully protected. The specified monitoring will provide evidence to the department that the effluent treatment and mixing zone sizes are adequate to protect all existing and designated uses in the receiving water. The entire biomonitoring program contained in the current NPDES Permit is also required in the Monitoring Plan under the Waste Management Permit issued by the department for the management of tailings, waste rock, and other wastes at the facility.

In accordance with State Regulations 18 AAC 15.090, the department may attach terms and conditions to a permit, variance, or approval, including operating, monitoring, inspection, sampling, access to records and reporting requirements, and the posting of a performance bond or other surety, that it considers necessary to ensure that all applicable criteria will be met.

In accordance with Federal Regulation 40 CFR 124.53(e)(3), the department shall include a statement of the extent to which each condition of the permit may be made less stringent without violating the requirements of State law. These statements are included above where it states that a change "could" be made in the final permit.

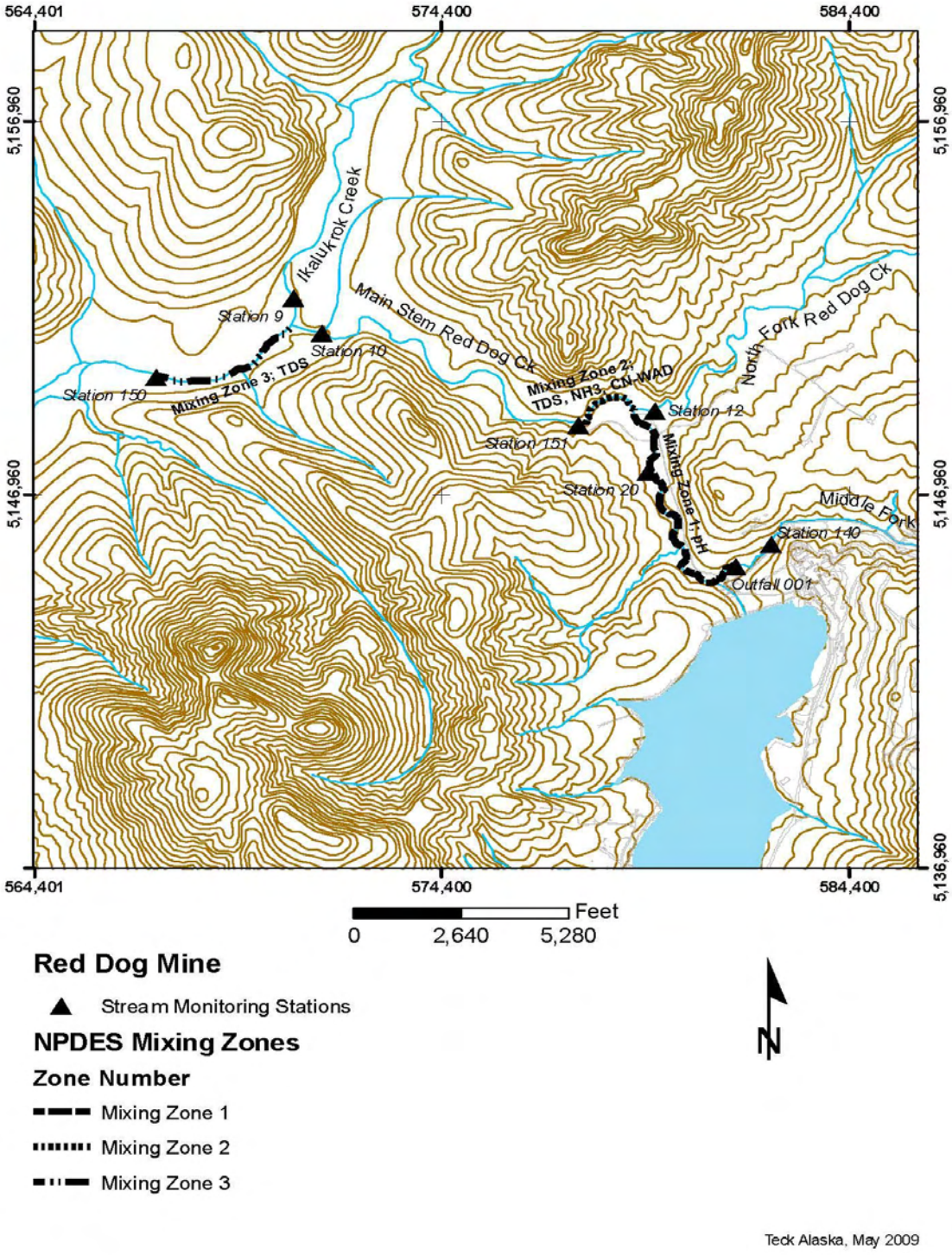
5. The NPDES Permit shall include the following permit part I.H.2.i.(vi):
   Ensure that best blasting practices are used in any wet blast holes to minimize the amount of blasting agent that dissolves into the groundwater in the vicinity of the blast hole.

Rationale: In accordance with State Regulations, 18 AAC 15.090, the department may attach terms and conditions to a permit, variance, or approval, including operating, monitoring, inspection, sampling, access to records, reporting requirements, and the posting of a performance bond or other surety, that it considers necessary to ensure all applicable criteria will be met. The department considers this requirement necessary to ensure that appropriate source control measures are undertaken to minimize the amount of ammonia in the effluent.

April 15, 2011
Date

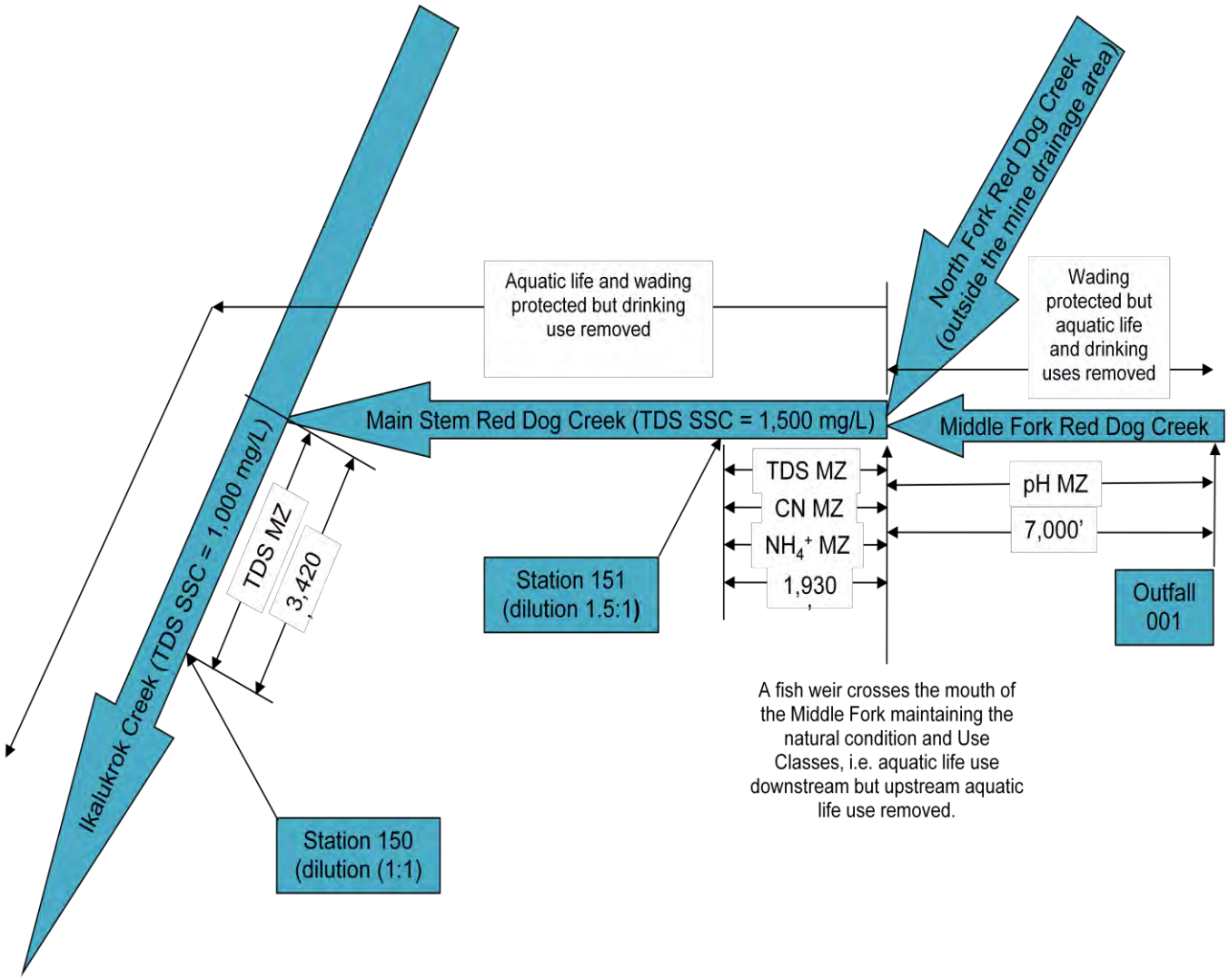
Sharon Morgan, Manager
Wastewater Discharge Authorization Program

Attachment A
Red Dog Mine Mixing Zones



Attachment B

Diagram of Red Dog Mine Mixing Zones



APPENDIX A
ANTIDEGRADATION ANALYSIS OF THE CERTIFICATE OF REASONABLE ASSURANCE FOR NPDES PERMIT AK-003865-2

This appendix analyzes and provides rationale for the Alaska Department of Environmental Conservation (department) decisions in Section 401 Certification with respect to the antidegradation policy. The department's approach to implementing the antidegradation policy found in 18 AAC 70.015 is based on the requirements in 18 AAC 70 and the department's July 14, 2010, Policy and Procedure guidance for *Interim Antidegradation Implementation Methods* (antideg guidance). Using these requirements and policies, the department determines whether a waterbody or portion of a waterbody is classified as Tier 1, Tier 2, or Tier 3, where a larger number indicates a greater level of water quality protection. This determination was made on a pollutant-by-pollutant basis.

To qualify as a Tier 3, or "outstanding national resource" water, one of two criteria must be met. The water must either be 1) in a national or state park or wildlife refuge or 2) a waterbody with exceptional recreational or ecological significance. The department determined that the affected waters are not Tier 3 waters and conducted an antidegradation analysis assuming that the affected waters are Tier 2. The basis for this finding ensues.

The waters of Red Dog Creek are atypical of most undeveloped Arctic streams because of the high concentrations of cadmium, lead, and zinc that enter the Lower Middle Fork of Red Dog Creek (Lower Middle Fork) as it flows through a highly mineralized orebody. The unique character of the Red Dog mineralization and its interaction with ground and surface waters was recognized in scientific studies of the area in the late 1970s and early 1980s (e.g. Ward and Olson 1980). Natural levels of metals were known to be unusually high, and fish kills in the Main Stem of Red Dog Creek (Main Stem) were documented. From 1981 through 1984, Cominco Alaska funded a series of baseline studies to document water quality and biological conditions in Red Dog Creek, Ikalukrok Creek, and the Wulik River (Houghton 1983, Peterson and Nichols 1983). In 1982, the department funded a detailed toxicological, biophysical, and chemical assessment of Red Dog Creek (EVS Consultants, Ltd. 1983). These studies formed the basis for addressing aquatic and water quality impacts associated with the development of the Red Dog Mine Project in the 1984 Environmental Impact Statement.

Water in the Middle Fork of Red Dog Creek (Middle Fork), beginning adjacent to the highly mineralized orebody, was naturally degraded and remained in this condition downstream to the confluence with the South Fork of Red Dog Creek (South Fork) (Peterson and Nichols 1983). The Middle Fork flowed directly over heavily mineralized rock, and the creek received surface and groundwater draining from the orebody, which contained high metal and sulfide concentrations (U.S. Environmental Protection Agency and U.S. Department of the Interior. 1984). Recovery of water quality began at the confluence of the Middle Fork and the South Fork, but was not particularly significant until flow from the North Fork of Red Dog Creek (North Fork) diluted the Middle Fork to form the Main Stem.

As discussed above, Red Dog and Ikalukrok Creeks have been documented to have naturally occurring water quality conditions that precluded some designated uses, which have been removed

(see 18 AAC 70.230(e)(8) and (18-20)). Specifically, the Lower Middle Fork is only classified for contact recreation (wading only), industrial, and secondary recreation (except fishing) uses. According to antideg guidance, this segment is considered a Tier 1 waterbody; therefore, protection of designated and existing uses is the threshold for compliance with Alaska's antidegradation policy. All of the requirements in the permit will ensure protection of these uses. This includes the mixing zone for pH, which will not affect either the instream levels or the designated and existing recreational and contact uses of the segment. In practice but not policy, actual contact uses of the Lower Middle Fork are exclusively confined to hydrologic, water quality, biological, and geologic sampling by mine and agency personnel, and these uses of the Lower Middle Fork will not be impacted by the elevated pH in the immediate vicinity of the discharge.

The Main Stem is classified for growth and propagation of fish, shellfish, and other aquatic life. Aquatic biomonitoring at the Red Dog Mine began in 1990 and has continued annually since then. As noted above, monitoring conducted prior to mining activities showed water quality and aquatic life impacts extending into the Main Stem. Aquatic biomonitoring and ambient water quality monitoring conducted during mine operations demonstrates that the effluent from the facility does not harm existing aquatic life in the Main Stem or Ikalukrok Creek. These results are summarized in the Comparison of Mainstem Red Dog Creek Pre-Mining and Current Conditions (Scannell, 2005) and the Final Supplemental Environmental Impact Statement (FSEIS) associated with the 2010 National Pollutant Discharge Elimination System (NPDES) Permit reissuance.

