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 Period Start Date: April 7, 2017
Public Comment Period Expiration Date: May 8, 2017
Alaska Online Public Notice System

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Reissuance of an Alaska Pollutant Discharge Elimination System (APDES) permit 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 68^0 04' 17" N, Longitude 162^0 52' 05" W

The Alaska Department of Environmental Conservation (Department or DEC) reissues an APDES individual permit (permit) to Teck Alaska, Incorporated (TAK). 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 limitations and other conditions
- technical material supporting the conditions in the permit
- monitoring requirements in the permit

After the close of the public comment period and after a public hearing, if applicable, the Department will review the comments received on the draft permit. The Department will respond to the comments received in a Response to Comments document that will be made available to the public. If no substantive comments are received, the tentative conditions in the draft permit will become the final permit.

The proposed final permit will be made publicly available for a five-day applicant review. The applicant may waive this review period. After the close of the proposed final permit review period, the Department will make a final decision regarding permit issuance. A final permit will become effective 30 days after the Department's decision, in accordance with the state's appeals process at 18 AAC 15.185.

The Department will transmit the final permit, fact sheet (amended as appropriate), and the 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
410 Willoughby Avenue, Suite 303
Juneau AK, 99811-1800

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 Avenue, Suite 303
Juneau AK, 99811-1800

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, application, and related documents can be obtained by visiting or contacting DEC between 8:00 a.m. and 4:30 p.m. Monday through Friday at the addresses below. The permit, fact sheet, application, and other information are located on the Department's Wastewater Discharge Authorization Program website: http://www.dec.state.ak.us/water/wwdp/index.htm .

Alaska Department of Environmental Conservation Division of Water Wastewater Discharge Authorization Program	
Fairbanks Office 610 University Ave. Fairbanks, AK 99709 (907) 451-2136	***Anchorage Office*** 555 Cordova Street Anchorage, AK 99501 (907) 269-6285

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1.0 APPLICANT

This fact sheet provides information on the Alaska Pollutant Discharge Elimination System (APDES) permit for the following entity:

Name of Facility:	Red Dog Mine
APDES Permit Number:	AK0038652
Facility Location:	82 miles Northeast of Kotzebue
Mailing Address:	Teck Alaska Incorporated 3105 Lakeshore Drive Anchorage, AK 99517
Facility Contact:	Mr. Henri Letient, General Manager

Figures in Appendix A show the location of the Red Dog Mine along with discharge and monitoring locations and a line drawing of the designated uses of creeks in the area.

2.0 FACILITY INFORMATION

2.1 Facility Activity

Teck Alaska, Incorporated (TAK), in partnership with the NANA Regional Corporation, Inc. operates the Red Dog zinc and lead mine in the Northwest Arctic Borough of Alaska, 82 miles north of Kotzebue and 47 miles inland from the coast of the Chukchi Sea. Mine facilities are 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 one of the world's largest zinc mines. 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 Delong Mountain Transportation System port facility.

The Red Dog deposit consists of metal sulfides in Mississippian-aged 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 mine facility 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. TAK currently mines a second pit, Aqqaluk, which would allow for continued mining through 2031. The mine produces approximately 9,000 tonnes of ore per day.

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 fed through 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 986 feet. The pond elevation is at 971 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.

2.2 Background

In the early 1980s, TAK submitted several applications for federal authorizations for the project. The surface water discharge was a new source which required the Environmental Protection Agency (EPA) to prepare an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA). The EIS was issued in 1984 and the first National Pollutant Discharge Elimination System (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. TAK re-applied for the NPDES permit in a timely manner so the permit was administratively extended until reissuance.

EPA reissued the NPDES permit in March 2007. The reissued 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 a Supplemental EIS for permit reissuance which included TAK's request to develop the Aqqaluk Pit.

On January 8, 2010, EPA Region 10 reissued the NPDES permit for 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, EPA 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 (CN), 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 using these methods 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, TAK 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 site specific criterion (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 a Statement of Basis for reinstating the permit limits that were withdrawn on March 17, 2010.

In November, 2012, EPA determined that all relevant appeals of the permit had been resolved and verbally notified DEC and TAK of the intent to transfer jurisdiction of the permit to DEC given primacy for mining NPDES permits had transferred to DEC in October 2011.

In a letter dated November 27, 2012, TAK requested that DEC not take action on the selenium daily maximum limit in light of TAK's continuing evaluation of recent discharge information. Based in part on TAK's request for no permit action on selenium, DEC took no action on selenium (daily maximum), lead (monthly average), and zinc (monthly average and daily maximum) at that time. Until DEC addressed selenium, lead, or zinc limits through a future permitting action, the corresponding limits from the 1998 permit remained 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 the 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 addressed the five withdrawn limits as described in EPA's April 25, 2011 Statement of Basis. DEC reinstated the 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 remained in effect for those parameters.

On February 15, 2013, DEC reinstated TDS and WAD cyanide limits in the APDES permit, which became effective on April 1, 2013.

Through APDES permit modification #1 effective May 8, 2014, DEC authorized a mixing zone for selenium and adjusted selenium effluent limits accordingly.

Due to the number and variety of appeals while under the jurisdiction of EPA and considering that all of those appeals were resolved before the permit was transferred to DEC, this permit reissuance mirrors the methods and conditions of the previous permit to the maximum extent possible. The primary, if not only, variation from the 2010 permit is the assimilation of new monitoring data resulting in new effluent limits and adjusted monitoring frequencies.

3.0 COMPLIANCE HISTORY

On December 4, 2012, jurisdiction over the Red Dog Mine NPDES permit was transferred to DEC. Discharge Monitoring Reports (DMRs) from December 2012, since taking over the permit, through December 2016 were reviewed to determine the facility's compliance with effluent limits. DMR's indicate that no permit violations have occurred under DEC's administration of the permit.

4.0 EFFLUENT LIMITS AND MONITORING REQUIREMENTS

4.1 Basis for Permit Effluent Limits

The CWA requires that the limits for a particular pollutant be the more stringent of either technology-based effluent limits (TBELs) or water quality-based limits (WQBELs). TBELs are set according to the level of treatment that is achievable using available technology. WQBELs are set as the permit limit if they are more stringent than TBELs to ensure that the receiving water quality is protected.

Outfall 001 discharges mine drainage at the site. EPA promulgated effluent limitation guidelines (ELGs) for the ore mining and dressing point source category at 40 CFR Part 440, which include TBELs for this point source category. Subpart J is applicable to the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory. The ELGs in Subpart J are applicable to Outfall 001.

The discharge at Outfall 001 is subject to the new source performance standards at 40 CFR § 440.104(a). These ELGs are applicable to a source that commenced construction after December 3, 1982. Table 1 identifies the parameters and TBELs for Outfall 001 found in 40 CFR Part 440.

Table 1: Technology-Based Effluent Limits for Outfall 001 [40 CFR § 440.104(a)]

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days	Range
Cadmium	mg/L[1]	0.10	0.05	-
Copper	mg/L	0.30	0.15	-
Lead	mg/L	0.6	0.3	-
Mercury	mg/L	0.002	0.001	-
Zinc	mg/L	1.5	0.75	-
pH	s.u.[2]	-	-	6.0-9.0
Total Suspended Solids (TSS)	mg/L	30.0	20.0	-

1. Milligrams per liter
2. Standard units

4.2 Basis for Effluent and Receiving Water Monitoring

In accordance with AS 46.03.110(d), the Department may specify in a permit the terms and conditions under which waste material may be disposed. Monitoring in a permit is required to determine compliance with effluent limits. Monitoring may also be required to gather effluent and receiving water data to determine if additional effluent limits are required or to monitor effluent impact on the receiving waterbody quality. The permittee is responsible for conducting the monitoring and for reporting results on DMRs or on the application for reissuance, as appropriate, to the Department. Fact Sheet Sections 4.3 and 4.4 summarize monitoring requirements DEC has determined necessary to implement in the permit (additional discussion about the basis for monitoring requirements can be found in APPENDIX B).

4.3 Effluent Limits and Monitoring Requirements

The permit contains effluent limits that are the most stringent of either TBELs or WQBELs and a flow limit based on the design of the treatment systems. Monitoring frequencies are based on the nature and effect of a pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance. Permittees have the option of taking more frequent samples than are required under the permit. These samples must be included in calculations and used for averaging if they are conducted using the Department-approved, significantly sensitive test methods (generally found in 18 AAC 70 and 40 CFR Part 136 [adopted by reference in 18 AAC 83.010(f)]) and if the method detection limits are less than the effluent limits.

Table 2 summarizes the effluent limits and monitoring requirements for Outfall 001 and provides a comparison to the limits in the previous permit. Please see APPENDIX B for more details regarding the legal and technical basis surrounding the selection of effluent limits.

Table 2: Effluent Limits and Monitoring Frequencies for Outfall 001 (Changes in Boldface)

Parameter (in µg/L[1] unless otherwise noted)	Daily Maximum		Monthly Average		Minimum Sample Frequency		
	2010 Permit	2017 Permit	2010 Permit	2017 Permit	1998 Permit	2010 Permit	2017 Permit
Aluminum[2]	157	**NA**	53	**NA**	1/month	1/month	**NA**
Ammonia, Total as N, mg/L[3]	8.8	**monitor**	5.7	**monitor**	1/week	1/week	1/week
Biochemical Oxygen Demand (BOD_5), mg/L	monitor				1/month	1/month	**1/2 months[4]**
Barium[2]	monitor				NA	1/month	1/month
Cadmium[2]	3.2	**3.7**	1.7	**1.4**	1/week	1/week	1/week
Chlorine, Total Residual	monitor				1/month	1/month	**1/2 months**
Chromium[2]	monitor	**NA**	monitor	**NA**	1/week	1/month	**NA**
Copper[2]	34.4	**52**	12.6	**21**	1/week	1/week	1/week
Cyanide, WAD[5]	22.2	**monitor**	10.3	**monitor**	1/week	1/week	1/week
Fecal Coliform, #/100 ml	400	**NA**	200	**NA**	1/ 2 months	1/ 2 months	**NA**
Iron[2]	monitor	**NA**	monitor	**NA**	1/month	1/month	**NA**
Lead[2]	18.3	**18.3[6]**	8.1	**8.1[6]**	1/week	1/month	1/month
Manganese[2]	monitor	**NA**	monitor	**NA**	1/week	1/month	**NA**
Mercury, Total	0.02	**0.018**	0.01	0.010	1/month	1/month	1/month
Nickel[2]	216.5	NA	80.0	NA	1/week	1/month	**NA**
Organic Priority Pollutant Scan[7]	monitor				3/year	1/year	1/year
pH, standard units (s.u.)	Within the range of 6.5 to 10.5				1/week	1/week	1/week
Selenium[2]	17	17	11	11	1/week	1/week	1/week
Temperature, °C	monitor				daily	daily	**1/week**
Total Dissolved Solids (TDS), mg/L	See note 8.				1/week	1/week	1/week
TDS, Anions and Cations[9]	monitor				NA	1/month	1/month
Total Suspended Solids (TSS), mg/L	30	30	20	20	1/week	1/week	1/week
Turbidity, NTU[10]	monitor	**NA**	monitor	**NA**	1/week	1/month	**NA**
Volume, cumulative gallons	2.418 billion gallons per year				continuous	continuous	continuous
Whole Effluent Toxicity (WET), TU_C[11]	12.2	12.2	9.7	9.7	1/month	1/month	**1/2 months**
Zinc[2]	257.3	**388**	119.6	**221**	1/week	1/month	1/month

