that these changes will not affect the levels of these pollutants in the discharge, and antidegradation review will be undertaken later in this appendix for the less stringent lead AMEL.

- For cyanide, the permit includes a less stringent AMEL, i.e. 10.3 versus 4.0 µg/L, and MDEL, i.e. 22.2 versus 9.0 µg/L, than the 1998 permit. Cyanide was previously measured as total cyanide but the Alaska Water Quality Standard is now measured as weak acid dissociable (WAD) cyanide. The department certifies that a mixing zone for WAD cyanide with a dilution ratio of 1.5 parts receiving flow to 1.0 part inflow, for a dilution factor of 2.5, protects water quality. Antidegradation review will be undertaken later in this appendix for the new cyanide limits based on WAD cyanide.

- For zinc, the permit includes a less stringent AMEL and MDEL based on the application of the statewide criteria instead of the natural condition-based site-specific criterion. Antidegradation review will be undertaken later in this appendix for the new zinc limits.

- The permit includes new effluent limits for ammonia based on a mixing zone that provides a dilution ratio of 1.5 parts receiving flow to 1 part inflow for a dilution factor of 2.5. Antidegradation review will be undertaken later in this appendix for the new ammonia limits.

- For TDS, the permit includes a less stringent limit than the 1998 permit limits of 170 mg/L (AMEL) and 196 mg/L (MDEL). The permit contains 3 limits for TDS: (i) 1,500 mg/L measured at station 151 in the Main Stem, (ii) 1,000 mg/L measured at station 150 in Ikalukrok Creek, and (iii) 500 mg/L at Station 160 from July 25th through the end of the discharge season.

  The new instream limit of 1,500 mg/L is based on the SSC in the Main Stem from the North Fork confluence to the confluence with Ikalukrok Creek, which was adopted subsequent to the 1998 permit. The 1,500 mg/L SSC was adopted in 18 AAC 70.236(b)(5) and approved by EPA for periods other than grayling spawning on July 16, 2003. The 2003 modification of the permit established a limit of 1,500 mg/L, measured at Station 151, for periods outside of grayling spawning. The 2003 permit modification was challenged before the Environmental Appeals Board (EAB), and relevant TDS limits and associated conditions have been stayed pending EPA's completion of the remand. Although it has not yet come into effect, the 1,500 mg/L limit was not overturned by the EAB. The SSC was revised in 2006 and established a 1,500 mg/L limit for grayling spawning and non grayling spawning times in the Main Stem from the North Fork confluence to the confluence with Ikalukrok Creek. This revision was approved by EPA on April 21, 2006 and forms the basis for the TDS limit in the current permit.

  The 2003 modification of the permit established a limit of 500 mg/L for the grayling season. That limit was appealed to EAB, and was remanded in 2004 to the agencies for further analysis. EPA is currently working to complete the remand on that issue, which will occur through issuance of the NPDES Permit. Subsequent to the EAB's decision in

2004, the agencies revised the SSC in 2006, as noted above, to establish 1,500 mg/L as the criteria for the grayling spawning season as well as for periods outside the grayling spawning season. This new limit for the grayling season of 1,500 mg/L has not yet been incorporated into the permit. Hence, antidegradation review will be undertaken later in this appendix of the 1,500 mg/L limit as it pertains to the grayling spawning season.

The instream limit of 1,000 mg/L measured at station 150 in Ikalukrok Creek was incorporated by EPA into the 2003 modification of the permit. That limit was certified by the department and subjected to antidegradation review as part of the 2003 modification. Although the 2003 modification was challenged before the EAB and its provisions continue to be stayed, the 1,000 mg/L limit was not overturned by the EAB. Because this limit is not being relaxed from the 2003 permit modification, no additional antidegradation review is required.

The instream limit of 500 mg/L at Station 160 from July 25th through the end of the discharge season was incorporated by EPA into a 2003 modification of the permit. That limit was certified by the department and subjected to antidegradation review as part of the 2003 permit modification. Although the 2003 modification was challenged before the EAB and its provisions continue to be stayed, the 500 mg/L limit was not overturned by the EAB. Because this limit is not being relaxed from the 2003 permit modification, no additional antidegradation review is required.

Accordingly, the department's antidegradation analysis focuses on the following parameters based on the possibility for water quality degradation: TDS, ammonia, cyanide, selenium, lead, and zinc. As discussed in detail below, changes to the 1998 permit limits with regard to these parameters are consistent with 18 AAC 70.015(a)(2), which allows the department to reduce water quality upon finding that five criteria are met.