Conservatively, the department assumes that the Main Stem and Ikalukrok Creek are Tier 2 waterbodies. According to the antideg guidance, this antidegradation analysis considers changes made in the 2010 permit and reinstated permit limits that relax comparable effluent limits included in the 1998 permit, as described below. The permit includes equally stringent or more stringent limits for cadmium, copper, lead, pH, selenium, and zinc than the 1998 permit. For these pollutants, the permit is more stringent than the previous permit, and no antidegradation analysis is required.

The specific changes made by this permit to effluent limits that are subject to antidegradation analysis include:

- For aluminum, the permit introduces new limits, where the 1998 permit lacked aluminum limits. The permit includes an average monthly effluent limit (AMEL) for aluminum concentration equal to 53 µg/L compared to the chronic Alaska Water Quality Standard (WQS) of 87 µg/L and a maximum daily effluent limit (MDEL) for aluminum concentration equal to 157 µg/L compared to the acute WQS of 750 µg/L. An antidegradation analysis is undertaken later in this appendix for the new aluminum limits.

- For nickel, the permit introduces new limits, where the 1998 permit lacked nickel limits. The permit includes an AMEL for nickel concentration equal to 80 µg/L compared to the chronic WQS of 117 µg/L and a MDEL for nickel concentration equal to 216.5 µg/L compared to the acute WQS of 1,053 µg/L. An antidegradation analysis is undertaken later in this appendix for the new nickel limits.

- For cyanide, the permit includes a less stringent AMEL, i.e. 10.3 versus 4.0 µg/L, and MDEL, i.e. 22.2 versus 9.0 µg/L, than the 1998 permit. Cyanide was previously measured as

total cyanide, but the Alaska WQS is now measured as weak acid dissociable (WAD) cyanide. The department certifies that a mixing zone for WAD cyanide with a dilution ratio of 1.5 parts receiving flow to 1.0 part inflow, for a dilution multiplier of 2.5, protects water quality. An antidegradation analysis is undertaken later in this appendix for the new cyanide limits based on WAD cyanide.

- The permit includes new effluent limits for ammonia based on a mixing zone that provides a dilution ratio of 1.5 parts receiving flow to 1 part inflow for a dilution multiplier of 2.5. An antidegradation analysis is undertaken later in this appendix for the new ammonia limits.

- For total dissolved solids (TDS), the permit includes a less stringent limit than the 1998 permit limits of 170 milligrams per liter (mg/L) AMEL and 196 mg/L MDEL. The permit contains 3 limits for TDS: (i) 1,500 mg/L measured at station 151 in the Main Stem; (ii) 1,000 mg/L measured at station 150 in Ikalukrok Creek; and (iii) 500 mg/L at Station 160 in Ikalukrok Creek over 10 miles downstream of Station 150 from July 25th through the end of the discharge season. An antidegradation analysis is undertaken later in this appendix for the new TDS limits.

  (i) The new instream limit of 1,500 mg/L is based on the SSC in the Main Stem from the North Fork confluence to the confluence with Ikalukrok Creek, which was adopted subsequent to the 1998 permit. The 1,500 mg/L SSC was adopted in 18 AAC 70.236(b)(5) and approved by U.S. Environmental Protection Agency (EPA) on July 16, 2003 for periods other than grayling spawning. The SSC was revised in 2006 and established a 1,500 mg/L limit for grayling spawning and non grayling spawning times in the Main Stem from the North Fork confluence to the confluence with Ikalukrok Creek. This revision was approved by EPA on April 21, 2006 and forms the basis for the TDS limit in the current permit.

  (ii) The new Ikalukrok Creek instream limit of 1,000 mg/L is based on the 1999 revision to the State's water quality criterion under 18 AAC 70.020(b) for inorganic dissolved solids regulated as TDS.

  (iii) The new Ikalukrok Creek instream limit of 500 mg/L is required during the period of chum salmon and/or Dolly Varden spawning to prevent any adverse effect on spawning activity.

For Tier 2 water in the context of reissuing a permit such as this, antidegradation analysis under 18 AAC 70.015(a)(2) is applied to permit limits that were relaxed or others which the department concludes should be subjected to antidegradation analysis. Under antideg guidance for Tier 2 waterbodies, the department's antidegradation analysis focuses on the following parameters based on the possibility for water quality degradation: aluminum, ammonia, cyanide, nickel, and TDS.

The Antidegradation Policy of the AWQS (18 AAC 70.015(a)(2)) states that, if the quality exceeds levels necessary to support propagation of fish, shellfish, and wildlife in and on the water, that quality shall be maintained and protected, unless the department makes five specific findings.

1. 18 AAC 70.015(a)(2)(A). Allowing lower water quality is necessary to accommodate important economic or social development in the area where the water is located.

Degradation of water quality associated with the permitted discharge of wastewater from Red Dog Mine is justified for the following reasons. First, even though wastewater discharge quality is considered degraded, wastewater discharge quality is elevated relative to the natural condition of historic water quality at the discharge point. Before mining, Red Dog Creek earned its name, in part, from its red color. The creek originated above the mineralized deposit bearing ore. As it flowed over the deposit, water became acidic and dissolved metals content climbed. Beyond the mineral deposit, acidity of creek water decreased, iron precipitated, and the stream turned red, hence Red Dog Creek. The natural condition of the creek water quality in the vicinity of the mine is very acidic with elevated concentrations of metals, and it was unable to support aquatic life. Permitted wastewater discharge quality may be considered degraded. However, water quality in Red Dog Creek has improved since mining began. This is demonstrated by fish colonizing parts of Red Dog Creek, which were uninhabitable to them before mining, and by water quality monitoring data indicating nearer neutral pH and lower metals content. Further, Red Dog Mine provided a $254 million financial surety for long term water treatment so that water quality will not revert to its original state after mine closure.

Second, permit limits ensure protection of water quality standards, provide for water quality adequate to protect existing and designated uses, and treat and control discharges by the most effective and reasonable means and to the highest statutory and regulatory requirements. The permit, fact sheet, and statement of basis addressing withdrawn permit limits explain that limits for aluminum, ammonia, cyanide, nickel, and TDS are water quality-based and more stringent than any applicable technology-based standards.

Third, analyses performed in the FSEIS, Red Dog Mine Closure and Reclamation Plan, and Appendix A to EPA's statement of basis for reinstating withdrawn permit limits each conclude that there are no reasonable alternatives to the current water treatment system based on either economics or effectiveness.

On pages 3-324 through 3-326 of the FSEIS, EPA provides an analysis discussing direct and indirect socioeconomic impacts of Red Dog Mine on the Northwest Arctic Borough (NWAB), NANA, and the local work force. The FSEIS details large contributions by Red Dog Mine to the local economy's job market and revenue and tax bases. The following was excerpted from Section 3.17.4 of the FSEIS on which the State of Alaska Department of Natural Resources participated as a cooperating agency.

> The Red Dog Mine provides substantial benefit to the NWAB, NANA, and NANA shareholders by providing local employment opportunities, PILT (payments in lieu of taxes), royalties, and dividends. Alternative A would see the end of operations in 2011, 20 years sooner than the other alternatives. Closure in 2011 would result in the loss of $8 million annually in PILT to NWAB, and an estimated loss of $155 million in annual NANA royalties, $70 million in annual payments to the state, and over 500 jobs held by employees from inside and outside the region.

As noted above, the operation of Red Dog Mine is important to the economy of the NWAB. The department finds that authorization of the mine's discharge is justified, accommodates important economic activity in the NWAB, and that this requirement is met.

2. 18 AAC 70.015(a)(2)(B). Except as allowed under this subsection, reducing water quality will not violate the applicable criteria of 18 AAC 70.020, 18 AAC 70.235, or 18 AAC 70.030.

The permit limits will not violate water quality or applicable SSC. The mixing zones are specifically authorized in accordance with 18 AAC 70.240 to 18 AAC 70.270 (June 26, 2003). The authorized mixing zones have been sized to ensure that all applicable water quality criteria are met at all points outside of the mixing zone. There is no mixing zone for whole effluent toxicity and the limit is unchanged from the 1998 permit at 12.2 MDEL and 9.7 AMEL. The department finds that this requirement is met.

3. 18 AAC 70.015(a)(2)(C). The resulting water quality will be adequate to fully protect existing uses of the water.

The permit reissue application does not propose any changes that would likely result in wastewater of lower quality to be discharged than has been discharged since issuance of the 1998 permit. Although TDS levels have been relaxed in this permit compared to the limits in the 1998 permit, the mine has never been able to comply with the TDS limits from the 1998 permit and, consequently, has discharged under Compliance Orders by Consent (COBCs). The TDS limits established under the COBCs are identical to those established in the reissued permit. Therefore, an assessment of the impact of discharges on existing uses over the past 5-10 years[2] provides a reasonable means to evaluate the potential impacts on designated and existing uses under the reissued permit.

Aquatic biomonitoring and ambient water quality monitoring conducted for about 20 years of mine operations demonstrates that the effluent from the facility does not negatively affect designated or existing uses in the Main Stem, Ikalukrok Creek, or local tributaries such as the North Fork. As discussed below, the department finds that the resulting water quality will be adequate to fully protect designated and existing uses.

For aluminum, new limits based on total recoverable concentration are established in the permit. The actual discharge of aluminum is expected to be consistent with historic levels and will not contribute to impairment of designated or existing uses. Aluminum concentration discharge data with a median aluminum concentration of 11.5 µg/L indicate a large margin of compliance when compared to the AMEL of 53 µg/L. In turn, the AMEL equal to 53 µg/L offers a large margin of protection when compared to the chronic WQS of 87 µg/L. For these reasons, the department determined that the water quality associated with the aluminum limits will be adequate to fully protect designated and existing uses.

[2] See State's biological monitoring reports as cited in References section below.

For nickel, new limits based on total recoverable concentration are established in the permit. The actual discharge of nickel is expected to be consistent with historic levels and will not contribute to impairment of designated or existing uses. Discharge data with a maximum nickel concentration of 51.9 µg/L indicate a large margin of compliance when compared to the AMEL of 80 µg/L. In turn, the AMEL equal to 80 µg/L offers a large margin of protection when compared to the chronic WQS of 117 µg/L. For these reasons, the department determined that the water quality associated with the nickel limits will be adequate to fully protect designated and existing uses.

For cyanide, a new limit based on WAD cyanide is established in the permit. The actual discharge of cyanide is expected to be consistent with historical levels and will not contribute to any impairment of designated or existing uses. Based on analysis of discharge data, the median value of cyanide at the point of discharge (outfall 001) is below chronic levels. Given the dilution that occurs, chronic levels of cyanide would rarely occur in the mixing zone between the North Fork and Station 151. Additionally, the maximum projected concentration for cyanide at the point of discharge is below the acute water quality standard. Concentrations of cyanide in the mixing zone are, therefore, expected to be significantly below the acute water quality standard. For these reasons, the department determined that the water quality associated with the WAD cyanide limit will be adequate to fully protect designated and existing uses.

For ammonia, a new limit is established in the reissued permit. The actual discharge of ammonia is expected to be consistent with, or less than, historical levels and will not contribute to any impairment of designated or existing uses. Based on analysis of discharge data, the median value of ammonia at the point of discharge (outfall 001) is below chronic levels. Given the dilution that occurs, chronic levels of ammonia would rarely occur in the mixing zone between the North Fork and Station 151. Concentrations of ammonia in the mixing zone are expected to be significantly below the acute water quality standard. For these reasons, the department has determined that the water quality associated with the ammonia limit will be adequate to fully protect designated and existing uses.

For TDS, the reissued permit provides new limits of: (i) 1,500 mg/L at Station 151; (ii) 1,000 mg/L at Station 150; and (iii) 500 mg/L at Station 160 from July 25th through the end of annual discharge.

The mine has never been able to comply with the TDS limits imposed by the 1998 permit. As a result, the mine was subject to EPA COBCs from 1999 through 2006. The 2004 and 2005 EPA COBCs limited instream TDS concentration to 1,500 mg/L outside of grayling spawning season and 500 mg/L during grayling spawning. In 2006, the EPA COBC established TDS limits identical to those proposed in this reinstated permit. From 2007 through 2010, State-issued COBCs also established TDS limits that mirrored those of the 2006 EPA COBC as well as those proposed in this reinstated permit.

i) For the TDS limit of 1,500 mg/L at Station 151: During non-grayling spawning times, the department promulgated under 18 AAC 70.235 a site-specific criterion of 1,500 mg/L for TDS in the Main Stem from the confluence of the Middle Fork with the North Fork to the confluence of the Main Stem with Ikalukrok Creek, except during Arctic grayling spawning in the Main Stem, This standard was extensively evaluated by EPA and the department and found to be protective of grayling and other existing and designated uses.

Further information and support for the site-specific criterion for this waterbody is part of the department's file for that rule-making.

For periods during grayling spawning, the limit is based on the 2006 SSC for Red Dog Creek, which set water quality criterion at 1,500 mg/L at all times. The technical analyses by the department and EPA supporting the 2006 SSC indicate that the 1,500 mg/L TDS limit is sufficiently conservative to protect spawning grayling, as well as all other existing and designated uses. Results from toxicity tests undertaken in 2005 consistently demonstrated no effect on reproduction at TDS concentrations in excess of the maximum TDS concentrations tested (2,782 mg/L). In light of the extensive analysis of TDS and its potential impact on grayling and Dolly Varden spawning, the department has determined that the water quality associated with the 1,500 mg/L limit will be adequate to fully protect grayling spawning and other designated or existing uses of the water, including use of the mixing zone as a migration corridor to reach the North Fork.

ii) For the TDS limit of 1,000 mg/L at Station 150: In 1999, the department changed the water quality criterion under 18 AAC 70.020(b) for inorganic dissolved solids, regulated as TDS, to the following: TDS may not exceed 1000 mg/L. A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life (see note 12).