1. Micrograms per liter
2. All metals shall be analyzed as total recoverable unless otherwise indicated.
3. Milligrams per liter
4. Once every two months
5. Weak acid dissociable
6. Based on the chronic WQS and Department-prescribed methodology, the calculated limits are 34 and 11 µg/L. However in a letter dated May 8, 2017, TAK requested that the more stringent limits from the 2010 permit be retained in this permit.
7. Volatile organics shall be monitored using EPA analytical method 624, and semi-volatile organics shall be monitored using EPA analytical method 625. The pollutants assayed should include the following pollutants listed in Table 6-C of DEC's APDES permit application form 2C: (1) 1V-31V – volatile organic compounds, (2) 1A- 11A – acid fraction compounds, and (3) 1B – 46B base/neutral compounds.
8. Based on TDS measurements from Stations 151, 150, and 160 as described in Permit Part 1.2.8
9. This monitoring shall include carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. The carbonate analysis should be estimated based on direct measurement of alkalinity.
10. Nephelometric turbidity units
11. Chronic toxicity units

As required under 18 AAC 83.435, a reasonable potential analysis was conducted to determine if effluent from Outfall 001 has reasonable potential to exceed Alaska WQS. An analysis of five years of monitoring data showed that there is no reasonable potential to exceed WQS for aluminum, chromium, iron, manganese, and nickel. Consequently, the permit no longer requires monitoring for those parameters. Additionally, there is no reasonable potential to exceed WQS for ammonia and cyanide at the boundary of the mixing zone. However, ammonia and cyanide monitoring was maintained while the limits were removed to track potential pollutants of concern.

Effluent limits must be developed for parameters that have a reasonable potential to exceed WQS. Analysis of recent data resulted in a number of changes to the effluent limits in the permit. Some limits have decreased, while other limits have increased. For parameters that did not demonstrate reasonable potential, limits or monitoring requirements may have been revised or removed as discussed in the preceding paragraph. The Department has required the necessary antibacksliding analysis in Section 6.0, which is further examined in Section 7.0.

The permittee shall also consult and review APDES application form 2C, which contains specific effluent monitoring requirements due to be submitted in the application for permit reissuance (180 days prior to the permit expiration date). A copy of Form 2C can be found at http://dec.alaska.gov/water/wwdp/index.htm.

4.4 Whole Effluent Toxicity Monitoring

WET tests are laboratory tests that measure total toxic effect of an effluent on living organisms. The tests use small vertebrate and invertebrate species and/or plants to measure the aggregate toxicity of an effluent. Chronic toxicity tests measure reductions in survival, growth, and reproduction over a 7-day or 48 hour exposure. Chronic toxicity monitoring shall be conducted by the permittee according to the methods and species approved by the EPA in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition* (October 2002).

Under 18 AAC 83.435, a permit shall contain limitations on WET when a discharge has reasonable potential to cause or contribute to exceedances of WQS. From 2010 through 2014, WET tests were conducted 32 times with a maximum of 9.0 TU_c and a mean equal 6.1 TU_c. The permit requires bimonthly WET testing at Outfall 001 to demonstrate compliance with permit limits.

5.0 RECEIVING WATERBODY

5.1 Water Quality Standards

Regulations in 18 AAC 70 require that the conditions in permits ensure compliance with the WQS. The state's WQS are composed of use classifications, numeric and narrative water quality criteria, and an Antidegradation Policy. The use classification system designates the beneficial uses that each waterbody is required to achieve. The numeric and narrative water quality criteria are deemed necessary by the state to support the beneficial use classification of each waterbody. The Antidegradation Policy ensures that beneficial uses and existing water quality are maintained.

Waterbodies in Alaska are designated for all uses unless the water has been reclassified under 18 AAC 70.230 as listed under 18 AAC 70.230(e). Some waterbodies in Alaska can also have site–specific water quality criterion per 18 AAC 70.235, such as those listed under

18 AAC 70.236(b). Waterbodies in the area of Red Dog Mine have been reclassified and assigned site-specific water quality criteria, 1,500 mg/L for TDS and 2.0 µg/L for cadmium in the Main Stem. See Figures 2 and 3 for further details. Fresh water designated use classes listed in 18 AAC 70.020(a)(1) include:

1. domestic water supply – 18 AAC 70.020(b)(1)(A)(i)
2. agriculture water supply – 18 AAC 70.020(b)(1)(A)(ii)
3. aquaculture water supply – 18 AAC 70.020(b)(1)(A)(iii)
4. industrial uses – 18 AAC 70.020(b)(1)(A)(iv)
5. contact recreation – 18 AAC 70.020(b)(1)(B)(i)
6. secondary recreation – 18 AAC 70.020(b)(1)(B)(ii)
7. growth and propagation of fish, shellfish, other aquatic life, and wildlife – 18 AAC 70.020(b)(1)(C)

5.2 Water Quality Status of Receiving Water

Any part of a waterbody for which the water quality does not or is not expected to meet applicable WQS is defined as a "water quality limited segment" and placed on the state's impaired waterbody list. For an impaired waterbody, Section 303(d) of the Clean Water Act (CWA) requires states to develop a Total Maximum Daily Load (TMDL) management plan for a waterbody determined to be water quality limited. The TMDL documents the amount of a pollutant a waterbody can assimilate without violating a state's WQS and allocates that load to known point sources and nonpoint sources.

No waterbodies affected by Red Dog Mine wastewater are included on the *Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report*, July 15, 2010, as impaired nor are any listed as a CWA 303(d) waterbody requiring a TMDL. As such, a TMDL has not been completed for the waterbody.

5.3 Ambient Monitoring

The permit carries forward the biomonitoring program from the previous permit. Alaska Department of Fish and Game (ADF&G) has conducted an annual ambient water quality monitoring and bioassessment program at Red Dog Mine since 2001. The program has been kept intact from the previous permit to assure reference point continuity. This biomonitoring program will verify that the designated uses downstream of Red Dog Mine have been protected.

5.4 Mixing Zones

Under 18 AAC 70.240, as amended through June 26, 2003, the Department may authorize a mixing zone in a permit. The Department authorizes mixing zones at designated reaches within Red Dog Creek for specified parameters described below. The three mixing zones authorized in the permit remain unchanged from the previously issued permit.

Mixing Zone 1: Lower Middle Fork Red Dog Creek extends from the terminus of the Red Dog Mine Water Management System to the confluence with North Fork Red Dog Creek. It is the location of Mixing Zone 1 for pH and is classified for the following designated uses: industrial, wading only, and secondary recreation. Since the designated and existing uses for the Lower Middle Fork Red Dog Creek are restricted, Mixing Zone 1, which starts at Outfall 001, is protective of all uses and ends at the point where designated and existing uses expand, the Main Stem. In accordance with 18 AAC 70.245, the mixing zone has been appropriately sized to fully protect the designated and existing uses of the Lower Middle Fork Red Dog Creek. DEC first

authorized Mixing Zone 1 as part of a 2010 NPDES permit reissuance. See the Fact Sheet of the 2010 NPDES permit for more details.

Mixing Zone 2: 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 is classified with the following designated uses: industrial, wading only, secondary recreation, human health for consumption of aquatic organisms only, and growth and propagation of fish, shellfish, other aquatic life, and wildlife
(18 AAC 70.230(e)(18)). Water quality criteria (WQC) for the designated uses of drinking water, stock water, irrigation water, and human health for consumption of water plus aquatic organisms are not applicable, because those are not designated uses for the Main Stem. DEC authorized Mixing Zone 2 for TDS (on June 25, 2003 as part of a permit modification process), ammonia and cyanide (as part of the 2010 NPDES permit reissuance), and selenium (on April 4, 2014 as part of the APDES permit modification). Mixing Zone 2 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 factor of 2.5.

Appendix C, Mixing Zone Analysis Checklist, outlines criteria that must be considered when the Department analyzes a permittee's request for a mixing zone. These criteria include: the size of the mixing zone, treatment technology, designated and existing uses of the waterbody, human consumption, spawning areas, human health, aquatic life, and endangered species. All criteria must be met in order to authorize a mixing zone. The following summarizes the Department's analysis:

Size - In accordance with 18 AAC 70.255, the Department determined that the size of the mixing zone for the Red Dog Mine wastewater discharge is appropriate. Based on conductivity cross section analysis performed in 2001, TAK provided data to the DEC for certification of a 2003 NPDES permit modification resulting in DEC authorizing Mixing Zone 2 to be approximately 1,930 feet downstream of the confluence of the Middle Fork and the North Fork of Red Dog Creek (otherwise known as the Main Stem). The exact length of the mixing zone varies slightly with stream stage. The conductivity analysis showed that a bedrock outcropping causing nearly a 90 degree change in stream direction forces mechanical mixing of the entire stream at all stream stages and results in complete chemical homogeneity downstream of the outcrop. Station 151 is located at the downstream boundary of Mixing Zone 2. This location is where the entire stream has been empirically demonstrated to be completely mixed at all stream stages. It defines the downstream boundary of the mixing zone and is therefore sized to be as small as practicable as required by 18 AAC 70.240(a)(2).

Technology - In accordance with 18 AAC 70.240(a)(3), the most effective technological and economical methods were used to disperse, treat, remove, and reduce pollutants. Additionally, the Department finds that treatment is consistent with the highest statutory and regulatory treatment requirements. See fifth finding of DEC's antidegradation analysis for more detailed explanation of this finding.

The primary treatment method used for the Red Dog Mine tailings pond water prior to its discharge to Outfall 001 is the high density sludge (HDS) treatment technology, which the Department finds to be the most effective and technologically and economically feasible method for Red Dog Mine. In Section 8.0, High Density Sludge Treatment Technology Review of the EPA Ore Mining and Dressing Preliminary Study Report (EPA, 2011), EPA describes the HDS as "a highly efficient treatment technology for certain types of waste streams." Further, EPA notes that HDS technology "may serve as a resource for ore mine operators and NPDES permit

writers when considering mine wastewater treatment systems." The HDS treatment process at the mine facility is described below:

Reclaim water is pumped to Water Treatment Plant 2 (WTP2) where it is treated before being discharged through Outfall 001. Within the WTP2 influent pipeline, reclaim water is first treated with sodium sulfide and mixed via an in-line mixer. The sulfide reacts primarily with the dissolved cadmium and also other metals in the reclaim water to form insoluble cadmium sulfide and other metal sulfides, which are stable through the remainder of the treatment process. The sodium sulfide-treated reclaim water then reports to a rapid mix tank where slaked 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 to facilitate complete chemical reactions. Additionally, compressed air is added into the lime reactor tank to ensure oxidation of ions in the solution, specifically and most significantly the oxidation of metals.