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.***

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

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

annual NANA royalties, $70 million in annual payments to the state, and over 500 jobs held by employees from inside and outside the region.

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

2. ***18 AAC 70.015(a)(2)(B). Except as allowed under this subsection, reducing water quality will not violate the applicable criteria of 18 AAC 70.020, 18 AAC 70.025, or 18 AAC 70.030.***

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

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

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

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

For selenium, the proposed change in the MDEL is a direct result of the application of specific EPA guidance-prescribed calculations that are based on both State water quality standards and on historic facility discharge data for the preceding five year period. The proposed change in the selenium limit will have no bearing on the mine's treatment of wastewater for removal of metals, including selenium. Therefore, treatment effectiveness for selenium will remain unchanged and will continue to contribute to the biologically enhanced conditions of Mainstem Red Dog Creek. Over the past 6 discharge seasons, the effluent's daily maximum measurements of selenium (total) have not exceeded 4.6 µg/L and have averaged only 2.6 µg/l (2003 through 2008; 122 samples), which are below both the proposed and existing daily maximum and monthly average limits respectively. For these reasons, the department has determined that the water quality

associated with the slightly relaxed limit for selenium will be adequate to fully protect existing uses.

For lead, the proposed change in the monthly average limit is a direct result of specific EPA guidance-prescribed calculations that are based on both State water quality standards and on actual, historic, facility, discharge data for the preceding five year period. The proposed limit change has no bearing on the mine's treatment of wastewater for removal of metals, including lead. Therefore, treatment effectiveness for lead will remain unchanged and will continue to contribute to the biologically enhanced conditions of Mainstem Red Dog Creek. Effluent daily maximum total lead concentrations have not exceeded 5 µg/L during the past 6 discharge seasons (2003 through 2008; 122 samples), which is below both the proposed and existing daily maximum and monthly average limits. For these reasons, the department has determined that the water quality associated with the less stringent limit for lead will be adequate to fully protect existing uses.

For zinc, outfall 001 discharge concentrations have not exceeded the current or proposed limits during the previous six discharge seasons. Further, historic zinc concentrations have been relatively stable, and future zinc discharge concentrations are expected at or about the same levels as those observed during previous years. The newly permitted discharge will be consistent with historical discharges, and the information assessed by the department indicates that these discharges have not impacted existing uses. For these reasons, the department has determined that the water quality associated with the less stringent limit for zinc will be adequate to fully protect existing uses.

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

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

For TDS, the renewed permit provides a new limit of 1,500 mg/L at Station 151 for the grayling spawning season and for periods outside of the grayling spawning season. In the 2003 modification of the permit, the department concluded that the 1,500 mg/L limit for periods outside of grayling spawning was adequate to protect existing uses. The focus here is whether the 1,500 mg/L for the grayling spawning period is adequate to protect existing uses. As noted above, the mine has never been able to comply with the TDS limits imposed by the 1998 permit. As a result, the mine has been subject to COBCs, which since 2006 established TDS limits identical to those proposed in this renewed permit. These limits were based on the 2006 SSC for Red Dog Creek, which set water quality criteria at 1,500 mg/L. The technical analyses by the department and EPA supporting the 2006 SSC indicate that the 1,500 mg/L limit is sufficiently conservative to protect spawning grayling and Dolly Varden (which spawn downstream). Results from toxicity tests undertaken in 2005 consistently demonstrated no effect on reproduction at TDS concentrations in excess of the maximum TDS concentrations tested (2,782 mg/L). In light of the extensive analysis of TDS and its potential impact on grayling and Dolly Varden spawning, the department has determined that the water quality associated with the 1,500 mg/L limit will be adequate to fully protect grayling spawning and other existing uses of the water, including use of the mixing zone as a migration corridor to reaching the North Fork.

In summary, the conditions proposed in this permit reflect virtually the same conditions which have historically demonstrated that the effluent from the facility does not negatively affect existing uses in Red Dog Creek, Ikalukrok Creek, or their tributaries. To illustrate, following is a summarized comparison of biological conditions in the Red Dog Creek drainage for pre-mining and current conditions (Weber Scannell 2005):

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

Biomonitoring in the Red Dog Creek drainage has continued from 2005 to 2008 and results of these studies indicate that the conclusions made by Weber Scannell in 2005 are still valid and appropriate.

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

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

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

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

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

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

Selenium, lead, and zinc are associated with the ore and, therefore, are found in the tailings and the impoundment discharge. The lime precipitation process represents the most commonly used, reasonable, and effective method for removing these metals from wastewater at hard rock mines such as Red Dog.

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

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

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