Note 12: If a permit applicant proposes to raise the TDS levels in the receiving water to result in a concentration in the waterbody between 500 mg/L and 1,000 mg/L for all sources or above 110 mg/L for the potassium ion, the department will require a permit applicant to provide information that the department identifies as necessary to determine if the proposed TDS level will cause or can reasonably cause an adverse effect to aquatic life; based on its analysis, the department will limit the TDS level in the waterbody as necessary to prevent an adverse effect, and will set permit effluent limits accordingly; the burden of proof to demonstrate no adverse effect is on the permit applicant; implementation of the "no adverse effect" criterion is not subject to 18 AAC 70.235.

The department finds that the biomonitoring and other information submitted by Teck, and other pertinent information reviewed, demonstrate that a criterion of 1,000 mg/L will fully protect existing and designated uses.

iii) For the TDS limit of 500 mg/L at Station 160 from July 25th through the end of the discharge season: During the period of chum salmon and/or Dolly Varden spawning, the department finds that a lower TDS level of 500 mg/L is required, and that this limit will protect existing and designated uses, including spawning activity and the aquatic life generally. The evidence to support these findings include the support documentation for the SSC in department files, as provided to EPA, as well as the bio-monitoring data received from Alaska Department of Fish and Game, Habitat Division.

In summary, the conditions proposed in this permit reflect virtually the same conditions which have historically demonstrated that the effluent from the facility does not negatively affect designated or existing uses in Red Dog Creek, Ikalukrok Creek, or their tributaries[3]. To illustrate, following is a

[3] See State's biological monitoring reports as cited in References section below.

summarized comparison of biological conditions in the Red Dog Creek drainage for pre-mining and current conditions (Weber Scannell 2005):

- Before development of the Red Dog Mine, (a) water quality was naturally degraded in Red Dog Creek; (b) fish use was limited to migration to the North Fork during high water events; (c) no fish spawning was documented in Red Dog Creek; and (d) natural fish kills commonly occurred in Red Dog Creek.
- Development of the Red Dog Mine included a number of water management practices that resulted in improved water quality in Red Dog Creek. These practices included collection, treatment and discharge of mineralized water; discharge of high volumes of water with low metals concentrations; and improvements in water treatment.
- High volumes of treated water are discharged to Lower Middle Fork. This water dilutes the naturally occurring metals in Red Dog Creek, moderates the pH, and lessens the toxicity of metals by increasing the hardness.
- As a result of improved water quality, Arctic grayling began using Mainstem Red Dog Creek for spawning and rearing and Dolly Varden for rearing.
- Improved water quality was followed by development of abundant and diverse aquatic invertebrate and periphyton communities.
- Over the last six years (1998 through 2004) there is a viable aquatic community in Mainstem Red Dog Creek with the current water quality and mine discharge.

Biomonitoring in the Red Dog Creek drainage has continued from 2005 to 2009 and results of these studies indicate that the conclusions made by Weber Scannell in 2005 are still valid and appropriate. The department finds that this requirement is met.

4. 18 AAC 70.015(a)(2)(D). The methods of pollution prevention, control, and treatment found by the department to be most effective and reasonable will be applied to all wastes and other substances to be discharged.

The mine wastewater treatment uses a lime precipitation process to treat for metals in the wastewater. This process replaces the dissolved metal ions with calcium ions in the wastewater, and the nature of the TDS changes from primarily metal sulfates to calcium sulfates, thus reducing TDS concentration. Water treatment methods for further reducing TDS (distillation, membrane filtration, etc.) are not practicable for the nature and volume of the effluent from the mine. The most effective and reasonable method for reduction of TDS in the mine's effluent is source control. The mine has implemented a TDS source control program to reduce the amount of TDS contained in the tailings pond water (the wastewater influent source). Source control measures include operation of a third water treatment plant to treat high TDS influent wastewater prior to entering the tailings pond, waste rock testing, and application of waste rock management practices to reduce the amount of TDS entering the tailings pond from waste rock runoff.

Water treatment methods for reducing the ammonia concentrations (air stripping, biological treatment, chlorination, etc.) in the effluent are not practicable given the volumes and concentrations present. Source control is the most effective and reasonable method for reducing the ammonia concentrations in the effluent. The primary source of ammonia in the effluent results from blasting

with an ammonium nitrate and fuel oil mixture in wet blast holes in the mine pit. When placed in wet holes the ammonium nitrate dissolves into the groundwater in the vicinity of the blast hole. Mine drainage water, including the groundwater encountered in blast holes, is collected in the mine drainage sump, which is then pumped into the tailings pond. Since 1999, the mine has implemented the use of an emulsified blasting agent that results in minimal ammonium nitrate dissolving into the groundwater and subsequently entering the mine drainage sump. This source control technique has resulted in decreasing effluent ammonia concentrations since 1999. Condition 5 of the Section 401 Certification contains a specific best management practice (BMP) requirement that is carried over to Section I.H.2.i.(vi) of the permit requiring development of a BMP to ensure that best blasting practices are used in any wet blast holes to minimize the amount of blasting agent that dissolves in the groundwater in the vicinity of the blast hole.

Cyanide is used in the lead extraction process as a pyrite depressant. Teck has investigated alternatives to the use of cyanide in the mill with unacceptable results. WAD cyanide concentrations less than 15 µg/L found in the effluent are of such low levels that they are not considered to be treatable with available water treatment technology. Some degradation of cyanide occurs in the tailings pond through oxidation. The following passage summarizes WAD cyanide monitoring results over the course of a seven-year period.

> From August 1998 through September 2005, 97 WAD cyanide analyses were conducted on samples collected at Station 10. All 97 samples were reported at levels below the minimum level of quantification (ML) for the WAD cyanide analytical method and 74 of the samples were reported as less than the method detection limit (MDL) for the WAD cyanide analytical method. Identical results have been documented in Ikalukrok Creek and the Wulik River. A combined 217 samples have been collected and analyzed by the WAD cyanide method at Stations 150, 160, and 2 since August 1998. Results from all samples were reported at levels below the minimum level of quantification (ML) and 189 of the samples were reported as less than the method detection limit (MDL). (EPA, 2006)

As demonstrated by these monitoring results, the department finds that the amount of treatment for WAD cyanide that occurs in the tailings pond is effective and reasonable for the concentrations present. The department finds that this requirement is met.

5. 18 AAC 70.015(a)(2)(E). All wastes and other substances discharged will be treated and controlled to achieve (i) for new and existing point sources, the highest statutory and regulatory requirements; and (ii) for nonpoint sources, all cost-effective and reasonable best management practices.

After review of the applicable statutory and regulatory requirements, including 18 AAC 70 and 18 AAC 72, and consideration of the methods of pollution prevention, control, and treatment utilized at the Red Dog Mine, as discussed in detail above, the department finds that the discharges from the existing point source meet the highest applicable statutory and regulatory requirements and that nonpoint sources are fully addressed through cost-effective and reasonable BMPs. The department finds that this requirement is met.

Finally, the department reflected on whether to consider in its antidegradation analysis an alternative of conveying wastewater to a marine discharge at the port site. A pipeline alternative was examined in the recent FSEIS resulting from new development of the Aqqaluk deposit. A pipeline alternative was also included in an agreement to settle a citizen suit.

Project development typically involves an early planning phase, often conducted pursuant to the National Environmental Policy Act (NEPA), that involves generating and comparing conceptual project designs and selecting a preferred alternative based on environmental impacts and other factors. After NEPA findings are made, applications for environmental and other permits follow.

As a practical matter, there must be some limit to the sorts of potential alternatives that the department will consider when projects have evolved through the planning process and reach the permitting phase. On the surface, it is difficult to imagine that the department would compel an applicant, as part of the permit process, to wholly redesign the wastewater treatment and discharge arrangement to implement an alternative that was considered, but not selected during the earlier NEPA planning phase.

EPA's "Technology-based Best Professional Judgment Analysis" accompanying the permit reissuance concluded that EPA has not identified the pipeline as an available technology for establishing technology-based effluent limitations. In the case of the settlement agreement, Teck agreed to 'diligently pursue' the concept of a pipeline.

For the reason cited by EPA, and for other reasons, the department concluded that it would not be reasonable to require the company to adopt a very different arrangement for discharge of treated wastewater and declined to conduct a detailed review of a pipeline alternative as part of its antidegradation analysis. Supporting this conclusion is that the wastewater infrastructure for the Red Dog Creek discharge point is largely extant and was constructed at considerable expense, that diverting the wastewater from Red Dog Creek would have immediate, direct and substantial adverse effects on the biota that now inhabit Red Dog Creek as a result of the diluting effect of the treated wastewater discharge, and that any pipeline alternative is highly speculative and would require not only overcoming significant wastewater permitting decisions surrounding a discharge to an entirely different waterbody (the Chukchi Sea), but also permitting decisions associated with construction of more than fifty miles of pipeline made by other jurisdictional state and federal agencies.

In the end, the department concluded that, for purposes of the antidegradation analysis, a pipeline would not be a reasonable alternative warranting further consideration at this time. In the event that the company chooses to advance a pipeline alternative through the NEPA and permit processes, the department will consider it more closely then.

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APPENDIX C
Development of Effluent Limitations

This section discusses the basis for and the development of metals, cyanide, ammonia, pH, total dissolved solids, and total suspended solids limitations in the permit. The discussions include the development of technology-based effluent limitations (Section A.) and water quality-based effluents limitations (Section B.) and a summary of the effluent limitations developed for the permit.

I. Outfall 001

A. Technology-based Evaluation

Section 301(b) of the CWA (18 AAC 83.435) requires technology-based controls on effluents. Red Dog Mine is considered a new source. The term "*new source*" means any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance under this section (Section 306 of the CWA) which will be applicable to such source, if such standard is thereafter promulgated in accordance with this section. On December 3, 1982, EPA published effluent limitation guidelines (ELGs) for the mining industry which are found in 40 CFR Part 440 (18 AAC 83.010(g)(3)). Within these ELGs, Subpart J, titled *Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory*, applies to the mine discharges from Red Dog. The New Source Performance Standards (40 CFR 440.104, 18 AAC 83.010(g)(3)) are used to provide the technology-based effluent limitations for copper, zinc, lead, mercury, cadmium, pH and total suspended solids (TSS).

40 CFR 440.104(a) (18 AAC 83.010(g)(3)) states that the concentration of pollutants discharged in mine drainage from mines that produce copper, lead, zinc, gold, silver or molybdenum bearing ores or any combination of these ores from open-pit or underground operations other than placer deposits shall not exceed the following concentrations:

Table C-1
Technology-based Effluent Limitation Guidelines

Parameter (in µg/L unless otherwise noted)	Average Monthly	Daily Maximum
Copper	150	300
Zinc	750	1500
Lead	300	600
Mercury	1	2
Cadmium	50	100
TSS, mg/L	20	30
pH, standard units	Within the range of 6.0 to 9.0	

40 CFR 440.130(d)(1) (18 AAC 83.010(g)(3)) allows for a pH adjustment above 9.0 where the application of neutralization and sedimentation technology to comply with relevant metal limitations results in an inability to comply with the pH range of 6 to 9. This is the case for Red Dog where metals precipitate out of solution better at higher pH. The previous permit contained a pH range of 6.0 to 10.5. However, EPA narrowed this range to 6.5 to 10.5 in this permit.

40 CFR 440.104(b) (18 AAC 83.010(g)(3)) states that there shall be no discharge of process wastewater to navigable waters from mills that use the froth-flotation process alone or in conjunction with other processes for the beneficiation of zinc ore. In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceed the annual evaporation (net precipitation), a volume of water equal to the difference may be discharged subject to the limitations set forth in Table C-1, above. The current NPDES permit includes an annual discharge limit of 2.418 billion gallons per year which represents the maximum estimated difference between precipitation and evaporation. The limit is retained in this permit. Because precipitation and evaporation are variable, the permit that requires Teck to measure and report annual precipitation and evaporation data in comparison to the discharge volume to demonstrate compliance with the net precipitation provision of 40 CFR 440.104(b) (18 AAC 83.010(g)(3)).

B. Water Quality-based Evaluation

Section 301(b)(1)(C) of the CWA requires the development of limitations in permits necessary to meet water quality standards (WQS). Discharges to state waters must also comply with limitations imposed by the state as part of its certification of NPDES permits under section 401 of the CWA. Regulations at40 CFR 122.44(d)(1) and 18 AAC 83.435 implement section 301(b)(1)(C) of the CWA and require that permits include limits for all pollutants or parameters which "are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard, including state narrative criteria for water quality."

The regulations require that this evaluation be made using procedures which account for existing controls on point and non-point sources of pollution, the variability of the pollutant in the effluent, species sensitivity (for toxicity), and where appropriate, dilution in the receiving water. The limits must be stringent enough to ensure that WQS are met, and must be consistent with any available wasteload allocation.

When evaluating the effluent to determine if water quality-based effluent limits are needed based on chemical-specific numeric criteria, a projection of the effluent water concentration for each pollutant of concern is made. If a mixing zone is authorized, then dilution is considered. The chemical-specific concentration of the effluent and ambient water and, if appropriate, the dilution available from the ambient water are factors used to project the receiving water concentration. If the projected concentration of the effluent exceeds the numeric criterion for a specific chemical, then there is a reasonable potential that the discharge may cause or contribute to an excursion above the applicable water quality standard, and a water quality-based effluent limit is required.