The precipitated solids containing the metals remain 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 tailing impoundment to maintain a constant sludge bed level in the clarifier.

Clarifier overflow water reports to sand filters which remove residual suspended solids. Automated pH and turbidity meters take final measurements of the sand filter effluent. If the pH is within the APDES 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 or turbidity are not within the prescribed ranges, the filtered water is automatically rerouted back into the tailing impoundment.

Low Flow Design - In accordance with 18 AAC 70.255(f), Appendix B describes the process used to determine if the discharge authorized in the permit has the reasonable potential to cause or contribute to a violation of a WQS. Appendix B, Table B- 2 compares maximum projected effluent concentrations for mixing zone to the respective criterion. The determination of the low flow design for the receiving water was conducted in accordance with 18 AAC 70.255(f)(1) as follows. Measured daily average flows from the mine discharge (Outfall 001) and the Main Stem (Station 10) from May 2003 through September 2005 were reported in monthly DMRs. The dilution factor of effluent in the Main Stem is based on low flow conditions. Using the lowest 5^{th} percentile of the calculated dilution factors (Station 10 flow/Outfall 001 flow), DEC certified a dilution factor of 2.5 for Mixing Zone 2 as part of a 2003 National Pollutant Discharge Elimination System (NPDES) permit modification process. This is a ratio of 1 part effluent to 1.5 or more parts receiving water flow. The 5^{th} percentile was chosen because the inherent error associated with stream flow monitoring would make the selection of the lowest dilution factor or a percentile less than the 5^{th} overly conservative and implies a level of accuracy that cannot be substantiated.

Designated and Existing Uses - In accordance with 18 AAC 70.245, the mixing zone has been appropriately sized to fully protect the designated and existing uses of the Main Stem. See designated uses as described in Section 5.1. The designated and existing uses have been maintained and protected under the terms of the previous permit, including preservation of a migration corridor between the Main Stem and North Fork for grayling. Semiannual migration of

resident grayling between Bons Creek and the North Fork via the Main Stem has been studied and documented by the ADF&G using tagged fish. The permit reissuance application does not contain any changes that would result in an impairment to the waterbody and consequently the elimination of existing uses if the terms of the permit are adhered to. See the Spawning Areas discussion below and Section 7.0 for additional information on the protection of designated and existing uses.

Human Consumption - In accordance with 18 AAC 70.250(b)(2) and (b)(3), the pollutants discharged cannot produce objectionable color, taste, or odor in aquatic resources harvested for human consumption; nor can the discharge preclude or limit established processing activities or commercial, sport, personal use, or subsistence fish and shellfish harvesting.

Spawning Areas - In accordance with 18 AAC 70.255(h), the mixing zone is not authorized in a known spawning area for anadromous fish or resident fish spawning redds for Dolly Varden and Arctic grayling. No active Arctic grayling spawning or spawning redds have been observed in Mixing Zone 2.

Human Health - In accordance with 18 AAC 70.250 and 18 AAC 70.255, the mixing zone authorized in the permit shall be protective of human health. An analysis of the effluent testing data that was included with the Red Dog Mine wastewater discharge application and the results of the reasonable potential analysis conducted for pollutants of concern indicate that the level of treatment at the Red Dog Mine is protective of human health. The quality of the effluent is expected to meet water quality criteria at the boundary of the mixing zone.

Aquatic Life and Wildlife - In accordance with 18 AAC 70.250 and 18 AAC 70.255, the mixing zone authorized in the permit is protective of aquatic life and wildlife. Based on a review of the effluent data, the Department concludes that the discharge will meet all water quality criteria at the termination of the mixing zone.

Endangered Species - In accordance with 18 AAC 70.250(a)(2)(D), the authorized mixing zone will not cause an adverse effect on threatened or endangered species. The National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) indicated that threatened or endangered species are not known to be present in Red Dog Creek and the downstream river system.

Mixing Zone 3: Mixing Zone 3 extends about 3,420 feet down Ikalukrok Creek from its confluence with the Main Stem and provides mixing in a ratio of 1 part receiving flow to 1 part Main Stem flow for a dilution factor of 2. Mixing Zone 3 is for TDS requiring a concentration of 1,000 mg/L or less at its downstream boundary, Station 150. DEC initially authorized Mixing Zone 3 for TDS on the June 25, 2003 as part of a permit modification process.

Under 18 AAC 70.020(b)(4)(A)(iii), *TDS may not exceed 1,000 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 total dissolved solids (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 be expected to 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 evidence submitted by TAK and other pertinent information reviewed, demonstrates that a criterion of 1000 mg/l will fully protect the designated use class 18 AAC 70.020(a)(1)(C): growth and propagation of fish, shellfish, other aquatic life, and wildlife, with no adverse effect during the non-spawning period. However during the period of chum salmon and/or Dolly Varden spawning starting on July 25th through the end of the discharge season, the Department finds that a lower TDS level of 500 mg/L is required downstream of the confluence of Ikalukrok and Dudd Creeks at Station 160, and that such level will prevent any adverse effect on the spawning activity and the aquatic life. The evidence supporting these findings includes biomonitoring data and reports received from ADF&G.

Mixing Zone Length Determination: Transects of conductivity readings on multiple sampling dates were used to determine the point of complete mixing. When conductivity readings reached a stable value across the width of the channel, complete mixing was achieved and the mixing zone length was established at that point. This method of determining complete mixing, based on measuring stable conductivity, is more accurate than mixing models often used by the department to assign mixing zones.

6.0 ANTIBACKSLIDING

Per 18 AAC 83.480(a), "Except as provided in (b) of the section, when a permit is renewed or reissued, interim effluent limitations, standards or conditions must be at least as stringent as the final effluent limitations, standards, or conditions in the previous permit, unless the circumstances on which the previous permit was based have materially and substantially changed since the permit was issued, and the change in circumstances would constitute cause for permit modification or revocation and reissuance under 18 AAC 83.135."

Effluent limitations may be relaxed as allowed under 18 AAC 83.480, CWA §402(o) and CWA §303(d)(4). 18 AAC 83.480(b) allows relaxed limitations in renewed, reissued, or modified permits when there have been material and substantial alterations or additions to the permitted facility or where new information is available that justifies the relaxation. Since the last permit was reissued, new information has been collected to characterize the effluent and determine limits.

CWA §402(o)(2)(B)(i) exempts antibacksliding provisions if information which was not available at the time of permit issuance and would have justified the application of a less stringent effluent limitation at the time of permit issuance. Outfall 001 was associated with certain limitations that are less stringent or removed (where no reasonable potential was indicated) based on the collection and statistical analysis of new effluent data, which satisfies the condition for the antibacksliding exemption under CWA §402(o)(2)(B)(i).

CWA §303(d)(4)(A) states that, for waterbodies where the water quality does not meet applicable WQS, effluent limitations may be revised under two conditions: the revised effluent limitation must ensure the attainment of the WQS (based on the waterbody TMDL or the waste load allocation) or the designated use which is not being attained is removed in accordance with the WQS regulations. Since the applicable waterbodies are not impaired and do not have a TMDL, further evaluation under this provision is not required.

CWA §303(d)(4)(B) states that, for waterbodies where the water quality meets or exceeds the level necessary to support the waterbody's designated uses, WQBELs may be revised as long as the revision is consistent with the State's Antidegradation Policy. Even if the requirements of CWA §303(d)(4) or 18 AAC 83.480(b) are satisfied, 18 AAC 83.480(c) prohibits relaxed limits that would result in

violations of WQS or ELGs. Since the receiving water meets WQS to support designated uses and ELGs are applied via the permitting action, further evaluation under this provision is not required.

Since the previous permit was reissued, new information has been collected to characterize the effluent from Outfall 001. An analysis of five years of recent effluent and receiving water data resulted in changes to effluent limits. The reasonable potential analysis demonstrated that limits on aluminum, ammonia, cyanide, and nickel could be removed because there was no reasonable potential to exceed WQS.

After analyzing five years of effluent data, the Department determined that some parameters required more stringent limits. Limits that are more stringent in the permit, in comparison to the previous permit, include the average monthly limit for cadmium and the maximum daily limit for mercury. Analysis of the effluent data also showed that the limits for other parameters could be relaxed. Both the maximum daily and average monthly limits for copper, lead, and zinc, and maximum daily limit for cadmium are less stringent than in the previous permit.

These changes in the effluent limitations for Outfall 001 are based on the collection and statistical analysis of new information and, where the limitations increased or showed no reasonable potential and are no longer necessary, these changes are permissible per 18 AAC 83.135(b)(2).

7.0 ANTIDEGRADATION

Section 303(d)(4) of the CWA states that, for waterbodies where the water quality meets or exceeds the level necessary to support the waterbody's designated uses, water quality-based effluent limitations may be revised as long as the revision is consistent with the State's Antidegradation Policy.

The Antidegradation Policy of the WQS (18 AAC 70.015) states that the existing water uses and the level of water quality necessary to protect existing uses must be maintained and protected. This section analyzes and provides rationale for the Department's decisions in the permit issuance 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 Department's *Policy and Procedure Guidance for Interim Antidegradation Implementation Methods*, dated July 14, 2010. 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 higher numbered tier indicates a greater level of water quality protection. At this time, no Tier 3 waters have been designated in Alaska. Accordingly, this antidegradation analysis conservatively assumes that the discharge is to a Tier 2 water, which is the next highest level of protection and is more rigorous than a Tier 1 analysis.

The State's Antidegradation Policy in 18 AAC 70.015(a)(2) states that if the quality of water exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water (i.e., Tier 2 waters), that quality must be maintained and protected. The Department may allow a reduction of water quality only after finding that five specific requirements of the Antidegradation Policy at 18 AAC 70.015(a)(2)(A)-(E) are met. The Department's findings follow.

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.

   Based on the evaluation required per 18 AAC 70.0015(a)(2)(D) below, the Department has determined that the most reasonable and effective pollution prevention, control, and treatment methods are being used and that the localized lowering of water quality is necessary.

Red Dog Mine's contributions to the social and economics of Northwest Alaska and statewide are important and highly significant. The mine is the largest private sector employer in the Northwest Arctic Borough (NWAB). The following summarizes some of Red Dog Mine's benefits to Alaska's economy during 2016. TAK provided annual payments in lieu of taxes to the NWAB totaling $11 million (including $2.4 million to the NWAB School District), $122 million in royalties to NANA, and $20 million in state taxes, spent $119 million on goods and services within Alaska, and supplied the Alaska Industrial Development and Export Authority with $37 million in fees.

As detailed above, the operation of Red Dog Mine is important to the economies of the NWAB, NANA, and the entire state of Alaska. The Department finds that authorization the mine's discharge to accommodates important local, regional, and statewide economic activity 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 or 18 AAC 70.235 or the WET limit in 18 AAC 70.030.

   The permit prohibits violation of the water quality criteria in 18 AAC 70.020. This permit establishes effluent limits and monitoring for discharges at Outfall 001.