The water quality parameters that may be affected by the discharge are metals, cyanide, ammonia, pH, dissolved solids, and turbidity.

1. **Toxics**

Water quality-based effluent limitations for toxics were developed based upon guidance in EPA's Technical Support Document for Water Quality-based Toxics Control (TSD). The water quality-based analysis consists of four steps:

- ► Determine the appropriate water quality standard,
- ► Determine if there is "reasonable potential" for the discharge to exceed the standard in the receiving water,
- ► If there is "reasonable potential", develop a wasteload allocation (WLA), and a long term average (LTA), then
- ► Develop effluent limitations based on the LTA.

The following sections provide a detailed discussion of each step. Appendix D provides an example calculation to illustrate how these steps are implemented.

a. Water Quality Standards

The first step in developing water quality-based limitations is to determine the applicable water quality standard. For Alaska, the current Water Quality Standards (WQS) are found in 18 AAC 70.020. The applicable standards are based on the designated uses of the receiving water, the Middle Fork Red Dog Creek, which is protected for the uses described in Section IV.B. of this Fact Sheet. The applicable WQS are used to calculate water quality-based effluent limitations. EPA has determined that the appropriate standards to use are those protecting for the downstream use of Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife (aquatic life standards).

Under the anti-backsliding provisions of the Act, any limit in a reissued permit must be at least as stringent as the current limit unless a change meets one of the exceptions listed in CWA § 402(o)(2) or in CWA § 303(d)(4)(B). These are listed below:

402(o)(2) EXCEPTIONS — A permit with respect to which paragraph (1) applies may be renewed, reissued, or modified to contain a less stringent effluent limitation applicable to a pollutant if —

(A) material and substantial alterations or addition to the permitted facility occurred after permit issuance which justify the application of a less stringent effluent limitation;

(B)(i) information is available which was not available at the time of permit issuance (other than revised regulations, guidance, or test methods) and which would have justified the application of a less stringent effluent limitation at the time of permit issuance; or

(ii) the Administrator determines that technical mistakes or mistaken interpretations of law were made in issuing the permit under subsection (a)(1)(B).

(C) a less stringent effluent limitation is necessary because of events over which the permittee has no control and for which there is no reasonably available remedy;

(D) the permittee has received a permit modification under section 301(c), 301(g), 301(h), 301(i), 301(k), 301(n), or 316(a); or

(E) the permittee has installed the treatment facilities required to meet the effluent limitations in the current permit and has properly operated and maintained the facilities but has nevertheless been unable to achieve the current effluent limitation, in which case the limitation in the reviewed, reissued, or modified permit may reflect the level of pollutant control actually achieved (but shall not be less stringent than required by effluent guidelines in effect at the time of permit renewal, reissuance, or modification).

303(d)(4) LIMITATIONS ON REVISION OF CERTAIN EFFLUENT LIMITATIONS —

(B) STANDARD ATTAINED — For waters identified under paragraph (1)(A) where the quality of such water equals or exceeds levels necessary to protect the designated use for such waters or otherwise required by applicable water quality standards, any effluent limitation based on a total maximum daily load or other waste load allocation established under this section, or any other permitting standards may be revised only if such revision is subject to and consistent with the antidegradation policy established under this section.

Some of the metals standards are hardness-based. In calculating these standards, an increase in hardness results in higher criteria. This is because at a higher hardness, these metals are less toxic. The current permit used a hardness of 260 mg/L $CaCO_3$ to calculate the effluent limitations. This hardness was calculated as the 5th-percentile hardness of the receiving water at Station 10, the downstream edge of the mixing zone where aquatic life uses are to be protected. EPA believes this location is appropriate to determine the hardness level for use in the permit.

The standards are provided in Table C-2.

Table C-2 Water Quality Standards		
Parameter, (in µg/L unless noted)	Acute	Chronic
Aluminum	750	87
Ammonia[1], mg/L	5.38	2.36
Cadmium	--	2.0
Chromium, III	3943	188
Chromium, VI	16	11
Copper	34.4	21.1
Cyanide[2]	22	5.2
Iron	—	1000
Lead	275.5	10.7
Manganese	—	—
Mercury	2.4	0.012
Nickel	1053	117
Selenium	20	5
Silver	21	—
Zinc	269	269[3]

1 – Ammonia criteria are based on the pH and temperature data collected at Station 10 in the main stem of Red Dog Creek – dilution not applied at this step.

2 – The cyanide standards is free cyanide measured as weak acid dissociable (WAD) – dilution not applied at this step.

3 - Teck requested, in their application package, that EPA retain the SSC developed for zinc during the current permit issuance but in a letter to DEC dated December 10, 2005, Teck requested that DEC not re-certify the SSC for zinc. The SSC was 210.

Prior to mining, the waters of Red Dog Creek were atypical of most undeveloped Arctic streams because of the high concentrations of cadmium, lead, and zinc that enter the Middle Fork as it flows through a highly mineralized ore body. Metals levels were reduced with dilution in the Main Stem Creek and further downstream in Ikalukrok Creek. On February 27, 2007, EPA approved a site-specific criterion (SSC) of 2 µg/L for cadmium in the Main Stem. This criterion was based on the 5th percentile of the pre-mining dissolved cadmium data at Station 8 in Ikalukrok Creek in order to be protective of the downstream uses. See Appendix B for the justification for the use of this criterion.

The WQS for ammonia are dependent on the pH and temperature of the receiving water. Since these two parameters can vary, EPA determined the pH and temperature based on data collected from 2003 through 2007 at the edge of the mixing zone, previously represented by Station 10. EPA calculated the 95th percentile of the data set to determine the criteria to be applied. The 95th

percentile of temperature is 15.02ºC and of pH is 8.00 standard units which results in a 30-day chronic criteria of 2.36 mg/L. See Appendix E.

b. Reasonable Potential Evaluation

A reasonable potential analysis was performed to determine the need for limits. This analysis compares the maximum projected effluent concentration (C_e) to the criteria for that pollutant. If the projected effluent concentration exceeds the criteria, there is "reasonable potential" (RP) and a limit must be included in the permit. EPA uses the recommendations in Chapter 3 of the TSD to conduct this analysis.

C_e is defined by the TSD as the 99th percentile of the effluent data. This is calculated by multiplying the maximum reported effluent concentration by a reasonable potential multiplier (RPM).

For parameters with technology-based ELGs, the maximum effluent concentration used to determine the RP is the technology-based maximum daily limitation. The technology-based limit is used since water quality-based limits are only required if discharges
at the technology-based limits have the RP to exceed water quality standards in the receiving water. The RPM accounts for uncertainty in the effluent data and statistically depends upon the amount of effluent data and variability of the data as measured by the coefficient of variation (CV) of the data. The RPM decreases as the number of data points increases and the variability of the data decreases. If the maximum projected effluent concentration is greater than an applicable water quality standard then a water quality-based effluent limit is required.

Table C-3 Reasonable Potential Determination						
Parameter (in µg/L unless otherwise noted)	Effluent Concentration	CV[1]	N= # of Samples	RPM	Maximum Projected Effluent Concentration	Reasonable Potential when compared with standards in Table C-2
Aluminum	210	1.69	74	2.5	516	Yes
Ammonia[2,4]	10.7	0.23	105	1.1	4.9	Yes
Cadmium[3]	100			1.0	100	Yes
Cadmium[5]	1.8	0.53	100	1.4	2.5	Yes
Copper[3]	300			1.0	300	Yes
Copper[5]	22	1.25	108	1.8	39	Yes
Cyanide[4]	12.4	0.70	205	1.2	6.1	Yes
Iron	90	1.01	74	1.9	172	No
Lead[3]	600			1.0	600	Yes
Lead[5]	2.9	0.69	103	1.5	4.3	No
Mercury[3]	2			1.0	2	Yes
Mercury[5]	0.0051	0.98	43	2.4	0.012	No
Nickel	77.6	1.21	102	1.8	140	Yes
Selenium	4.6	0.38	103	1.3	5.8	Yes
Silver	0.5	1.88	77	2.5	1.3	No
Zinc[3]	1500			1.0	1500	Yes
Zinc[5]	158	0.43	101	1.3	204	No

1 – CV is defined as the Standard Deviation ÷ the Mean of a data set.

2 - See Section 3.E., below.

3 - Metals with technology-based effluent guidelines.

4 - Teck has requested mixing zones for these parameters. The effluent would be diluted to 40% at the edge of the requested mixing zone.

5 - Reasonable potential if based only on water quality standards.

c. Water Quality-Based Permit Limitation Derivation

Once EPA has determined that a water quality-based limitation is required for a parameter, the first step in developing the permit limitation is development of a Wasteload Allocation (WLA). A WLA is the concentration (or loading) of a pollutant that the permittee may discharge without causing or contributing to an exceedance of water quality standards in the receiving water. WLAs and permit limitations are derived based on guidance in the TSD. WLAs for this permit were established based on meeting aquatic life standards or site specific

criteria at the Alaska WQS, with dilution considered as proposed in the § 401 Certification.

The acute and chronic WLAs are converted to long term average concentrations (LTAs) and compared. The most stringent LTA concentration for each parameter is statistically converted to effluent limitations. This section describes each of these steps.

Calculations of WLAs:

Where no mixing zone is allowed, the standard becomes the WLA. Establishing the standard as the WLA ensures that the permittee does not contribute to an exceedance of the standard.

DEC authorized Mixing Zones in this permit for total dissolved solids (TDS), WAD cyanide, ammonia, and pH.

A mixing zone in the Main Stem of Red Dog Creek (Main Stem) extends from the confluence of the Middle Fork of Red Dog Creek with the North Fork of Red Dog Creek (North Fork) to Station 151. The Main Stem mixing zone is approximately 1,930 feet in length and provides mixing in the ratio of 1.5 parts receiving flow to1 part inflow for a dilution factor of 2.5. This mixing zone is granted for the following parameters: total dissolved solids (TDS), ammonia, and WAD cyanide.

A mixing zone in Ikalukrok Creek extends downstream from the confluence of the Main Stem and Ikalukrok Creek to Station 150. The mixing zone is approximately 3,420 feet in length and provides mixing in the ratio of 1 part receiving flow to1 part inflow for a dilution factor of 2. The Ikalukrok Creek mixing zone is granted for TDS.

A mixing zone in the Lower Middle Fork of Red Dog Creek extends from Outfall 001 downstream to the confluence with North Fork Red Dog Creek to address the recreational designated use, wading only, in this segment. This mixing zone is granted for pH and shall be monitored at Station 151.

The NPDES regulations require that metals limits be expressed as total recoverable (TR) metals [40 CFR 122.45(c), 18 AAC 83.525]. Changes in water chemistry as the effluent and receiving water mix could cause some of the particulate metal in the effluent to dissolve and become bioavailable. Since the proposed WQS are expressed as dissolved, a translator is used in the WLA equation to convert the dissolved criteria to total recoverable. Since the State has not proposed translators in the recent revision to the WQS and there are no site-specific translators, the default translator is 1/CF where CF is the conversion factor in the WQS.

the WLA (TR) = the standard (dis) * the translator.

The standards are expressed as a total recoverable number or equation multiplied by a conversion factor (CF). Since the default translator is 1/CF, the equation becomes:

WLA (TR) = CF* standard (TR) * 1/CF
WLA (TR) = standard (TR).

Appendix D provides an example of how the WLAs for lead in Outfall 001 were developed.

Calculations of Long-term Average (LTA) Concentrations:

As discussed above, WLAs are calculated for each parameter for each standard (acute, chronic). Because standards are based on different criteria which apply over different time frames, it is not possible to compare them or the WLAs directly to determine which results in the most stringent limits. For example, acute criteria are applied as a one-hour average and chronic criteria are applied as a four-day average (30 day for ammonia).

To allow for comparison, the acute and chronic WLAs are statistically converted to LTA concentrations. The conversion is dependent upon the coefficient of variation (CV) of the effluent data and the probability basis used. The probability basis corresponds to the percentile of the estimated concentration. EPA uses a 99th percentile for calculating the LTA, as recommended in the TSD. The following equations from Chapter 5 of the TSD are used to calculate the LTA concentrations (Table 5-1 of the TSD may also be used).

$LTA = WLA * \exp[0.5\sigma^2 - z\sigma]$

Where:

$\sigma^2 =$ $\ln(CV^2 + 1)$ for acute WLA, and

$\sigma^2 =$ $\ln(CV^2/4 + 1)$ for chronic WLA

$\sigma^2 =$ $\ln(CV^2/30 + 1)$ for ammonia

CV = coefficient of variation (standard deviation/mean)

Z = 2.326 for the 99th percentile probability basis (TSD)

Calculation of Effluent Limitations:

The LTA concentration is calculated for each WLA and compared. The most stringent LTA concentration is then used to develop the maximum daily limitation (MDL) and the average monthly limitation (AML) to be used in the permit. The MDL is based on the CV of the data and the probability basis while the AML is dependent upon these two variables and the monitoring frequency. As recommended in the TSD, EPA uses a probability basis of 95 percent for the AML calculation and 99 percent for the MDL calculation. The MDL and AML are calculated using the following equations from the TSD (Table 5-2 of the TSD may also be used).

$$MDL \text{ or } AML = LTA * \exp[z\sigma - 0.5\sigma^2]$$

For the MDL: $\sigma^2 = \ln(CV^2 + 1)$
$z = 2.326$ for the 99th percentile probability basis

For the AML: $\sigma^2 = \ln(CV^2/4 + 1)$
$\ln(CV^2/30 + 1)$ for ammonia
$z = 1.645$ for the 95th percentile probability basis

Where there is only one standard specified, such as the site specific criteria for cadmium, it is used as the chronic WLA and the permit limitations are calculated as above except using just the chronic LTA.