   Since the previous permit was reissued, new information has been collected to characterize the effluent and determine limits for Outfall 001. An analysis of five years of recent effluent and receiving water data resulted in changes to effluent limits.

   These changes in the effluent limitations for Outfall 001 are based on the collection and statistical analysis of new information and, where the limitations increased or showed no reasonable potential to exceed WQS and were no longer necessary, these changes were exempt from antibacksliding per CWA §402(o)(2)(B)(i).

   An analysis of Outfall 001 sample data showed that there is no potential to exceed WQS for aluminum, ammonia, copper, cyanide, lead, mercury, nickel, zinc, and fecal coliform bacteria. Consequently, the permit no longer requires limits for those parameters where effluent limitation guidelines do not apply, which includes aluminum, ammonia, cyanide, and nickel. Chromium, iron, manganese, and turbidity, which did not have limits in the previous permit, had monitoring requirements removed.

   For metals with hardness-based limits, the previous permit used the 5^{th} percentile of the hardness data or 260 mg/L as $CaCO_3$ to calculate applicable water quality criteria (WQC). This permit attempted to use the 15^{th} percentile of 2010 through 2014 hardness data from Station 151 or 405 mg/L. According to regulation, the maximum allowable hardness for hardness-based WQC is 400 mg/L, which was used. Increasing the hardness from 260 mg/L to 400 mg/L, increased hardness-based WQC for cadmium, copper, lead, mercury, nickel, and zinc. That results in an increase in the margin of compliance for those WQC.

   Discharges authorized under this permit will not violate applicable water quality criteria, as allowed under 18 AAC 70.235. Under this regulation, the Department may establish a site-specific water quality criteria that modifies a water quality criterion set for a waterbody. Pursuant to 18 AAC 70.235(b), the Department has established site-specific criteria for the Main Stem Red Dog Creek (see Section 2.2). Effluent limitations and monitoring at Outfall 001 ensure that the applicable WQC for the Main Stem Red Dog Creek are met.

   Historic WET test results indicate that the discharge does not violate the WET limits. WET testing is required every two months for Outfall 001. WET tests reveal if the discharge has

toxicity, and the permittee is required to submit these results to DEC during the month in which the results are received. WET results are used to verify that the applicable criteria of 18 AAC 70.030 are met.

The Department finds that the reduced water quality will not violate applicable WQC and that the finding 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.

   Beginning at the Main Stem, existing and designated uses include growth and propagation of fish and aquatic life. A long history of biomonitoring demonstrates that the mine's effluent does not adversely affect fish and aquatic life in the Main Stem. To the contrary, fish use of the Main Stem has increased since the mine began operation. Permit conditions have proven over time to protect the Main Stem's existing and designated use of growth and propagation of fish and aquatic life.

   ADF&G conducted annual biomonitoring in the Main Stem from 2001 through 2016. According to the most recent ADF&G Red Dog Mine study conducted in 2015, Technical Report No. 16-01, "Median metals concentrations (Pb, Zn, Al, Cd) in Main Stem Red Dog Creek are consistently lower when compared with pre-mining data."

   The Department concludes that the resulting water quality will be adequate to fully protect existing uses and that the finding 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 Department finds the most effective methods of prevention, control, and treatment are the practices and requirements set out in this permit and currently in use at this mine. The permittee is required to implement a site management pollution prevention plan (Plan). The Plan includes pollution prevention measures and controls appropriate for each facility and discharge. The design, construction, and performance of the water treatment plants has also been reviewed and approved by the Department.

   The primary treatment method used for the Red Dog Mine tailings pond water prior to its discharge to Outfall 001 is the high density sludge (HDS) treatment technology, which the Department finds to be the most effective and technologically and economically feasible method for Red Dog Mine. In Section 8.0, High Density Sludge Treatment Technology Review of the EPA Ore Mining and Dressing Preliminary Study Report (EPA, 2011), EPA describes the HDS as "a highly efficient treatment technology for certain types of waste streams." Further, EPA notes that HDS technology "may serve as a resource for ore mine operators and NPDES permit writers when considering mine wastewater treatment systems." The HDS treatment process at the mine facility is described below:

   Reclaim water is pumped to WTP2 where it is treated before being discharged through Outfall 001. Within the WTP2 influent pipeline, reclaim water is first treated with sodium sulfide and mixed via an in-line mixer. The sulfide reacts primarily with the dissolved cadmium and also other metals in the reclaim water to form insoluble cadmium sulfide and other metal sulfides, which are stable through the remainder of the treatment process. The sodium sulfide-treated reclaim water then reports to a rapid mix tank where slaked 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 to facilitate complete

chemical reactions. Additionally, compressed air is added into the lime reactor tank to ensure oxidation of ions in the solution, specifically and most significantly the oxidation of metals.

The precipitated solids containing the metals remain 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 tailing impoundment to maintain a constant sludge bed level in the clarifier.

Clarifier overflow water reports to sand filters which remove residual suspended solids. Automated pH and turbidity meters take final measurements of the sand filter effluent. If the pH is within the APDES 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 or turbidity are not within the prescribed ranges, the filtered water is automatically rerouted back into the tailing impoundment

The Department finds that the most effective methods of prevention, control, and treatment are the practices and requirements set out in this permit and currently in use at this mine. The Department finds this criterion 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.

   Applicable "highest statutory and regulatory treatment requirements" are defined in 18 AAC 70.990(30) (as amended June 26, 2003) and in the July 14, 2010 DEC guidance titled "*Policy and Procedure Guidance for Interim Antidegradation Implementation Methods.*" Accordingly, there are three parts to the definition, which are:

   > (A) Any federal technology-based effluent limitation identified in 40 CFR § 125.3 and 40 CFR § 122.29, as amended through August 15, 1997, adopted by reference;
   >
   > (B) Minimum treatment standards in 18 AAC 72.040; and
   >
   > (C) Any treatment requirements imposed under another state law that is more stringent than a requirement of this chapter.

   The first part of the definition includes all federal technology-based ELGs, which would include those that apply to Red Dog Mine. EPA promulgated ELGs for the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores point source category at 40 CFR Part 440 Subpart J (adopted by reference at 18 AAC 83.010(g)(3)). The ELGs applicable to a new source, which is a source that has commenced construction after the ELGs were established on December 3, 1982, are applicable to discharges from active mines, and these ELGs apply to Outfall 001. All applicable ELGs have been incorporated into the permit. Therefore, the Department concludes that this requirement is met.

   The second part of the definition 18 AAC 70.990(B) (2003) appears to be in error, as 18 AAC 72.040 describes discharges to sewers and not minimum treatment. The correct reference appears to be the minimum treatment standards found at 18 AAC 72.050, which refers

to domestic wastewater discharges only. No discharge of domestic wastewater is authorized under the permit; therefore, further analysis under this regulation is not required.

The third part of the definition includes any more stringent treatment required by state law, including 18 AAC 70 and 18 AAC 72. The correct operation of equipment, visual monitoring, and implementing BMPs, as well as other permit requirements, will control the discharge and satisfy all applicable federal and state requirements.

The Department finds that the treatment required in this permit achieves the highest statutory and regulatory requirements, and this finding is met.

8.0 OTHER PERMIT CONDITIONS

8.1 Electronic Reporting (E-Reporting) Rule

The Permittee is responsible for electronically submitting DMRs and other reports in accordance with 40 CFR §127. The start dates for e-reporting are provided in 40 CFR §127.16. DEC has established a website at http://dec.alaska.gov/water/Compliance/EReportingRule.htm that contains general information. As DEC implements the E-Reporting Rule, more information will be posted on this webpage. The permittee will be further notified by DEC in the future about how to implement the conditions in 40 CFR §127.

8.2 Quality Assurance Project Plan

The permittee is required to develop procedures to ensure that the monitoring data submitted are accurate and to explain data anomalies if they occur. The permittee is required to update the Quality Assurance Project Plan (QAPP) within 60 days of the effective date of the final permit. Additionally, the permittee must submit a letter to the Department within 60 days of the effective date of the permit stating that the plan has been implemented within the required time frame. The QAPP shall consist of standard operating procedures the permittee must follow for collecting, handling, storing and shipping samples; laboratory analysis; and data reporting. The plan shall be retained on site and made available to the Department upon request.

8.3 Site Management Pollution Prevention Plan

In accordance with AS 46.03.110(d), the Department may specify in a permit the terms and conditions under which waste material may be disposed. This permit requires the permittee to develop a Site Management Pollution Prevention Plan in order to prevent or minimize the potential for the release of pollutants to waters and lands of the State of Alaska through plant site runoff, spillage or leaks, or erosion. The permit contains certain conditions that must be included in the Plan, such as prescribed best management practices, and storm water management for industrial and construction activities. The permit requires the permittee to develop or update and implement the Plan within 60 days of the effective date of the final permit. The Plan must be kept on site and made available to the Department upon request.

8.4 Standard Conditions

Appendix A of the permit contains standard regulatory language that must be included in all APDES permits. These requirements are based on the regulations and cannot be challenged in the context of an individual APDES permit action. The standard regulatory language covers requirements such as monitoring, recording, reporting requirements, compliance responsibilities, and other general requirements.

9.0 OTHER CONSIDERATIONS

9.1 Endangered Species Act

The Endangered Species Act (ESA) requires federal agencies to consult with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) if their actions could beneficially or adversely affect any threatened or endangered species. As a state agency, DEC is not required to consult with USFWS or NMFS regarding permitting actions. However, DEC values input from the Services on ESA concerns, and on February 6, 2017, DEC solicited USFWS and NMFS for feedback about ESA impacts associated with this permit. John Kurland of NMFS and Kathryn Ott of USFWS stated that there are no threatened or endangered species near Red Dog Mine or in the area of impact.

9.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires federal agencies to consult with NMFS when any activity proposed to be permitted, funded, or undertaken by a federal agency has the potential to adversely affect (reduce quality and/or quantity of) Essential Fish Habitat (EFH). EFH includes the waters and substrate (sediments, etc.) necessary for fish from commercially-fished species to spawn, breed, feed, or grow to maturity.

As a state agency, DEC is not required to consult with NMFS regarding permitting actions. However, DEC is concerned with protecting EFH, and on February 6, 2017, DEC spoke with Matt Eagleton, Alaska Regional EFH Coordinator. Matt Eagleton reported that there is no EFH associated with this permitting action. Additionally, Jack Winters of ADF&G provided that there is no EFH near Red Dog Mine.

9.3 Permit Expiration

The permit will expire five years from the effective date of the permit.

10.0 REFERENCES

ADF&G (Alaska Department of Fish and Game). Aquatic Biomonitoring at Red Dog Mine, 2015. Technical Report No. 16-01. March 2016.

DEC (Alaska Department of Environmental Conservation). 2003. 18 AAC 70, Water Quality Standards. State of Alaska, Department of Environmental Conservation. June 26, 2003.

DEC. 2008a. 18 AAC 83, Alaska Pollutant Discharge Elimination System. State of Alaska, Department of Environmental Conservation. October 31, 2008.

DEC. 2008b. 18 AAC 70, Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. State of Alaska, Department of Environmental Conservation. December 12, 2008.