Appendix D shows an example of the permit limitation calculation for lead in Outfall 001.

2. **Total Dissolved Solids (TDS)**: TDS consists of inorganic salts and small amounts of organic matter dissolved in water. The principal constituents are: carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. TDS is typically introduced into surface waters by geologic formations underlying an area, groundwater (via seeps and springs into a freshwater system), wind-borne sea spray, and human activities (mining and other surface excavation, water treatment chemicals, road salting, residential and urban runoff, agricultural chemicals, and irrigation). The levels of TDS proposed in this permit reissuance are designed to prevent adverse affects to aquatic life.

The following summarizes the proposed effluent limitations that are in the permit for the facility:

a. Effluent may be discharged so as to maintain the in-stream TDS concentrations at the approved site specific criteria (SSC) of 1500 mg/L at the edge of the mixing zone in Main Stem Red Dog (Station 151). Effluent may be discharged so as to maintain the in-stream TDS concentrations at the approved site specific criteria (SSC) of 1500 mg/L at the edge of the mixing zone in Main Stem Red Dog (Station 151). The SSC is a promulgated standard under the Alaska Water Quality Standards and has been approved by EPA as a WQS change for this waterbody. The mixing zone is described in the draft § 401 Certification found in Appendix B. The discharge may start after the free flow of water in the Main Stem Red Dog Creek begins. The SSC has been approved by EPA so there is no need to determine the start of spawning or notify the agencies since the limit is the same before, during and after spawning.

b. In Ikalukrok Creek, the effluent from the mine site must be regulated at the discharge point so that the TDS concentration outside the mixing zone (Station 150) in Ikalukrok Creek does not exceed 1000 mg/L.

c. When salmon and Dolly Varden are spawning in Ikalukrok Creek (July 25 through the end of the discharge season), effluent from the mine site must be

regulated so that the TDS concentration in Ikalukrok Creek where spawning occurs does not exceed 500 mg/L (Station 160).

d. In the current permit, an end-of-pipe limit of 3900 mg/L was included for TDS. The primary reason for including this limit was to make assumptions to determine the flow that the facility could discharge and still remain in compliance with in-stream limits. The limit of 3900 mg/L was not a water quality-based effluent limitation but the best professional judgment at the time the permit was modified. During this reissuance, EPA is removing this end-of-pipe limit from the permit based on new information showing that the control of flow is more of a determining factor in controlling the downstream concentration of TDS than is the TDS concentration in the effluent. EPA is replacing the 3900 mg/L in the equations with 110% of the highest measured effluent value. Review of the equations in Permit Part I.A.7.d. indicates that this will be more conservative than relying on an absolute value of 3900 mg/L because the equations will assume higher effluent concentrations and therefore will not underestimate the downstream impact of the effluent.

Since the SSC during spawning has been approved, less stringent limitations appear in this permit than in the previous permit. An exception to the anti-backsliding provision of the CWA is that a reissued permit may contain a higher limitation in light of new information [CWA § 401(o)(2)(B)(i)]. The studies that Teck conducted provide new information specific to the site that was not available at the time the current permit limitations were imposed. As such, EPA is proposing to use the less stringent limitations.

3. **Turbidity:** The aquatic life standard for turbidity is that turbidity may not exceed 25 nephelometric turbidity units (NTU) above natural conditions. Natural condition, as defined in 18 AAC 70.990(42), means any physical, chemical, biological, or radiological condition existing in a waterbody before any human- caused influence on, discharge to, or addition of material to the waterbody.

The highest value for turbidity that was found in the effluent was 2.1 NTU. It is not expected that the maximum projected effluent would reach 25 NTU so this parameter is not limited in the permit although monitoring will continue.

4. **pH**: The WQS require a pH range of 6.5 - 8.5 standard units for waters protected for contact recreation. The draft 401 Certification includes a justification for the limits of the current permit which are 6.5 – 10.5. DEC retains these limits in the permit.

5. **Ammonia:** The ammonia criteria are dependent on the pH and temperature of the receiving water. Since these two parameters can vary, EPA determined the pH and temperature based on data collected from 2003 – 2007 at the edge of the mixing zone, previously represented by Station 10. EPA utilized the procedure outlined in Water Quality Criteria; Notice of Availability; 1999 Update of Ambient Water Quality Criteria for Ammonia (64 Federal Register 71974 – 71980, December 22, 1999). EPA calculated the 95th percentile of the data set (15.02ºC for temperature and 8.00 standard units for pH) to determine the applicable criteria (2.36 mg/L). EPA multiplied this criterion by the dilution factor (2.5) authorized by DEC in the § 401

Certification to determine the effluent goal (5.89 mg/L). EPA then compares this goal to the maximum projected effluent value (11.77 mg/L). This value is calculated by multiplying the maximum effluent value (10.7 mg/L) by the reasonable potential multiplier (1.1). Since 11.77 mg/L is greater than 5.89 mg/L, there is reasonable potential for the effluent to exceed the standard and a limit is necessary.

6. **Cyanide:** DEC has proposed a mixing zone for cyanide with a dilution factor of 2.5. EPA determined the most stringent criteria to be applied (5.2 chronic). EPA multiplied this criterion by the dilution factor (2.5) to determine the effluent goal (13.0). EPA then compares this goal to the maximum projected effluent value (14.9). This value is calculated by multiplying the maximum effluent value (12.4) by the reasonable potential multiplier (1.2). Since 14.9 is greater than 13.0, there is reasonable potential for the effluent to exceed the applicable criteria, and limits are necessary. Ambient monitoring for WAD cyanide has also been added to Station 151.

   The mixing zone for WAD cyanide does not violate the State's Antidegradation Policy. The above analysis indicates that the effluent, in compliance with permit limits, should not cause exceedances of the criteria at the edge of the mixing zone so it should be protective of the designated and existing uses downstream as required by 18 AAC 70.015(a)(1) Antidegradation Policy. As such, the permit may allow backsliding based on the CWA § 303(d)(4)(B) exception outlined above.

7. **Zinc:** The State has not re-certified the site specific criterion (SSC) used for zinc in the current permit, which contained a zinc limit based on the natural condition SSC of 210 µg/L provided in the State's 1998 § 401 Certification of the permit. This means that the state-wide criteria of 269 µg/L (both acute and chronic at a hardness of 260 mg/L $CaCO_3$) would be utilized to calculate the permit effluent limit. DEC has determined that the use of these criteria would not violate their Antidegradation Policy. Also, EPA believes that the adoption by DEC of the EPA Water Quality Criteria for Water [63 FR 68354-68364, December 10, 1998] for this parameter is protective of designated and existing uses downstream of the outfall as required by 18 AAC 70.015(a)(1) Antidegradation Policy, so the permit may allow backsliding based on the 303(d)(4)(B) exception outlined above.

8. **Whole Effluent Toxicity (WET):** The WET limits proposed in the permit for this facility fully account for the ambient toxicity of the receiving system that naturally occurs. These limits have been tailored to allow the mine to discharge effluent that contains toxic concentrations of various compounds, but at limits that will not increase the background toxicity. Although aquatic life is not a designated use at the point of discharge, the state water quality criterion for toxicity applies downstream of the discharge point, and the permit must ensure that the discharge does not cause or contribute to exceedances of that criterion when it does apply downstream. The permit contains the limitations developed during the 1998 permit reissuance. DEC cannot justify a change in these limits based on antibacksliding.

9. **Fecal Coliform**: For discharges to Red Dog Creek, the most protective applicable standard for fecal coliform is for Water Recreation - Secondary. 18 AAC 70.020(b)(2)(B)(ii) states, "In a 30-day period, the geometric mean may not exceed 200 FC/100 ml, and not more than 10% of the total samples may exceed 400 FC/100

ml." An average of 200 FC/100ml and a maximum of 400 FC/100ml are included as limits in the permit.

C. Summary of Permit Effluent Limitations – Outfall 001

As discussed in Section V.A. of the fact sheet, the permit contains the more stringent of technology and water quality-based effluent limitations. The water quality-based limits are more stringent than the technology-based limits for the metals and have therefore been included in the permit. The permit contains those limits based on the latest version of the EPA-approved WQS. EPA believes that the adoption by DEC of the EPA Water Quality Criteria for Water [63 FR 68354-68364, December 10, 1998] for these parameters is protective of designated and existing uses downstream of the outfall as required by 18 AAC 70.015(a)(1) Antidegradation Policy so the permit may allow backsliding based on the CWA 303(d)(4)(B) exception outlined above. Also, some limits may have changed slightly (higher or lower) based on the statistical information gathered from the current data set. Any change resulting in higher limits is considered new information and is allowed under the exception in CWA 401(o)(2)(B)(i). Any lower limits have been incorporated into the permit. Table C-4 shows a comparison between the technology-based and water quality-based effluent limitations and which limitations are in the permit.

Table C-4
Permit Effluent Limitations

Parameter[1]	Technology-based		WQ-based		Permit Limits	
	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly
Aluminum	-	-	157	53	157	53
Ammonia, mg/L N	-	-	8.8	5.7	8.8	5.7
Cadmium	100	50	3.2	1.7	3.2	1.7
Copper[2]	300	150	34.4	12.6	34.4	12.6
Cyanide, WAD	-	-	22.2	10.3	22.2	10.3
Lead[2]	600	300	18.3	8.5	18.3	8.5
Mercury	2	1	0.02	0.01	0.02	0.01
Nickel	-	-	216.5	80.0	216.5	80.0
Selenium	-	-	7.2	4.4	7.2	4.4
Zinc	1500	750	269.2	155.9	269.2	155.9
TSS, mg/L	30	20	-	-	30	20
pH, S.U.	6.0 to 9.0[3]		6.5 to 10.5		6.5 to 10.5	
WET, TU_c	-		12.2	9.7	12.2	9.7

1 - Units are µg/L unless otherwise noted.
2 - Hardness based metals criteria used a hardness of 260 mg/L $CaCO_3$
3 - The Effluent Limitation Guidelines allow this to exceed 9 in certain circumstances, see Fact Sheet Appendix C Part I.

APPENDIX D

Example Water Quality-based Effluent Limitation Calculation

This appendix demonstrates how the water quality-based analysis (reasonable potential determination and development of effluent limitations) was performed using lead in Outfall 001 as an example.

Step 1: *Determine the applicable water quality standard.*

The current Alaska water quality standards for lead are provided below at a hardness value of 260 mg/L $CaCO_3$.

Table D-1 Lead criteria		
Parameter	Acute standard	Chronic standard
Lead, µg/L	275.5	10.7
* these standards are already translated from the proposed dissolved standard to a total recoverable standard		

Step 2: *Determine if there is reasonable potential for the discharge to exceed the standard.*

To determine reasonable potential, the maximum projected effluent concentration, when no mixing zone is authorized, is compared to the applicable water quality standards. If this exceeds the standard, then a reasonable potential exists and a water quality-based effluent limit is established.

Since lead is a technology-based effluent limit, the following equation applies:

300 * RPM (reasonable potential multiplier) = 300 * 1 = 300

If this had been based on a water quality-based limit, the statistics discussed in the previous Appendix would have been applied to determine the RPM:

The tables in the TSD used to determine reasonable potential multipliers are not broad enough for parameters with more than 20 data points. EPA utilized the equations on page 52 of the TSD to determine the multiplier for lead. The maximum effluent measure for lead was 2.9 µg/L, the CV is 0.69, the number of effluent samples is 103 and the RPM is 1.5. The maximum projected effluent value for lead would be 4.3 µg/L and is less than the chronic criteria of 10.7 µg/L. So if the RP was determine strictly on a WQ basis, there would be no reasonable potential for lead to violate the criteria.

The effluent from outfall 001 has the reasonable potential to exceed the lead aquatic life standard based on the analysis of the technology-based limitation. Therefore, water quality-based limitations are required.

Step 3: *Determine the wasteload allocation.*

The wasteload allocations (WLAs) for lead are equal to the standards:

WLA

Acute	275.5
Chronic	10.7

Step 4: *Develop long-term average (LTA) concentrations.*

Effluent limitations are developed by converting the aquatic WLAs to LTAs. The most stringent of the acute or chronic LTA is then used to develop the effluent limitations.

$$LTA = WLA * \exp[0.5\sigma^2 - z\sigma]$$

where,

z = 2.326 for 99th percentile probability basis (per the TSD)

CV = 0.69

For acute: $\sigma^2 = \ln(CV^2 + 1) = \ln[(0.69)^2 + 1] = 0.39$ $\sigma = 0.62$

For chronic: $\sigma^2 = \ln(CV^2/4 + 1) = \ln[(0.69)^2/4) + 1] = 0.11$ $\sigma = 0.34$

LTA	
Acute	78.4
Chronic	5.2

The most stringent LTA concentration will be used to derive the effluent limitations for lead. In this case, the chronic LTA is used.