DEC. 2010a. Interim Antidegradation Implementation Methods, Effective July 14, 2010. State of Alaska, Department of Environmental Conservation, Policy and Procedure No. 05.03.103.

DEC. 2010b. Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report. July 15, 2010.

DEC. 2014. Alaska Pollutant Discharge Elimination System (APDES) Permits Reasonable Potential Analysis and Effluent Limits Development Guide.

DEC. 2016. 18 AAC 72, Wastewater Disposal. State of Alaska, Department of Environmental Conservation. October 22, 2016.

DEC. 2017. 18 AAC 70, Water Quality Standards. State of Alaska, Department of Environmental Conservation. February 5, 2017.

EPA. 1986. Inductively Coupled Plasma Emission Spectrometry. Test Methods for Evaluating Solid Waste Physical/Chemical Methods. EPA SW-846.

EPA. 1986. Mercury Digestion and Cold Vapor Atomic Absorption Spectrometry. Test Methods for Evaluating Solid Waste Physical/Chemical Methods. EPA SW-846.

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EPA. 1993. Guidance Manual for Developing Best Management Practices (BMP). Office of Water, October 1993, EPA 833-B-93-004.

EPA. 1996. The Metals Translator: Guidance for Calculation a Total Recoverable Permit Limit from a Dissolved Criterion. June 1996, EPA 823-B-96-007.

EPA. 2002. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition. October 2002, EPA 821-F-02-013.

EPA. 2010. NPDES Permit Writer's Manual. EPA, Office of Water, Office of Wastewater Management, Permits Division. Washington, DC. September 2010. EPA 833-K-10-001.

APPENDIX A. FACILITY INFORMATION

Figure 1: Red Dog Mine Map

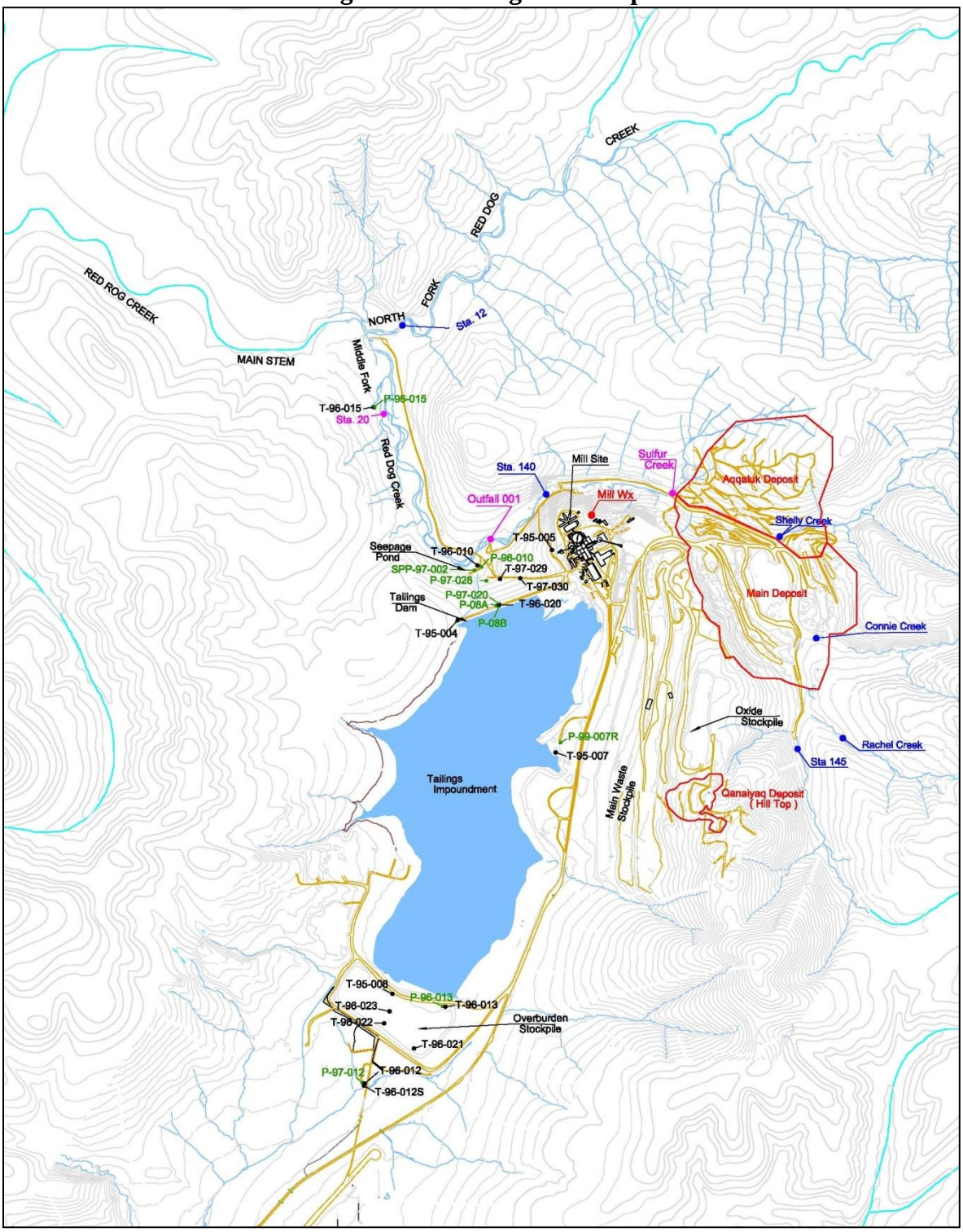


Figure 2: Map of Mixing Zones

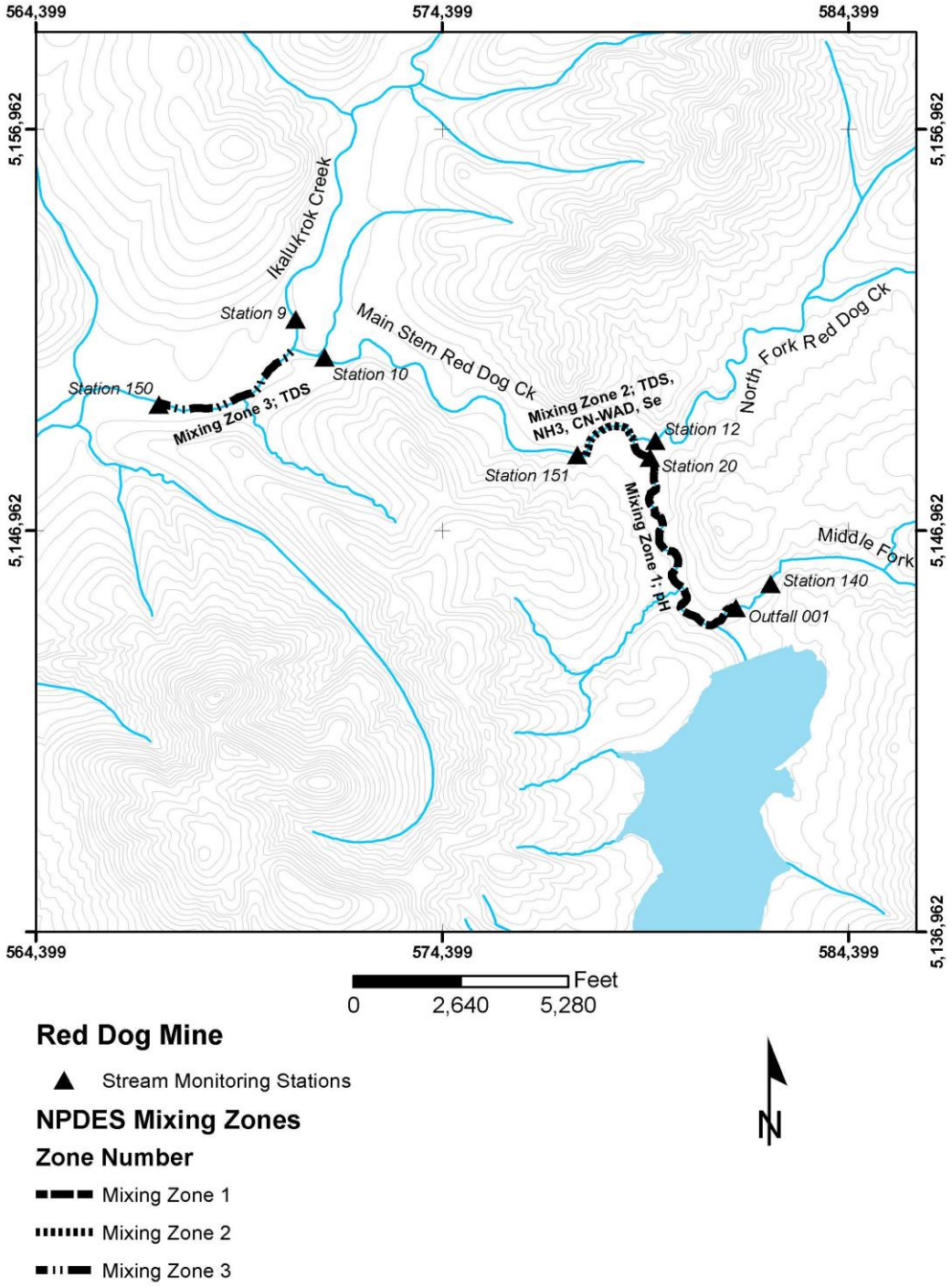
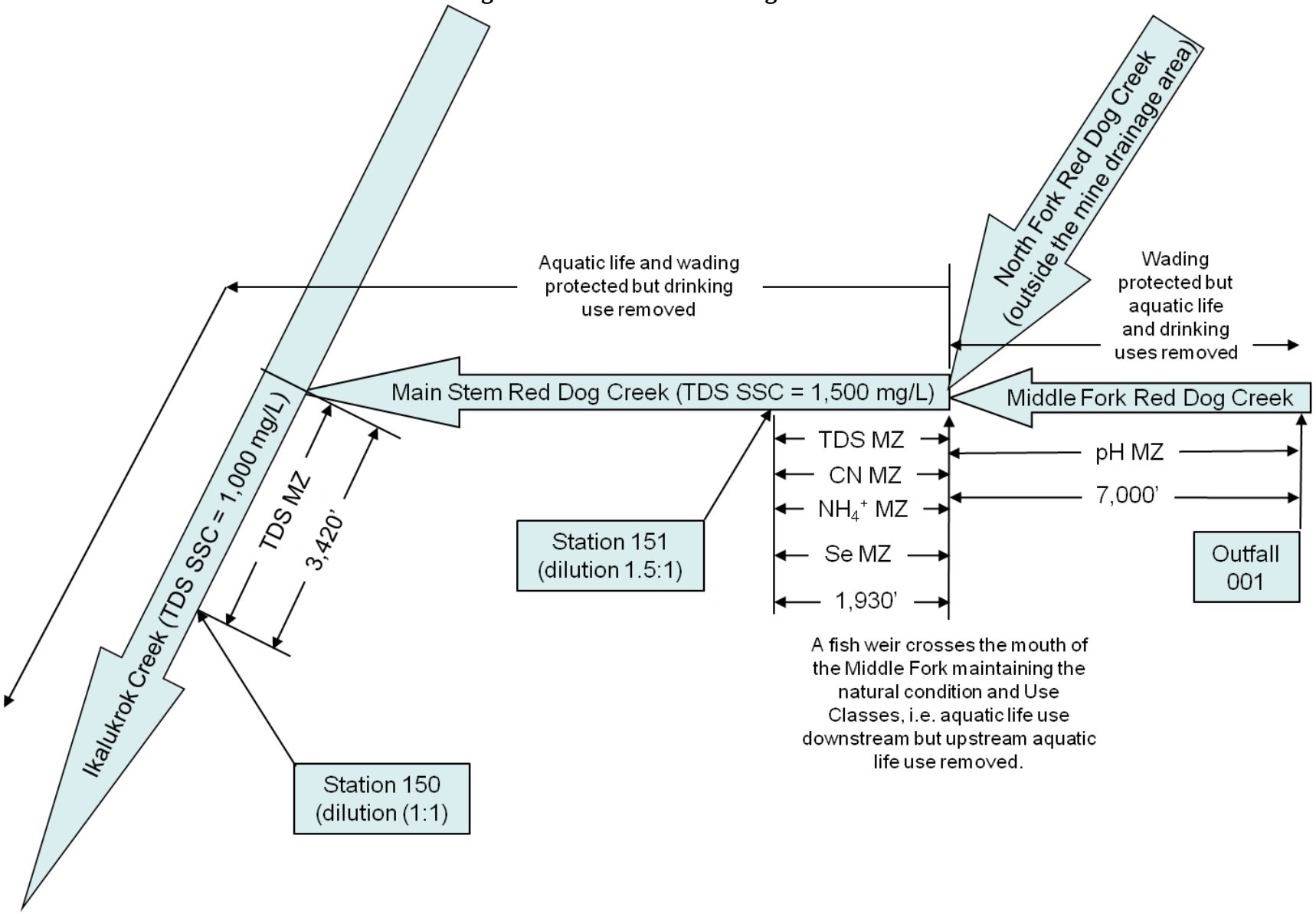


Figure 3: Schematic of Mixing Zones



APPENDIX B. BASIS FOR EFFLUENT LIMITS

This section discusses the basis for and the development of effluent limits in the permit. It is organized as follows: an overall discussion of the statutory and regulatory basis for development of effluent limitations (Section B-I); discussions of the development of technology-based effluent limits (Section B-II), water quality-based effluent limits (Section B-III); and a summary of the effluent limits (Section B-IV).

B-I Statutory and Regulatory Basis for Limits

Sections 101, 301(b), 304, 308, 401, 402, and 405 of the Clean Water Act (CWA) provide the basis for the effluent limitations and other conditions in the permit. The Department evaluates the discharges with respect to these sections of the CWA and the relevant Alaska Pollutant Discharge Elimination System (APDES) regulations to determine which conditions to include in the permit.

In general, the Department first determines if any federally-promulgated technology-based effluent limits have been developed that must be considered as the ceiling for permit limits. The Department then evaluates the effluent quality expected to result from these controls to see if the discharge could result in any exceedances of the Alaska Water Quality Standards (WQS) in the receiving water. If reasonable potential exists that exceedances could occur, the Alaska Department of Environmental Conservation (DEC or the Department) must include water quality-based effluent limits in the permit. The permit limits reflect whichever requirements (technology-based or water quality-based) are more stringent.

B-II Outfall 001 - Technology-Based Evaluation

Section 301(b) of the CWA requires industrial dischargers to meet technology-based effluent limitation guidelines (ELGs) established by the Environmental Protection Agency (EPA) and adopted by reference in 18 AAC 83.010. These are enforceable through their incorporation into an APDES permit. Direct dischargers that are new sources must meet New Source Performance Standards (NSPS), which are based on the best available demonstrated control technology. These NSPS apply to a source that has commenced construction after the ELGs were established and, as such, are directly applicable to the discharge of treated mine drainage and contact water from Outfall 001 at Red Dog Mine.

In 40 CFR Part 440 Subpart J, EPA established ELGs for the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores point source category. These ELGs apply NSPS to a new source mine, which is a source that has commenced construction after the ELGs were established on December 3, 1982. The NSPS that apply to Red Dog Mine are shown in Table B- 1.

Table B- 1: Technology-Based Effluent Limits for Outfall 001

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days
Cadmium	mg/L[a]	0.10	0.05
Copper	mg/L	0.30	0.15
Lead	mg/L	0.6	0.3
Mercury	mg/L	0.002	0.001
Zinc	mg/L	1.5	0.75
pH	s.u.[b]	6.5 to 10.5	
Total Suspended Solids (TSS)	mg/L	30.0	20.0
Total Dissolved Solids (TDS)	mg/L	4,925	--
Flow	billion gallons per year	2.418	

a. milligrams per liter
b. standard units

Regulation 40 CFR 440.130(d)(1) (adopted by reference in 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 the discharge at Red Dog Mine where metals precipitate out of solution better at higher pH. This permit contains the same pH limits as the 2010 permit, and the allowable pH range is 6.5 to 10.5 s.u.

Because TDS was not considered in development of the ELGs, a case-by-case technology-based effluent limitation (TBEL) was evaluated in accordance with 40 CFR 125.3(c). Based on existing information, EPA determined that the TBEL for TDS equals 4,925 mg/l, measured at the discharge location, Outfall 001.

Regulation 40 CFR 440.104(b) (adopted by reference in 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 above in Table B- 1. The permit includes an annual discharge limit of 2.418 billion gallons per year, which represents the maximum estimated difference between precipitation and evaporation. Because precipitation and evaporation are variable, the permit requires that Teck Alaska, Inc. (TAK) 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-III Water Quality-Based Evaluation

In addition to the TBELs discussed above, the Department evaluated Red Dog Mine discharges to determine compliance with Section 301(b)(1)(C) of the CWA. This section requires permit limits necessary to meet WQS.

Under 18 AAC 83.435, the Department must implement Section 301(b)(1)(C) of the CWA. It requires that APDES 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 WQS, including state narrative criteria for water quality." The limits must be stringent enough to ensure that WQS are met and must be consistent with any available wasteload allocation (WLA).

To determine if water quality-based effluent limits (WQBEL) are needed and develop those limits when necessary, the Department follows guidance in the *APDES Permits Reasonable Potential Analysis and Effluent Limits Development Guide* (RPA Guidance, 2014). The water quality-based analysis consists of the following three step sequence:

1. Identify the applicable water quality criteria (see Section B-III.A);
2. Determine if there is "reasonable potential" for the discharge to exceed a water quality criterion in the receiving water (see Section B-III.B); and,
3. If there is "reasonable potential" or where a parameter has a technology-based limit and it requires dilution to meet WQS, develop effluent limits based on the WLA (see Section B-III.C).

The following sections provide a detailed discussion of each step.

B-III.A Water Quality Criteria

The first step in determining if WQBELs are needed is to identify the applicable water quality criteria. Alaska's WQS are found at 18 AAC 70. The applicable criteria are determined based on the beneficial uses of the receiving water.

The beneficial uses for the Lower Middle Fork Red Dog Creek (Middle Fork) from the terminus of the Red Dog Mine Water Management System to the confluence with North Fork Red Dog Creek (North Fork), the receiving water of Outfall 001, and the regulatory citation for the water quality criteria applicable to the uses are as follows:

1. industrial uses – 18 AAC 70.020(b)(1)(A)(iv)
2. contact recreation, wading only – 18 AAC 70.020(b)(1)(B)(i)***
3. secondary recreation, except fishing – 18 AAC 70.020(b)(1)(B)(ii)****

The beneficial uses for the Main Stem Red Dog Creek (Main Stem) from the confluence with the North Fork downstream to the confluence with Ikalukrok Creek and continuing downstream in Ikalukrok Creek to it confluence with the Wulik River, and the regulatory citation for the water quality criteria applicable to the uses are as follows:

1. industrial uses – 18 AAC 70.020(b)(1)(A)(iv)

2. contact recreation, wading only – 18 AAC 70.020(b)(1)(B)(i)***
3. secondary recreation – 18 AAC 70.020(b)(1)(B)(ii)
4. growth and propagation of fish, shellfish, other aquatic life, and wildlife – 18 AAC 70.020(b)(1)(C)

Under 18 AAC 70.235(b), the Department established a natural condition-based site specific criterion (NCBSSC) for cadmium (two micrograms per liter) in the Main Stem and Ikalukrok Creek, which EPA approved on February 27, 2007. Additionally according to 18 AAC 70.236(b)(5), a site specific water quality criterion of 1,500 milligrams per liter (mg/L) for total dissolved solids (TDS) applies to the Main Stem. Finally according to 18 AAC 70.020(b)(4) and note 12, TDS in concentrations up to 1,000 mg/L are in effect from the confluence of Ikalukrok Creek with the Main Stem to the Wulik River, except during chum salmon or Dolly Varden spawning in the Ikalukrok Creek, when the 500 mg/L criterion applies at Station 160 in Lower Ikalukrok Creek from July 25th through the end of the discharge season.

For a given pollutant, different uses may have different criteria. To protect all beneficial uses, the reasonable potential analysis and permit limits are based on the most stringent water quality criteria for protecting those uses. For the Main Stem, the most stringent applicable criteria are summarized in Table B- 2.

Table B- 2: Most Stringent Applicable Water Quality Criteria in the Main Stem

Parameter[a] (µg/L unless otherwise noted)	Acute	Chronic	
	Aquatic Life Criterion	Aquatic Life Criterion	Human Health Criterion[b]
Aluminum	750	750[c]	N/A
Ammonia as N[d]	7.28	2.95	N/A
Barium	NA	NA	NA
Cadmium[e]	NA	2.00[f]	NA
Chromium, Total	NA	N/A	NA
Copper[e]	51.7	30.5	NA
Cyanide, Weak Acid Dissociable (WAD)	22.0	5.20	NA
Iron	NA	1,000	NA
Lead[e]	477	18.6	NA
Manganese	NA	NA	NA
Mercury	2.40	0.012	NA
Nickel[e]	1,516	169	NA
Selenium	20.0	5.00	NA
Zinc[e]	388	388	NA
pH (s.u.)	within the range of 6.5 – 8.5		

a. Criteria for metals have been converted to total recoverable.
b. The Main Stem's designated uses 18 AAC 70.230(e)(18) exclude protection for Human Health Criteria.
c. When the hardness ≥ 50 mg/L as $CaCO_3$ and pH ≥ 7.0 s.u., then the chronic criterion changes from 87 to 750 µg/L. The 15th percentile of background measurements at Station 151 for hardness and pH are 405 mg/L and 7.31 s.u.
d. Temperature and pH based limit is calculated using the 85th percentile of Station 151 background data or 10.328 ^{0}C and 7.86 s.u.
e. Hardness-based limits using a hardness of 400 mg/L $CaCO_3$. The 15th percentile of Station 151 background data is 405 mg/L $CaCO_3$.
f. NCBSSC

B-III.B Reasonable Potential Analysis

This section discusses how reasonable potential was evaluated for Outfall 001. For each parameter, the Department compared the maximum projected concentration to the criteria for that pollutant to determine if there is "reasonable potential" to cause or contribute to an exceedance of a water quality criterion for each pollutant present in the discharge. If the projected concentration exceeds a criterion, there is "reasonable potential," and a limit must be included in the permit. The Department used the recommendations in the *RPA Guidance* to conduct the reasonable potential analysis.