Step 5: *Develop effluent limitations*

The LTA concentration is converted to a maximum daily limit (MDL) and an average monthly limit (AML).

$$MDL, AML = LTA * \exp[z\sigma - 0.5\,\sigma^2]$$

where, for the MDL:

z = 2.326 for 99th percentile probability basis (per the TSD)

$\sigma^2 = \ln(CV^2 + 1) = \ln[(0.69)^2 + 1] = 0.39$

$\sigma = 0.62$

for the AML:

z = 1.645 for the 95th percentile probability basis (per the TSD)

$\sigma^2 = \ln(CV^2/n + 1) = \ln[(0.69)^2/4) + 1] = 0.11$

since n = number of samples per month = 4

(4 is the minimum recommended by the TSD)

$\sigma_4 = 0.34$

$MDL = 5.2 * \exp[z\sigma - 0.5\,\sigma^2] = 5.2 * \exp[2.326*0.62 - 0.5*0.39] = 18.3\ \mu g/L$

$AML = 5.2 * \exp[z\sigma_4 - 0.5\,\sigma^2] = 5.2 * \exp[1.645*0.34 - 0.5*0.11] = 8.5\ \mu g/L$

APPENDIX E
Ammonia Criteria and Limit Determination

Calculate Criteria & Wasteload Allocation (WLA)

P = 95th percentile of the pH dataset at Station 151 (10) = 8.00 s.u.
T = 95th percentile of the temperature dataset at Station 151(10) = 15.02ºC
M = MIN(2.85,1.45*10^(0.028*(25-T))) = Multiplier from Criteria Calculation

Acute (A)	= (0.275/(1+10^(7.204+P)))+(39/(1+10^(P-7.204))) = 5.62
Chronic -30 (C_{30})	= ((0.0577/(1+10^(7.688-P)))+(2.487/(1+10^(P-7.688))))*MIN(2.85,1.45 x $10^{0.028(25-T)}$ = 2.36
Chronic -4 (C_4)	= 2.5*C_{30} = 5.89
WLA-a (Wa)	= 2.5*A = 13.46
WLA-c30 (Wc)	= 2.5* C_{30} = 5.89
WLA-c4 (W4)	= 2.5* C_4 = 14.73

Determine most restrictive Long Term Average (LTA)

CV = the coefficient of variation of the ammonia dataset at Outfall 001 = 0.23
σ^2 = Variance
σ = Standard Deviation
z = 2.326 for the 99th percentile probability basis

Acute (A)	σ^2 = LN((CV^2)+1) = 0.052	σ = SQRT(σ^2) = 0.227
Chronic -30 (C_{30})	σ^2 = LN(((CV^2)/30)+1) = 0.002	σ = SQRT(σ^2) = 0.042
Chronic -4 (C_4)	σ^2 = LN(((CV^2)/4)+1) = 0.013	σ = SQRT(σ^2) = 0.115

LTA-a	= Wa * EXP((0.5*σ^2)-(2.326*σ)) = 8.14
LTA-c	= Wc * EXP((0.5*σ^2)-(2.326*σ)) = 5.35
LTA-c4	= W4 * EXP((0.5*σ^2)-(2.326*σ)) = 11.35

Calculate Effluent Limitations

LTA = Most stringent LTA = 5.35
MDL is Maximum Daily Limit
AML is Average Monthly Limit
Z = 1.645 for 95th percentile probability basis

MDL	σ^2 = LN((CV^2)+1) = 0.052	σ = SQRT(σ^2) = 0.227
AML	σ^2 = LN(((CV^2)/30)+1) = 0.002	σ = SQRT(σ^2) = 0.042

MDL	= LTA * EXP((2.326* σ)-(0.5* σ^2)) = 8.84
AML	= LTA * EXP((1.645* σ)-(0.5* σ^2)) = 5.72

APPENDIX F

United States Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Statement of Basis

A Draft National Pollutant Discharge Elimination System (NPDES) Permit
has been prepared to address withdrawn portions.

NPDES Permit: AK-003865-2

Applicant: Teck Alaska, Inc.
Red Dog Operations
3105 Lakeshore Dr. Bldg A Suite 101
Anchorage, AK 99507

Facility Contact: Robert Napier (907) 426-9145
Facility Location: Foothills of the DeLong Mountains near Kotzebue, Alaska

Receiving Water: Middle Fork Red Dog Creek

I. PROPOSED ACTION, TYPE OF FACILITY AND DISCHARGE LOCATION:

Pursuant to 40 CFR 124.19(d), Region 10 of the United States Environmental Protection Agency is proposing to reissue certain portions of National Pollutant Discharge Elimination System Permit No. AK-003865-2, which the Region issued to Teck Alaska Incorporated on January 8, 2010 ("2010 Permit"). EPA is proposing this action to address five effluent limitations that EPA withdrew from the 2010 Permit on March 17, 2010.

The Red Dog zinc/lead mine is located in the Northwest Arctic Borough of Alaska, 82 miles north of Kotzebue and 47 miles inland from the coast of the Chukchi Sea. The mine site is located on a ridge between the Middle and South Forks of Red Dog Creek, in the DeLong Mountains of the Western Brooks Range. The ore body lies within the drainage basin of the Middle Fork of Red Dog Creek. The open pit mine is established on both sides of the valley of the Middle Fork of Red Dog Creek. Facilities at the mine site include an open pit zinc/lead mine, concentrator, tailings impoundment, concentrate storage building, maintenance facilities, power generation plant and an accommodations complex. Red Dog Mine discharges to the Middle Fork Red Dog Creek through Outfall 001, which is the discharge point for treated mine drainage and excess precipitation. Outfall 001 is located at latitude 68º 04' 17" N, and longitude 162º 52' 05" W. Detailed descriptions of the mine and the history of Permit No. AK-003865-2 are included in the Fact Sheet that accompanied the draft of the 2010 Permit. The Fact

Sheet is available at http://www.epa.gov/region10/pdf/permits/npdes/ak/ak0038652-fs-1208.pdf.

II. LIMITATIONS AND CONDITIONS

As described below, EPA is proposing to retain or change five effluent limitations found in Part I.A.1. of the 2010 Permit. All other conditions of the 2010 permit, including effluent limitations and monitoring provisions, became fully effective and enforceable on March 31, 2010, and remain effective and unchanged. For clarity, rather than issue only the revised permit provisions, the proposed draft permit includes the entire text of the permit. **However, EPA is requesting comment only on the five effluent limitations proposed in this action. Comments on any other permit conditions will not be considered.**

III. BACKGROUND FOR THIS ACTION

On January 8, 2010, Region 10 reissued the NPDES Permit for the Red Dog Mine. On February 16, 2010, Trustees for Alaska and the Center on Race, Poverty and the Environment, representing regional environmental groups, local individuals and the Native Villages of Kivalina and Point Hope, filed a petition for review of the permit with EPA's Environmental Appeals Board (EAB). Among other things, the petition raised issues regarding antidegradation implementation procedures in the State of Alaska. By letter dated February 26, 2010, Region 10 identified five contested permit conditions that were stayed by the petition for review – effluent limits for lead (monthly average limit), selenium (daily maximum limit), zinc, weak acid dissociable (WAD) cyanide, and total dissolved solids. All remaining, uncontested permit conditions became fully effective and enforceable on March 31, 2010, in accordance with 40 CFR 124.16(a)(2) and 124.20(d). On March 17, 2010, EPA withdrew the five contested effluent limits and on April 30, 2010, the EAB dismissed as moot those portions of the petition for review related to the withdrawn limits.

On July 14, 2010, the State of Alaska's Department of Environmental Conservation issued a policy and procedure document setting forth *Interim Antidegradation Implementation Methods.*

On November 8, 2010, the EAB denied review of the remaining issue in the petition related to monitoring requirements. On December 8, 2010, Region 10 issued a final permit decision notifying the parties that, with the exception of the withdrawn limits identified above, all conditions in the 2010 Permit remained in effect. In addition, Region 10 stated that the following conditions in the 1998 NPDES Permit No. AK-003865-2 would remain in effect until further agency action:

- Part I.A.1 - effluent limitations for lead (monthly average limit), selenium (daily maximum limit), zinc, total dissolved solids, and total cyanide

EPA now proposes this action pursuant to 40 CFR 124.19(d) to address the five withdrawn limits. As described in detail below, EPA is proposing effluent limitations for the following parameters: lead (monthly average limit), selenium (daily maximum limit), zinc, total dissolved solids, and WAD cyanide.

IV. BASIS FOR PROPOSED EFFLUENT LIMITATIONS

Lead, Selenium and Zinc

Section 301(b) of the Clean Water Act requires technology-based controls on effluents. EPA's effluent limitation guidelines (ELGs) for the mining industry at 40 CFR Part 440, Subpart J, provide technology-based effluent limitations for lead and zinc, among others. Within this ELG, the New Source Performance Standards at 40 CFR 440.104 apply to Red Dog Mine. Table 1 shows the technology-based limitations:

Table 1
Technology-based Limitations

Parameter[1]	Maximum Daily	Average Monthly
Lead[2]	600	300
Selenium[3]	-	-
Zinc[2]	1500	750

1 - Units are ug/L unless otherwise noted.
2 - Hardness based metals criteria used a hardness of 260 mg/L $CaCO_3$
3 - The ELG development document considered selenium and determined that it was found at levels too low to be effectively treated but that a surrogate relationship exists between selenium and total suspended solids. *Development Document for Effluent Limitations Guidelines and Standards for the Ore Mining and Dressing Point Source Category*, EPA 440/1-82/061, at pp. 197-98, 202.

EPA then determines the Water Quality-based effluent limitations (WQBELs). By letter dated September 8, 2010, Teck requested that EPA replace the withdrawn monthly average limitations for lead and zinc as well as the daily maximum limitations for selenium and zinc with the 1998 Permit limitations, which currently remain in effect. The 1998 Permit limitations for these parameters are more stringent than those calculated for the 2010 Permit and are more stringent than necessary to protect the receiving water. Based on Teck's request, EPA is proposing to reissue the 1998 Permit limitations for these specific parameters. Table 2 shows the comparison between the 1998 and 2010 Permit limitations, along with the limits proposed in this action.

Table 2
WQBELs Comparison

Parameter[1]	1998 Permit		2010 Permit		2011 Proposed WQBELs	
	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly
Lead[2]	19.6	8.1	18.3	8.5	18.3	8.1
Selenium	5.6	4.9	7.2	4.4	5.6	4.4
Zinc[2]	257.3	119.6	269.2	155.9	257.3	119.6

1 - Units are ug/L unless otherwise noted.
2 - Hardness based metals criteria used a hardness of 260 mg/L $CaCO_3$

Table 3 shows a comparison between technology-based limits from the ELGs and the WQBELs proposed above. NPDES permits must include WQBELs if the technology-based ELGs are not sufficient to achieve water quality standards, 40 CFR 122.44(d). Based on this comparison, the draft permit limits appear in the far right column below.

Table 3 Draft Permit Effluent Limitations						
Parameter[1]	Technology-based		WQ-based		Draft Permit Limits	
	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly
Lead[2]	600	300	18.3	8.1	18.3	8.1
Selenium[3]	-	-	5.6	4.4	5.6	4.4
Zinc[2]	1500	750	257.3	119.6	257.3	119.6

1 - Units are ug/L unless otherwise noted.
2 - Hardness based metals criteria used a hardness of 260 mg/L $CaCO_3$
3 - The ELG development document considered selenium and determined that it was found at levels too low to be effectively treated but that a surrogate relationship exists between selenium and total suspended solids. *Development Document for Effluent Limitations Guidelines and Standards for the Ore Mining and Dressing Point Source Category*, EPA 440/1-82/061, at pp. 197-98, 202.

Total Dissolved Solids (TDS)

Because TDS was not considered in development of the ELGs, a case-by-case technology-based effluent limitation has been evaluated in Appendix A, in accordance with 40 CFR 125.3(c). As detailed in Appendix A, based on existing information, the technology-based effluent limitation for TDS was determined to be 4925 mg/l, measured at the discharge location, Outfall 001.

For water quality-based requirements, DEC has adopted and EPA has approved a site-specific criterion (SSC) for TDS that would result in effluent limitations only applicable to main stem Red Dog Creek different from those otherwise required under the state-wide water quality standard for TDS. According to the SSC, effluent may be discharged so as to restrict in-stream TDS concentrations to no more than 1500 mg/L at the edge of the mixing zone in Main Stem Red Dog Creek (Station 151). The SSC is a promulgated standard under the Alaska Water Quality Standards and was approved by EPA on April 21, 2006, for this waterbody. The mixing zone is described in the draft § 401 Certification found in Appendix B of the final updated APDES Fact Sheet. The discharge may start after the free flow of water in the Main Stem Red Dog Creek begins.

The 1998 Permit limited TDS in the mine's discharges to 170 mg/l (monthly average) and 196 mg/l (daily maximum). The proposed TDS limit of 1500 mg/l at the edge of the mixing zone is less stringent that the 1998 limit. Clean Water Act Section 402(o)(1) allows for “backsliding” from water-quality based effluent limitations if the requirements of CWA § 303(d)(4) are met. Under CWA § 303(d)(4)(B), which applies to attainment waters, water-quality based effluent limitations may be relaxed provided doing so is consistent with the State’s antidegradation policy. The State’s draft CWA § 401 Certification includes an analysis based on the requirements of 18 AAC 70.015 and 40 CFR 131.12, which determined that changes to TDS effluent limitations are consistent with Alaska’s antidegradation policy and will protect applicable state water quality standards.

EPA has determined that the water quality-based requirements are more stringent than the technology-based requirements (see Appendix A). EPA is therefore proposing the following TDS limitation, which is the same as that withdrawn from the 2010 Permit:

The permittee shall limit the TDS load discharged from Outfall 001 so as to maintain in-stream TDS concentrations at or below all of the following:

(1) At the edge of the mixing zone (Station 151) in Main Stem Red Dog Creek: 1500 mg/L throughout the discharge season,

Cyanide

Cyanide was considered in the development of the ELG but not included because a quantifiable reduction could not be documented with any technology known to the Administrator. *Development Document,* EPA 440/1-82/061, at p. 203. As such, technology-based limitations are not included for comparison.

The WQS contains criteria for free cyanide. Free Cyanide was previously measured as total cyanide but is now measured as weak acid dissociable (WAD) cyanide. For water quality-based requirements, EPA first determines the water quality criteria to be applied to this discharge and chooses the most stringent.