For a given parameter discharged from Outfall 001, the maximum expected effluent concentration was compared to the most stringent applicable water quality criterion.

C_e (Maximum expected effluent concentration or MEC): The maximum expected effluent concentration was calculated using the statistical approach recommended in Section 2.4 of the *RPA Guidance*. In this approach, a maximum expected effluent concentration is derived by multiplying the maximum observed effluent concentration by a reasonable potential multiplier (RPM):

C_e = MEC = (maximum observed effluent concentration) x RPM

The RPM accounts for uncertainty in the effluent data. The RPM depends upon the amount of effluent data, the statistical distribution assigned to the data, and the variability of the data as measured by the coefficient of variation (CV). Effluent data for each pollutant of concern was analyzed in ProUCL—a statistical software package developed under the direction of EPA—and the statistical distributions and corresponding CVs that best fit the data were selected.

There are three equations in the *RPA Guidance* for calculating the RPM. Each equation is valid for certain statistical distributions or sample populations. These three equations—with the citation to the Section in the *RPA Guidance* in which they appear are:

Equation 2.4.2.1 (RPM for Non-Parametric and Normal Statistical Distributions)

$$\text{RPM} = \frac{\exp(\hat{\mu}_n + z_{99}\hat{\sigma})}{\exp(\hat{\mu}_n + p_n\hat{\sigma})}$$

Where,

$\hat{\mu}_n =$ the mean calculated by ProUCL

$\hat{\sigma} =$ the standard deviation calculated by ProUCL

Equation 2.4.2.2 (RPM for Lognormal Statistical Distributions)

$$\text{RPM} = \frac{\exp(z_{99}\hat{\sigma}_y - 0.5\hat{\sigma}_y{}^2)}{\exp(p_n\hat{\sigma}_y - 0.5\hat{\sigma}_y{}^2)}$$

Where,

$\hat{\sigma}_y =$ the lognormal standard deviation calculated by ProUCL

$\hat{\sigma}_y{}^2 =$ the lognormal variance (square of the standard deviation calculated by ProUCL)

Table B-3 shows the assigned statistical distribution, references the equation used to calculate the RPM, and lists the calculated RPM for each parameter at Outfall 001.

Table B- 3: RPM Calculation for Outfall 001

Parameter	Statistical Distribution	Equation	RPM
Aluminum	Non-parametric	2.4.2.1	1.53
Ammonia as N	Normal	2.4.2.1	1.07
Barium	Non-parametric	2.4.2.1	1.14
Cadmium	Non-parametric	2.4.2.1	1.18
Chromium, Total	Non-parametric	2.4.2.1	1.44
Copper	Non-parametric	2.4.2.1	1.18
Cyanide, WAD	Non-parametric	2.4.2.1	1.05
Iron	Non-parametric	2.4.2.1	1.42
Lead	Non-parametric	2.4.2.1	1.21
Manganese	Lognormal	2.4.2.2	3.61
Mercury	Non-parametric	2.4.2.1	1.30
Nickel	Non-parametric	2.4.2.1	1.18
Selenium	Lognormal	2.4.2.2	1.10
Zinc	Lognormal	2.4.2.2	1.23

Reasonable Potential Summary: The reasonable potential analysis covers two groups of parameters, those without a mixing zone and those with a mixing zone. Parameters without a mixing zone receive no dilution, and consequently, the reasonable potential analysis focuses on the end-of-pipe discharge. Results of the reasonable potential analysis for parameters without a mixing zone are provided in Table B- 4.

Table B- 4: Reasonable Potential Determination at the End-of-Pipe

Parameter[a] (µg/L unless otherwise noted)	Effluent Data					Most Stringent Water Quality Criterion[c]	Reasonable Potential (yes or no)
	Max Observed Effluent Conc.	Number of Samples	Coefficient of Variation (CV)	Reasonable Potential Multiplier (RPM)	Max Expected Effluent Conc. (MEC)[b]		
Aluminum	35.0	25	1.12	1.53	53.6	750	no
Barium	57.3	84	0.502	1.14	65.1	NA	no
Cadmium	2.20	87	1.07	1.18	2.60	2.00	yes
Chromium, Total	1.30	25	0.751	1.44	1.87	100	no
Copper	8.00	86	0.960	1.18	9.41	30.5	no
Iron	29.1	25	0.689	1.42	41.3	1,000	no
Lead	8.90	86	1.66	1.21	10.8	18.6	no
Manganese	436	23	1.55	3.61	1,576	NA	no
Mercury	0.00062	25	0.400	1.30	0.000806	0.012	no
Nickel	26.3	86	0.967	1.18	30.9	169	no
Zinc	220	88	0.446	1.23	271.5	388	no

a. Criteria for metals have been converted to total recoverable.
b. For each parameter, the MEC equals the maximum observed effluent concentration times the RPM producing a number based on water treatment plant performance, which was used to determine if there is a reasonable potential for the effluent to exceed WQS.
c. From Table B- 2

The mixing zone for TDS, ammonia, WAD cyanide, and selenium provides a dilution factor of 2.5. TDS has an instream site specific criterion and the permit assumes reasonable potential in requiring concurrent monitoring at the boundary of the mixing zone, Station 151. Unlike the parameters without a mixing zone, where the reasonable potential is determined at the end-of-pipe, the remaining parameters with a mixing zone, ammonia, WAD cyanide, and selenium, receive dilution from the receiving water. Therefore, reasonable potential analyses must consider the assimilative capacity of the receiving water and determine if there is reasonable potential at the boundary of the mixing zone.

Table B- 5: Reasonable Potential Determination at the Edge of the Mixing Zone

Parameter (µg/L)	Critical Upstream Concentration (total)	Max Expected Effluent Concentration	Most Stringent Water Quality Criterion	End-of-Pipe Reasonable Potential (yes or no)	Dilution Factor	Max Expected Concentration at the Boundary of the Mixing Zone	Boundary of Mixing Zone Reasonable Potential (yes or no)
Ammonia as N	0.100[a]	5.89	2.95	yes	2.5	2.42	no
Cyanide, WAD	0.0[b]	12.55	5.2	yes	2.5	5.02	no
Selenium	0.0[c]	11.15	5.0	yes	2.5	6.18	yes

a. 85th percentile of 2010 through 2014 data from the North Fork Red Dog Creek
b. Assumed to be zero because all North Fork data from 2010 through 2014 were non-detect
c. Set at zero because selenium concentration data from Station 151 demonstrates that the assimilative capacity of the receiving water provides a dilution factor ≥ 2.5.

B-III.C Water Quality–Based Effluent Limit Calculation

Once the Department determines that the effluent has a reasonable potential to exceed WQS or a parameter has a technology-based limit that exceeds WQS, a WQBEL for the pollutant is developed. Outfall 001 has shown to have reasonable potential to exceed select WQS so WQBELs were developed. This section explains the procedure used to develop WQBELs.

The first step in calculating a permit limit is development of a WLA for the pollutant. The WLA is the concentration of the pollutant that may be discharged while still ensuring that the downstream water quality criterion is met.

Outfall 001 - The derivation of WQBELs is described below.

B-III.C.A END-OF-PIPE LIMITS

WLAs

In the absence of dilution, the applicable water quality criterion becomes the WLA. Establishing the criterion as the WLA ensures that the Permittee's discharge does not contribute to an exceedance of the criterion. There may be up to three different WLAs for a given pollutant if there are acute, chronic, and human health water quality criteria for the pollutant. These WLAs include the acute WLA (WLA_{acute}) and chronic WLA ($WLA_{chronic}$).

Long Term Averages (LTAs)

Acute and chronic standards apply over different time frames; therefore, it is not possible to compare the WLAs directly to determine which standard results in the most stringent limits. The acute criteria are applied as a one-hour average and chronic criteria are applied as a four-day average. To allow for comparison of acute and chronic WLAs, long term average (LTA) loads are calculated from the acute and chronic WLAs. The most stringent LTA is used to calculate the permit limits.

Permit Limit Derivation

Once the appropriate LTA has been calculated, the Department applies the statistical approach described in Chapter 3 of the *RPA Guidance* to calculate maximum daily and average monthly permit limits. This approach takes into account effluent variability [using the Coefficient of Variation (CV)], sampling frequency, and the difference in time frames between the average monthly and maximum daily limits.

The maximum daily limit is based on the CV of the data and the probability basis, while the average monthly limit is dependent on these two variables and the monitoring frequency. As recommended in the *RPA Guidance*, the Department used a probability basis of 95 percent for average monthly limit calculation and 99 percent for the maximum daily limit calculation.

The following is a summary of the steps to derive WQBELs. Copper for Outfall 001 is used as an example.

Step 1- Determine the WLA

In this case, where there is no dilution, the acute and chronic aquatic life criteria become the WLAs. As shown in Table B- 2, the acute and chronic water quality criteria for copper are 51.7 and 30.5 µg/L, respectively. Accordingly, the WLAs are:

$WLA_{acute} = 51.7$ µg/L

$WLA_{chronic} = 30.5$ µg/L

Step 2 - Determine the Long-Term Average (LTA)

From Section 3.3 in the *RPA Guidance*,

$$LTA_{acute} = WLA_{acute} * e^{(0.5\sigma^2 - z_{99}\sigma)}$$

Where,

$\sigma^2 = \ln(CV^2 + 1)$

$\sigma^2 = \ln(0.960^2 + 1)$

$\sigma^2 = 0.653$

$z_{99} = 2.326$ for 99^{th} percentile probability basis

$\boldsymbol{LTA_{acute} = 10.9}$ **µg/L**

$$LTA_{chronic} = WLA_{chronic} * e^{(0.5{\sigma_4}^2 - z_{99}\sigma_4)}$$

Where,

$${\sigma_4}^2 = \ln\left(\frac{CV^2}{4} + 1\right)$$

$${\sigma_4}^2 = \ln\left(\frac{0.960^2}{4} + 1\right)$$

${\sigma_4}^2 = 0.207$

$$\boldsymbol{LTA_{chronic} = 11.7\ \mu g/L}$$

Step 3 - Most Limiting LTA

To protect a waterbody from both acute and chronic effects, the most limiting of the calculated LTAs is used to derive the effluent limitations. LTA_{acute} is the most limiting LTA.