Table 4
WQ Criterion for Free Cyanide
(measured as WAD Cyanide)

Acute*	Chronic*	Drinking Water	Human Health
22	5.2	200	700

* Aquatic Life Criteria

A reasonable potential analysis was performed to determine the need for limits. This analysis compares the maximum projected effluent concentration (C_e) to the wasteload allocation for that pollutant. If the projected effluent concentration exceeds the most stringent criterion, there is “reasonable potential” (RP) and a limit must be included in the permit. EPA uses the recommendations in Chapter 3 of the TSD to conduct this analysis.

Since DEC has proposed a mixing zone for cyanide with a dilution multiplier of 2.5 (See Appendix B of the final updated APDES Fact Sheet), EPA multiplied the criterion by 2.5 to determine the wasteload allocation. This value assures that the criterion would be met at the edge of the mixing zone. EPA then compares this goal to the maximum projected effluent value, which is calculated by multiplying the maximum effluent value by the reasonable potential multiplier. Since 14.9 is greater than the wasteload allocation of 13.0, there is reasonable potential for the effluent to exceed the applicable water quality criteria, and limits are therefore necessary.

Table 5
Reasonable Potential Determination

	Maximum Effluent Concentration	CV[1]	N= # of Samples	RPM	Maximum Projected Effluent Concentration	Reasonable Potential
Cyanide	12.4 ug/L	0.70	205	1.2	14.9 ug/L	Yes

1 – CV is defined as the Standard Deviation ÷ the Mean of a data set.

The proposed draft limits for cyanide are based on the more stringent chronic criterion with the proposed mixing zone included. This results in monthly average and daily maximum limits of 10.3 ug/L and 22.2 ug/L which are less stringent than the 1998 Permit limits of 4.0 ug/L and 9.0 ug/L.

Table 6
Draft Permit Effluent Limitations

Parameter	Technology-based		WQ-based		Draft Permit Limits	
	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly	Maximum Daily	Average Monthly
WAD Cyanide, ug/L	-	-	22.2	10.3	22.2	10.3

The State's draft CWA § 401 Certification includes an analysis based on the requirements of 18 AAC 70.015 and 40 CFR 131.12, which determined that the cyanide mixing zone and changes to cyanide effluent limitations are consistent with Alaska's antidegradation policy and will protect applicable state water quality standards. As discussed above, the permit may therefore allow backsliding based on Clean Water Act §§ 402(o)(1) and 303(d)(4)(B).

V. PUBLIC COMMENT PERIOD AND PROCEDURE FOR FINAL DECISION

EPA will consider comments only on the effluent limitations proposed in this Statement of Basis.

Persons wishing to comment on, or request a public hearing for, the draft permit action may do so in writing by the expiration date of the public notice period. A request for a public hearing must state the nature of the issues to be raised as well as the requester's name, address, and telephone number. All comments should include name, address, phone number, a concise statement of the basis for a comment and relevant facts upon which it is based. All written comments should be addressed to the Office of Water & Watersheds Director at U.S. EPA, Region 10, 1200 Sixth Avenue Suite 900, OWW-130, Seattle, WA 98101; submitted by facsimile to (206) 553-0165; or comments on the draft permit may be submitted via e-mail to godsey.cindi@epa.gov

After the Public Notice expires and all substantive comments have been considered, EPA's Regional Director for the Office of Water & Watersheds will make a final decision regarding the proposed effluent limitations. If no comments requesting a change in these limitations are received, the proposed limitations will be made final, and will become effective upon final issuance. If comments are received, EPA will address the comments and issue the limitations along with a response to comments. The limitations will become effective 30 days after the issuance date, unless they are appealed to EPA's Environmental Appeals Board within 30 days.

Persons wishing to comment on the State Certification should submit written comments by the public notice expiration date to the Alaska Department of Environmental Conservation c/o Tim Pilon, 610 University Avenue, Fairbanks, Alaska 99709 or Tim.Pilon@alaska.gov.

Documents are Available for Review.

The draft NPDES permit and related documents can be reviewed or obtained by visiting or contacting EPA's Regional Office in Seattle between 8:30 a.m. and 4:00 p.m., Monday through Friday.

United States Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 900 OWW-130
Seattle, Washington 98101
(206) 553-0523 or
1-800-424-4372 (within Alaska, Idaho, Oregon and Washington)

The draft permit, this Statement of Basis, and other information can also be found by visiting the Region 10 website at www.epa.gov/r10earth/water.htm. The draft Administrative Record for this action contains the pertinent documents from the 2010 permit and any documents listed in the References section that were not included in the previous Administrative Record. The Administrative Record or documents from it are available upon request by contacting Cindi Godsey.

The draft permit and Statement of Basis are also available at:

EPA Alaska Operations Office
222 W. 7th Avenue Room 537
Anchorage, Alaska 99513-7588
(800) 781-0983 toll free in Alaska only

DEC
610 University Avenue
Fairbanks, Alaska 99709

For technical questions regarding the Statement of Basis, contact Cindi Godsey at (907) 271-6561 or godsey.cindi@epa.gov. Services can be made available to persons with disabilities by contacting Audrey Washington at (206) 553-0523.

VI. REFERENCES

EPA 1982. Development Document for Effluent Limitations Guidelines and Standards for the Ore Mining and Dressing Point Source Category Office of Water, Washington, DC. November 1982. EPA 440/1-82/061.

http://www.safewater.org (2011). Ultrafiltration, Nanofiltration and Reverse Osmosis. Retrieved March 21, 2011, from http://www.safewater.org/PDFS/resourcesknowthefacts/Ultrafiltration_Nano_ReverseOsm.pdf

Red Dog Mine Extension Aqqaluk Project Supplemental Environmental Impact Statement. January 2010.

EPA 1991. *Technical Support Document for Water Quality-based Toxics Control*. Office of Water Enforcement and Permits, Office of Water Regulations and Standards. Washington, DC. March 1991. EPA/505/2-90-001.

EPA 2010. *NPDES Permit Writers' Manual 2010.* Office of Wastewater Management, Water Permits Division, State and Regional Branch. Washington, DC. September 2010. EPA-833-K-10-001.

http://www.epa.gov (2011). Water Health Series: Filtration Facts. Retrieved March 21, 2011, from http://www.epa.gov/safewater/faq/pdfs/fs_healthseries_filtration.pdf.

Memorandum dated February 11, 2011, from Chris Eckert and Robert Napier, Teck Alaska Incorporated, to Cindi Godsey, EPA, regarding information related to the use of the barium hydroxide water treatment process at Red Dog Mine.

Memorandum dated February 21, 2008, from Frank Johns and Ron Rimelman, TetraTech (EPA's 3rd party SEIS contractor), to Gene Weglinski, TetraTech regarding Water Treatment Alternatives for Red Dog Mine.

E-mail dated February 16, 2011, from Gene Weglinski, TetraTech, to Cindi Godsey, EPA, regarding cost of reverse osmosis treatment described in the SEIS.

Appendix A
Technology-based Best Professional Judgment Analysis

REGULATORY REQUIREMENT

Federal regulations at 40 CFR 125.3(c)(3) require EPA to develop technology-based effluent limitations on a Best Professional Judgment (BPJ) case-by-case basis for each aspect or activity not subject to an effluent limitation guideline. An *effluent limitation* is defined in 40 CFR 122.2 as "any restriction imposed by the Director on quantities, discharge rates, and concentrations of 'pollutants' which are 'discharged' from 'point sources' into 'waters of the United States'. . ." A technology-based treatment requirement represents "the minimum level of control that must be imposed in a permit issued under section 402 of the [Clean Water] Act." 40 CFR 125.3(a).

The Effluent Limitation Guideline (ELG) for Ore Mining and Dressing, Subpart J - Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory (40 CFR Part 440, Subpart J) applies to the discharge from the Red Dog Mine. The ELG, however, does not limit total dissolved solids (TDS), nor was TDS a pollutant considered during development of the ELG. Because TDS is present in the discharge from the Red Dog Mine, EPA is developing a BPJ case-by-case effluent limitation for TDS based on the information that follows.

For non-toxic, non-conventional pollutants such as TDS, technology-based effluent limitation must be established based on the best available technology economically achievable (BAT). 40 CFR 125.3(a)(2)(v). In addition, 40 CFR 125.3(d)(3) lists the factors for consideration in developing a BAT effluent limitation. These factors are (i) the age of equipment and facilities involved; (ii) the process employed; (iii) the engineering aspects of the application of various types of control techniques; (iv) process changes; (v) the cost of achieving such effluent reduction; and (vi) non-water quality environmental impact (including energy requirements).

The BPJ analysis that follows addresses these regulatory factors.

A range of wastewater treatment options for TDS were considered for inclusion in this BPJ analysis including the current treatment technology used at the Red Dog Mine, several membrane processes, treatment with barium hydroxide, ion exchange, and biological treatment. Much of the information on the treatment technologies is based on the evaluation in the Red Dog Mine Extension Aqqaluk Project Supplemental Environmental Impact Statement (SEIS).

Current Wastewater Treatment Process

Tailings pond water (reclaim water) is pumped to Water Treatment Plant 2 (WTP-2) near the mill, which is seasonally operated and treats reclaim water for discharge through Outfall 001. While parts of WTP-2 are older, the present configuration of treatment has been operating at least since the 1998 Permit was issued. Within the WTP-2 supply pipeline, reclaim water is first treated in the pipeline with sodium sulfide and mixed via an in-line mixer. The sulfide reacts with the dissolved cadmium and other metals in the reclaim water to form insoluble cadmium sulfide and other metal sulfides, which are stable throughout the remainder of the treatment process. The sodium sulfide-treated reclaim water then

proceeds to a rapid mix tank where lime (calcium hydroxide) and recycled clarifier underflow solids are added to adjust the pH. From the rapid mix tank: the solution flows into the lime reactor which provides residence time for complete chemical reactions to occur. Additionally, compressed air is added into the lime reactor tank to ensure full oxidation of all ions in solution, specifically and most significantly the oxidation of metals.

The precipitated solids containing the metals are maintained in suspension and flocculent is added to unite smaller particles into larger solids in the flocculent mix tank. The solution then flows into a clarifier where the solids are allowed to gravity-settle. Settled solids are removed through the "underflow" and the treated decant water leaves the clarifier through the "overflow". Underflow solids are recycled back to the beginning of the treatment process with some solids periodically purged from the system to the tailings impoundment to maintain a constant sludge bed level in the clarifier.

Clarifier overflow water proceeds to four sand filters operated in a parallel configuration. The sand filters remove any residual solids not settled out of solution within the clarifier. Automated pH and turbidity meters take final measurements of the sand filter effluent. If the pH is within NPDES permit limits and within the operating range established to ensure effective treatment and the turbidity is within an established range which indicates that effective solids removal has been accomplished, the water is discharged to Red Dog Creek. If the pH and turbidity are not within the prescribed range, the filtered water is discharged back into the tailings impoundment.

Currently, Teck is focused on using source control techniques to reduce the TDS levels in the tailings impoundment. WTP-3 was constructed during the winter/spring of 2004/2005 and began operating in 2006. The plant treats seepage and runoff from the Main Waste Stockpile and Mine Sump (both of which have high TDS concentrations) before it enters the tailings impoundment. Like WTP-2, WTP-3 uses a lime precipitation process for metals removal.

Membrane Processes

Reverse osmosis units force water through a semi-permeable membrane under pressure, leaving contaminants behind. Reverse osmosis units treat approximately three times more water than they discharge. Reverse osmosis removes turbidity, microbes, and virtually all dissolved substances. However, while reverse osmosis removes many harmful minerals, such as salt and lead, it also removes some healthy minerals, such as calcium and magnesium.

The pressure utilized during reverse osmosis depends on the TDS concentration and must be greater than the osmotic pressure for the solution. Typical pressures for reverse osmosis applications range from 300 to 1,200 pounds per square inch to create a flow of clean water from low TDS concentration to high TDS concentration through the membrane. The current high TDS concentrations in the tailings reclaim water (>4,000 mg/L), would reduce the effectiveness of a reverse osmosis system. As noted above, the mine has been disposing of sludge generated from WTP-2 in the tailings impoundment since the start of treatment operations, contributing to gypsum levels near saturation in the pond water. Using gypsum saturation as the design point for the reverse osmosis process, the maximum recovery of clean water would likely be in the range of 30 to 50 percent. Therefore, to discharge 15

million gallons per day (MGD) of treated water during the discharge season, 30 to 50 MGD would need to be processed. This would result in a brine wastestream of 15 to 35 MGD. With the reverse osmosis influent at the gypsum saturation concentration, the membranes are highly likely to foul or clog, resulting in unreliable performance.

To permanently reduce TDS levels in the impoundment, the brine wastestream cannot be disposed of in the tailings impoundment. Disposal of brine in the waste rock dump and Main Pit would present similar challenges because the brine (and its contained metals) could be resolublized into the water draining from these disposal facilities, which is pumped to the tailings impoundment. Therefore, an encapsulated disposal area able to contain 100 tons per day of brine during the operating discharge season and for the foreseeable future after closure would need to be built near the Red Dog Mine site. The SEIS assumed the encapsulated brine disposal site would be located in a portion of the Main Pit. The Main Pit would have the capacity to hold more than 50 years of both precipitation sludge and brine. Therefore, an additional site would need to be built and managed to dispose of brine during long-term post-closure water treatment.

Reverse osmosis systems are in place at other mines and other industrial facilities, and are used on wastewaters with metals loadings comparable to the Red Dog Mine. While reverse osmosis may be technically feasible, the high TDS levels in the influent and the adverse climatic conditions present challenges for successful design and operation. In addition, large volumes of brine would need to be disposed and managed over the long-term.

Nanofiltration is a membrane process similar to reverse osmosis except the membrane has a higher particle size cutoff; up to 0.005 µm for nanofiltration compared to less than 0.002 µm for reverse osmosis. Typical pressures for nanofiltration applications range from 50 to 200 pounds per square inch. Nanofiltration removes bacteria, protozoa and some viruses from the water, as well as most natural organic matter and some natural minerals, especially divalent ions which cause hard water. Nanofiltration, however, does not remove dissolved compounds. Therefore, it is not considered a viable option for TDS treatment and was not evaluated in detail.

Electrodialysis is another membrane treatment technology where electricity is used as the driving force for separation instead of pressure. An electrical current is used to move the ions through a series of selective membranes. The consecutive membranes concentrate the ions in a wastestream and away from the treated water. Electrodialysis reversal is a modification of the process that switches charges during operation to promote cleaning. This technology is applicable for treatment of high TDS water because it is less susceptible to plugging and is easily cleaned. As discussed in more detail below, the downside to this process is the high energy use and the large volume of concentrated wastes requiring disposal (typically more volume than reverse osmosis). In addition, there are no examples of the use of electrodialysis at mining operations. Electrodialysis is therefore not considered a viable option for TDS treatment and was not evaluated in detail.

Ion Exchange

Ion exchange is a process where water flows through an ion exchange resin and undesirable ions in the water are exchanged for more benign ions on the resin. For this application, the ion exchange process would need to be a sequential process with strong

acid cation resin to remove calcium followed by weak base anion resin to remove sulfate. The columns would be regenerated with sulfuric acid and caustic material, so the process would be removing TDS in exchange for water. Since there is no experience operating ion exchange systems of this type at the required volumes (15 MGD), and because of the large amount of sulfuric acid and caustic material required, ion exchange is not considered a viable option for TDS treatment and was not evaluated in detail.

Biological Treatment

Biological processes are used for sulfate removal in mine wastewaters by reducing sulfate to sulfide. The result is a change from calcium sulfate to calcium carbonate; however, both of these compounds contribute to TDS. Biological processes change the form of sulfur but do not provide for TDS removal and therefore are not considered viable for TDS treatment and were not evaluated in detail.

Barium Hydroxide

Barium hydroxide could be used with the existing water treatment to remove gypsum from the wastewater instead of or in combination with calcium hydroxide. Treatment of the entire discharge with barium hydroxide is expected to result in an end-of-pipe TDS levels around 1,500 mg/L. Enhanced treatment of a portion of the discharge is expected to reduce the annual average TDS concentration of the effluent from the current level of 4,120[4] mg/L to 3,000 mg/L. Sludge from the barium hydroxide process would be chemically stable and could be disposed of in the tailings impoundment during operations and in the Main Pit after closure for the reasonably foreseeable future.

Teck tested the use of enhanced barium hydroxide treatment during the summer and fall of the 2010 discharge season, during periods of low precipitation resulting in low stream flow in Red Dog Creek. Barium hydroxide was used during low stream flow events when stream capacity limited the discharge rate to less than 5,000 gallons per minute. The barium hydroxide treatment process was used from June 13 to June 30, July 18 to July 22, August 4 to August 13, and August 26 to September 8. The table below contains the TDS results of the weekly composite samples utilizing the barium hydroxide treatment process.

Date	TDS (mg/L)
6/14/2010	3230
6/21/2010	3000
6/28/2010	3120
7/20/2010	3260
8/9/2010	3020
8/30/2010	2950
9/8/2010	3300

Wastewater Pipeline

One of the alternatives analyzed in the Red Dog Aqqaluk SEIS entailed replacing the current discharge location in Red Dog Creek with a wastewater discharge pipeline

[4] 2010 Final Supplemental Environmental Impact Statement.

transporting treated effluent from the mine site to the port site and discharging to the Chukchi Sea. The wastewater discharge pipeline was considered because it would allow Teck more flexibility in managing its wastewater.

As explained above, the purpose of this BPJ analysis is to determine a technology-based effluent limitation for TDS. In accordance with the Clean Water Act's national goal of eliminating the discharge of pollutants, identification of BAT and the resulting technology-based effluent limitations are meant to reduce the level of pollutants entering waters of the U.S. In this case, the wastewater discharge pipeline would not reduce the level of TDS entering waters of the U.S. Rather, it would only move the discharge from one water body to another, *i.e.*, from Red Dog Creek to the Chukchi Sea. Therefore, EPA has not identified the wastewater pipeline as an available technology for establishing technology-based effluent limitations, even though there may be other advantages to its use (as described in the SEIS).

OTHER ISSUES

In evaluating the treatment options described above, two stand out as potentially viable alternatives for treating the discharge at the Red Dog Mine to reduce TDS levels: reverse osmosis and the use of barium hydroxide. The following items were considered when making the final BPJ determination:

Reverse Osmosis. Based on the analysis in the SEIS, three 5-MW engines (only two would be operational at any given time) would need to be added to the site's generating capacity to supply power for the reverse osmosis water treatment system. This results in potential impacts to air quality (from the engine emissions). In addition, the use of reverse osmosis would require disturbance of additional land beyond the current mine site in order to build the treatment plant and site the brine disposal facility. The required space is not available at the mill. The SEIS assumed that a new treatment facility could be constructed at the northeast edge of the impoundment. This would include a thermal evaporation system to consolidate reverse osmosis solids in the brine prior to disposal. The required area could vary greatly depending on the final design configuration. As explained above, the brine from the process would have to be specially handled and encapsulated separately from other wastewater to prevent re-entrainment of the solids already removed from the wastestream. The brine disposal site would require long-term maintenance, in addition to that already required for the treatment plant and tailings pond.

It is estimated that utilization of the reverse osmosis system described in the SEIS would have a capital cost of $70 - $100 million with an additional $3 - $6 million in annual operating costs.

Given the high cost, additional energy needs, and additional impacts (long-term brine disposal and management), EPA has determined that the reduction of TDS in the effluent does not warrant the establishment of BAT limits based on reverse osmosis treatment.

Barium Hydroxide. The current design of WTP-2 uses slaked lime. Teck used the lime slakers[5] to dissolve the solid barium hydroxide for the barium hydroxide test. Due to the

[5] The mechanism in which quick lime is added to water to form a slurry.

low temperature of the water added to dissolve the barium hydroxide, only 3% to 4% by weight could be dissolved using the lime slakers. This limited the treatment capacity of the plant to approximately 5,000 gpm of discharge quality water. There is not a sufficient volume of fresh water (Bons Creek Reservoir) available to dissolve the quantity of barium hydroxide that would be required to operate the plant at the 15,000 gpm discharge rate required to maintain the site's water balance. To operate the water treatment plant at the required rates, a new dry bulk reagent handling system would need to be designed and installed. In theory, a bulk handling system could be designed to feed dry barium hydroxide into water treatment plant. However, it is unknown if the barium hydroxide could be delivered to the site in a free-flowing condition that would enable the product to be directly fed into the water treatment plant.

Assuming a free flowing reagent source could be secured, the theoretical design of a bulk dry handling system would be similar to a lime bulk handing system. Teck estimates that design and installation of the bulk handling system would cost approximately $30 million. This is a preliminary estimate as a significant amount of engineering work would be required to determine if a barium hydroxide bulk handling system is possible. The shipping of the barium hydroxide to site would require approximately 1,700 shipping containers specially modified for direct feed into the bulk handling system. Assuming the modification required would be similar to the containers used for the current ammonia nitrate bulk handling system, the cost of the containers would be approximately $10.2 million.

To estimate the cost of water treatment, a volume of 1.5 billion gallons was used. This is the approximate volume of water that would need to be treated in an average precipitation year to provide sufficient discharge volume to maintain the site-wide water balance.

Estimated Reagent Cost to treat 1.5 billion gallons of water				
	Reagent Demand (g/L)	Mass of Reagent Required (metric ton)	Cost per metric ton	Estimated annual reagent cost
Lime	0.94	5,337	$333	$1.8 m
Barium hydroxide	3.79	21,520	$1,185	$25.5 m

There would be additional costs associated with the movement of the additional 16,180 tonnes of reagent from the port to the mine that have not been included in the estimated cost. It is unclear if there is sufficient worldwide production capacity available to produce the 22 thousand tonnes of barium hydroxide that would be required annually. Teck experienced significant difficulty in securing the 3,800 tonnes of barium hydroxide that were used in a (nondischarge) test run in 2008 and for discharge during portions of the 2010 discharge season. At a minimum, the market would tighten and there would be a significant increase in the reagent's cost. However, it is likely that in the short term Teck would not be able to secure the required amount of barium hydroxide and in the long term it is unknown if there is a sufficient resource available – worldwide – to provide the amounts of reagent required for full-scale treatment.

Given the high cost, additional energy needs, and additional impacts (transport of the material from the port to the mine and the potential effect on the world-wide market), EPA has determined that the reduction of TDS in the effluent does not warrant the establishment of BAT limits based on treatment utilizing barium hydroxide.

BPJ LIMITATION DETERMINATION

EPA has considered the regulatory factors and determined that the BAT effluent limitation should be established based on the current treatment technology at the facility, described above. EPA calculated the TDS BAT limit based on procedures in Chapter 5 of the NPDES Permit Writers' Manual. The procedure calls for multiplying the long term average of effluent data by a daily variability factor, defined as the 99th percentile of the distribution of daily values divided by the mean. Using the data from Outfall 001 over the 5 year period 2006 – 2010 as shown in Attachment 1 (data for enhanced barium treatment was excluded from the calculation) and considering the long term average and the mean to be equal, the result is a maximum effluent value of 4925 mg/L. As discussed in the Statement of Basis, EPA has compared this effluent limitation with the water quality-based requirement of 1500 m/l at the edge of the mixing zone (Station 151) in Main Stem Red Dog Creek.

Since there is no assurance that a constant discharge of 4925 mg/L will meet the water quality based requirement of 1500 mg/L at Station 151 at all times, especially in low flow situations, EPA has concluded that the water quality-based requirement will result in a more stringent end-of-pipe discharge than application of BAT. The water quality-based requirements included in the draft permit are as follows:

> The permittee shall limit the TDS load discharged from Outfall 001 so as to maintain in-stream TDS concentrations at or below all of the following:
>
> > At the edge of the mixing zone (Station 151) in Main Stem Red Dog Creek: 1500 mg/L throughout the discharge season.

ATTACHMENT 1

Sample Date	Reporting Result	Sample Date	Reporting Result	Sample Date	Reporting Result
5/11/2006	4,010	8/27/2007	4,150	9/14/2009	4,700
5/11/2006	4,090	9/4/2007	4,170	9/21/2009	4,670
5/11/2006	4,120	9/10/2007	4,050	5/8/2010	4,930
5/11/2006	4,240	9/16/2007	4,140	5/11/2010	5,070
5/15/2006	4,040	9/24/2007	4,120	5/17/2010	4,710
5/15/2006	4,150	10/1/2007	4,120	5/24/2010	4,590
5/15/2006	4,170	5/16/2008	4,220	6/1/2010	4,350
5/15/2006	4,190	5/19/2008	4,330	6/8/2010	4,360
5/15/2006	4,220	5/26/2008	4,410	6/14/2010	3,230
5/22/2006	3,130	6/2/2008	4,220	6/21/2010	3,000
5/22/2006	3,140	6/9/2008	3,570	6/28/2010	3,120
5/29/2006	2,330	6/15/2008	3,590	7/17/2010	4,300
6/5/2006	3,580	6/23/2008	3,740	7/20/2010	3,260
6/12/2006	3,340	7/1/2008	3,760	7/26/2010	4,280
6/19/2006	3,480	7/6/2008	3,840	8/3/2010	4,570
6/26/2006	3,750	7/14/2008	4,050	8/9/2010	3,020
7/4/2006	3,860	7/17/2008	4,130	8/18/2010	4,400
7/10/2006	3,560	7/22/2008	4,080	8/23/2010	4,410
7/17/2006	3,690	7/27/2008	3,980	8/30/2010	2,950
7/24/2006	3,740	8/4/2008	4,020	9/8/2010	3,300
8/1/2006	3,570	8/11/2008	4,180	9/13/2010	4,400
8/7/2006	3,680	8/18/2008	4,070	9/20/2010	4,360
8/14/2006	3,710	8/25/2008	4,410		
8/20/2006	3,800	9/5/2008	4,290		
8/27/2006	3,540	9/10/2008	4,310		
9/5/2006	4,050	9/14/2008	4,400	Max	5,070
9/10/2006	3,960	9/22/2008	4,330	Min	2,330
9/18/2006	3,880	5/8/2009	4,600	Mean	4,092
9/24/2006	3,880	5/13/2009	4,270	Std Dev	435.7
10/1/2006	4,110	5/18/2009	4,530	CV	0.11
5/26/2007	2,800	5/25/2009	4,390		
5/28/2007	2,740	6/2/2009	4,260	99 %tile	4924.8
6/4/2007	3,610	6/8/2009	4,030		
6/10/2007	4,020	6/15/2009	4,530		
6/10/2007	4,030	6/22/2009	4,420		
6/17/2007	4,000	7/2/2009	4,280		
6/25/2007	4,170	7/7/2009	4,430		
7/1/2007	4,220	7/13/2009	4,420		
7/9/2007	4,260	7/20/2009	4,560		
7/16/2007	3,660	8/4/2009	4,400		
7/24/2007	4,140	8/10/2009	4,800		
8/1/2007	4,110	8/22/2009	4,330		
8/6/2007	4,270	8/24/2009	4,620		
8/13/2007	4,040	9/1/2009	4,220		
8/20/2007	4,210	9/7/2009	4,480		

Data collected during enhanced barium treatment.