Step 4 - Calculate the Permit Limits

The *RPA Guidance* recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL). The MDL and the AML for aquatic life are calculated as follows:

$$\text{MDL}_{aquatic} = LTA_{acute} * e^{(z_{99}\sigma - 0.5\sigma^2)}$$

Where,

$\sigma^2 = 0.653$ (as previously calculated)

$$\boldsymbol{MDL_{aquatic} = 51.5\ \mu g/L}$$

$$\text{AML}_{aquatic} = LTA_{acute} * e^{(z_{95}\sigma_n - 0.5{\sigma_n}^2)}$$

Where,

$${\sigma_n}^2 = \ln\left(\frac{CV^2}{n} + 1\right)$$

$${\sigma_n}^2 = \ln\left(\frac{0.960^2}{4} + 1\right)$$

${\sigma_n}^2 = 0.207$ (as previously calculated)

$z_{95} = 1.645$ for 95th percentile probability basis

n = number of sampling events per month for copper = 4

$$\boldsymbol{AML_{aquatic} = 20.8\ \mu g/L}$$

B-III.C.B BOUNDARY OF MIXING ZONE LIMITS

Step 1- Determine the WLA

The acute and chronic aquatic life criteria are converted to acute and chronic WLAs using the following equation:

$$Q_d C_d = Q_e C_e + Q_u C_u$$

Q_d = downstream flow = $Q_u + Q_e = 1.5 + 1 = 2.5$
C_d = aquatic life criteria that cannot be exceeded downstream = 5
Q_e = effluent flow = 1
C_e = concentration of pollutant in effluent = $WLA_{acute} = 20$ or $WLA_{chronic} = 5$
Q_u = upstream flow = 1.5
C_u = upstream background concentration of pollutant = 0.0

Rearranging the above equation to determine the effluent concentration (C_e) or WLA results in the following:

$$C_e = WLA = \frac{Q_d C_d - Q_u C_u}{Q_e} = \frac{C_d(Q_u + Q_e) - Q_u C_u}{Q_e}$$

substitute and solve

$$WLA_{chronic} = C_e = \frac{(2.5 * 5) - (1.5 * 2.87)}{1} = 12.5$$

$$WLA_{acute} = C_e = \frac{(2.5 * 20) - (1.5 * 2.87)}{1} = 50.0$$

Steps 2 (determine LTAs), Step 3 (chose the smallest LTA), and Step 4 (calculate limits)

Performing these steps as described above produces the following selenium limits: MDL = 17.3 and AML = 11.2.

Table B- 6 summarizes the WQBEL calculations for Outfall 001. Parameters listed include selenium, which has a mixing zone, and metals with TBELs that are not protective of WQS. Hence, a WQBEL was generated for metals with TBELs, cadmium, copper, lead, mercury, and zinc.

Table B- 6: Water Quality-Based Effluent Limit Calculations for Outfall 001

Parameter (µg/L unless otherwise noted)	**Most Stringent Water Quality Criterion**	**CV**	**WLA_{acute}**	**$WLA_{chronic}$**	**$LTA_{limiting}$**	**MDL**	**AML**
Cadmium	2.00	1.07	NA	2.00	0.705	3.7	1.4
Copper	30.5	0.960	51.7	30.5	10.9	52	21
Lead	18.6	1.66	477	18.6	4.48	34	11
Mercury	0.012	0.444	2.40	0.012	0.00772	0.018	0.010
Selenium	5.00	0.324	50.0	12.5	8.71	17	11
Zinc	388	0.446	388	388	158	388	221

B-IV Summary of Permit Effluent Limitations

As discussed in Section B-I of this appendix, technology-based and water quality-based limits have been applied to the Outfall 001discharges. The following table offers Outfall 001 permit limits and their bases.

Table B- 7: Outfall 001 Effluent Limits

Parameter	Units	Daily Maximum		Monthly Average	
		Effluent Limit	Basis for Limit	Effluent Limit	Basis for Limit
Cadmium	µg/L	3.7	Chronic WQS	1.4	Chronic WQS
Copper	µg/L	52	Acute WQS	21	Acute WQS
Lead	µg/L	18.3	other[a]	8.1	other[a]
Mercury	µg/L	0.018	Chronic WQS	0.010	Chronic WQS
Selenium	µg/L	17	Chronic WQS	11	Chronic WQS
Zinc	µg/L	388	Acute WQS	221	Acute WQS
pH	mg/L	6.5 to 10.5	TBEL	NA	NA
TSS	mg/L	30	TBEL	20	TBEL
Flow	2.418 billion gallons per year				TBEL
WET	TU_c	12.2	Toxicity	9.7	Toxicity

a. Based on the chronic WQS and Department-prescribed methodology, the calculated limits are 34 and 11 µg/L. However in a letter dated May 8, 2017, TAK requested that the more stringent limits from the 2010 permit be retained in this permit.

APPENDIX C. MIXING ZONE ANALYSIS CHECKLIST

Mixing Zone Authorization Checklist

based on Alaska Water Quality Standards (2003)

The purpose of the Mixing Zone Checklist is to guide the permit writer through the mixing zone regulatory requirements to determine if all the mixing zone criteria at 18 AAC 70.240 through 18 AAC 70.270 are satisfied, as well as provide justification to authorize a mixing zone in an APDES permit. In order to authorize a mixing zone, all criteria must be met. The permit writer must document all conclusions in the permit Fact Sheet; however, if the permit writer determines that one criterion cannot be met, then a mixing zone is prohibited, and the permit writer need not include in the Fact Sheet the conclusions for when other criteria were met.

Criteria	Description	Resources	Regulation	MZ Approved Y/N
Size	Is the mixing zone as small as practicable? - Applicant collects and submits water quality ambient data for the discharge and receiving waterbody (e.g. flow and flushing rates) - Permit writer performs modeling exercise and documents analysis in Fact Sheet at: ►Section 5.4 Mixing Zones - describe what was done to reduce size.	•Technical Support Document for Water Quality Based Toxics Control •Fact Sheet, Appendix C • DEC's RPA Guidance • EPA Permit Writers' Manual	18 AAC 70.240 (a)(2) 18 AAC 70.245 (b)(1) - (b)(7) 18 AAC 70.255(e) (3) 18 AAC 70.255 (d)	**Y**
Technology	Were the most effective technological and economical methods used to disperse, treat, remove, and reduce pollutants? **If yes**, describe methods used in Fact Sheet at Section 5.4 Mixing Zones. Attach additional documents if necessary.		18 AAC 70.240 (a)(3)	**Y**

Criteria	Description	Resources	Regulation	MZ Approved Y/N
Low Flow Design	**For river, streams, and other flowing fresh waters.** - Determine low flow calculations or documentation for the applicable parameters. Justify in Fact Sheet	• Fact Sheet Section 5.4	18 AAC 70.255(f)	**Y**
Existing use	Does the mixing zone…			
	(1) partially or completely eliminate an existing use of the waterbody outside the mixing zone? **If yes, mixing zone prohibited.**		18 AAC 70.245(a)(1)	**Y**
	(2) impair overall biological integrity of the waterbody? **If yes, mixing zone prohibited.**		18 AAC 70.245(a)(2)	**Y**
	(3) provide for adequate flushing of the waterbody to ensure full protection of uses of the waterbody outside the proposed mixing zone? **If no, then mixing zone prohibited.**		18 AAC 70.250(a)(3)	**Y**
	(4) cause an environmental effect or damage to the ecosystem that the Department considers to be so adverse that a mixing zone is not appropriate? **If yes, then mixing zone prohibited.**		18 AAC 70.250(a)(4)	**Y**
	Does the mixing zone…			

Criteria	Description	Resources	Regulation	MZ Approved Y/N
Human consumption	(1) produce objectionable color, taste, or odor in aquatic resources harvested for human consumption? **If yes, mixing zone may be reduced in size or prohibited.**		18 AAC 70.250(b)(2)	**Y**
	(2) preclude or limit established processing activities of commercial, sport, personal use, or subsistence shellfish harvesting? **If yes, mixing zone may be reduced in size or prohibited.**		18 AAC 70.250(b)(3)	**Y**
Spawning Areas	Does the mixing zone…			
	(1) discharge in a spawning area for anadromous fish or Arctic grayling, northern pike, rainbow trout, lake trout, brook trout, cutthroat trout, whitefish, sheefish, Arctic char (Dolly Varden), burbot, and landlocked coho, king, and sockeye salmon? **If yes, mixing zone prohibited.**		18 AAC 70.255 (h)	**Y**
Human Health	Does the mixing zone…			
	(1) contain bioaccumulating, bioconcentrating, or persistent chemical above natural or significantly adverse levels? **If yes, mixing zone prohibited.**		18 AAC 70.250 (a)(1)	**Y**

Criteria	Description	Resources	Regulation	MZ Approved Y/N
	(2) contain chemicals expected to cause carcinogenic, mutagenic, tetragenic, or otherwise harmful effects to human health? **If yes, mixing zone prohibited.**			**Y**
	(3) Create a public health hazard through encroachment on water supply or through contact recreation? **If yes, mixing zone prohibited.**		18 AAC 70.250(a)(1)(C)	**Y**
	(4) meet human health and aquatic life quality criteria at the boundary of the mixing zone? **If no, mixing zone prohibited.**		18 AAC 70.255 (b),(c)	**Y**
	(5) occur in a location where the Department determines that a public health hazard reasonably could be expected? **If yes, mixing zone prohibited.**		18 AAC 70.255(e)(3)(B)	**Y**
Aquatic Life	Does the mixing zone…			
	(1) create a significant adverse effect to anadromous, resident, or shellfish spawning or rearing? **If yes, mixing zone prohibited.**		18 AAC 70.250(a)(2)(A-C)	**Y**
	(2) form a barrier to migratory species? **If yes, mixing zone prohibited.**			**Y**
	(3) fail to provide a zone of passage? **If yes, mixing zone prohibited.**			**Y**

Criteria	Description	Resources	Regulation	MZ Approved Y/N
	(4) result in undesirable or nuisance aquatic life? **If yes, mixing zone prohibited.**		18 AAC 70.250(b)(1)	**Y**
	(5) result in permanent or irreparable displacement of indigenous organisms? **If yes, mixing zone prohibited.**		18 AAC 70.255(g)(1)	**Y**
	(6) result in a reduction in fish or shellfish population levels? **If yes, mixing zone prohibited.**		18 AAC 70.255(g)(2)	**Y**
	(7) prevent lethality to passing organisms by reducing the size of the acute zone? **If yes, mixing zone prohibited.**		18 AAC 70.255(b)(1)	**Y**
	(8) cause a toxic effect in the water column, sediments, or biota outside the boundaries of the mixing zone? **If yes, mixing zone prohibited.**		18 AAC 70.255(b)(2)	**Y**
Endangered Species	Are there threatened or endangered species (T/E spp) at the location of the mixing zone?If yes, are there likely to be adverse effects to T/E spp based on comments received from USFWS or NOAA. If yes, will conservation measures be included in the permit to avoid adverse effects? **If yes, explain conservation measures in Fact Sheet. If no, mixing zone prohibited.**	Applicant or permit writer requests list of T/E spp from USFWS prior to drafting permit conditions.	Program Description, 6.4.1 #5 18 AAC 70.250(a)(2)(D)	**Y**