UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

2720

APR 21 2006

Reply to
Attn Of: OWW-131

Lynn J. Tomich Kent
Director, Division of Water
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501

Re: EPA Review of the Main Stem Red Dog Creek Site-Specific Criterion for Total Dissolved Solids for the Arctic Grayling spawning period

Dear Ms. Kent:

The Environmental Protection Agency (EPA) has completed its review of the site-specific criteria (SSC) revisions to Alaska's aquatic life criterion for total dissolved solids (TDS) for mainstem Red Dog Creek received by EPA on February 2, 2006. Our review was conducted pursuant to our authority under Section 303(c) of the Clean Water Act and the implementing regulations at 40 CFR 131.5 and 131.21. The purpose of this letter is to inform you of our decision. In accordance with our authorities, EPA approves the 1,500 mg/l TDS SSC for mainstem Red Dog Creek during the Arctic grayling spawning period.

On June 11, 2003 the Alaska Department of Environmental Conservation (ADEC) submitted two SSC for TDS for Red Dog Creek: 1,500 mg/L TDS when Arctic grayling are not spawning and 500 mg/L during Arctic grayling spawning. EPA approved the 1,500 mg/L on July 16, 2003 and took no action, on the 500 mg/l TDS SSC. At the time of the submittal, the Alaska Science and Technology Foundation (ASTF) released a study, *Salmon as a Bioassay Model of Effects of Total Dissolved Solids*, that provided clear evidence that TDS in the composition similar to that present in the Red Dog Mine effluent has impacts on fertilization success in salmonids. It also demonstrated that these effects vary widely from species to species, and that it is not possible to extrapolate the results of one species to another. Therefore, EPA sent a 308 Information Request to Teck Cominco that required tests to be performed to determine the effects of TDS on the spawning success of Arctic grayling The results from these tests are the basis for this new TDS SSC applicable during the Arctic grayling spawning period on Red Dog Creek.

The February 2, 2006 submittal from ADEC officially withdrew the 2003 500 mg/L TDS SSC to protect Arctic grayling spawning. This new TDS SSC replaces the 2003 Arctic grayling spawning value and thus no further action is required by EPA for the 2003 TDS submittal.

This SSC was submitted to EPA by ADEC on January 30, 2006 and was received by EPA on February 2, 2006. In accordance with EPA's regulations at 40 CFR 131.6, the Alaska water quality standards revisions submittal package contained: a copy of the final regulation at 18AAC 70.236(b)(5), the adoption order, the Lt. Governor's certification that the revision to 18 AAC

70.236(b) were duly adopted in accordance with State law, the specific change to the regulatory language at 18 AAC 70.236(b), the decision document that presents the technical justification that demonstrates that the TDS SSC will protect designated uses, and the response to comments received during the public comment period.

Modification of numeric criteria for toxic pollutants to reflect site-specific conditions is allowed by Federal regulation at 40 CFR 131.11(b)(1)(ii). The Alaska Water Quality Standards (WQS) regulations at 18 AAC 70.235 allow for the development of SSC. This TDS SSC is established in accordance with 18 AAC 70.235(a) and (c-e) which identifies the process that Alaska must follow to establish a SSC and the determinations that must be made by the State. The technical information submitted to EPA in support of this TDS SSC demonstrates that the 1,500 mg/l TDS SSC is scientifically defensible, the SSC will protect all designated uses, and Alaska has completed a public participation process.

Section 7 of the Endangered Species Act (ESA) requires Federal agencies to consult with the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NOAA-Fisheries) regarding potential effects that an action may have on proposed and listed threatened and endangered species. EPA requested a listing of threatened and endangered species in the vicinity of the Red Dog Mine site from the FWS (EPA letter dated August 26, 2005) and from NOAA-Fisheries (EPA letter dated August 26, 2005) for the re-issuance of the National Pollutant Discharge Elimination System permit (which proposes to include this TDS SSC). The FWS responded on September 21, 2005 and stated that there are no threatened or endangered species under their jurisdiction in the vicinity of the mine site and further consultation was not necessary. NOAA-Fisheries responded on September 28, 2005 stating that there are no threatened or endangered species under their jurisdiction in the area. Therefore, this action will not affect listed threatened or endangered species and no additional consultation under ESA is required.

Similarly, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires federal agencies to consult with NOAA-Fisheries on any actions authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH) identified by Regional Fishery Management Councils. NOAA-Fisheries stated that "the described action will not result in any adverse effect to Essential Fish Habitat (EFH). No EFH Assessment is required and NMFS does not offer any EFH Conservation Recommendations. Further EFH consultation is not necessary. NMFS has no objection to the project" (email dated March 27, 2006). Therefore, no further EFH consultation is required.

We greatly appreciate the efforts of your staff to coordinate this action with EPA throughout the SSC development process. Please feel free to contact me at (206) 553-7151 or if you have any questions concerning this letter please contact Sally Brough, Water Quality Standards Coordinator, at (206) 553-1295.

Sincerely,

Mary Kay Lynch for

Michael F. Gearheard
Director, Office of Water and Watersheds

cc: Nancy Sonafrank, ADEC – Water/ Fairbanks
Pete McGee, ADEC- Water/Fairbanks

April 21, 2006

Technical Justification
Red Dog Creek Total Dissolved Solids (TDS) Site-Specific Criterion (SSC) for the Arctic Grayling Spawning Period

Background

On June 11, 2003 the Alaska Department of Environmental Conservation (ADEC) submitted two SSC for TDS for Red Dog Creek: 500 mg/L during Arctic grayling spawning and 1,500 mg/L TDS throughout the rest of the year (when Arctic grayling are not spawning). EPA approved the 1,500 mg/L on July 16, 2003 and took no action, on the 500 mg/l TDS SSC. At the time of the ADEC submittal, the Alaska Science and Technology Foundation (ASTF) (Stekoll et al. 2003) released a study, *Salmon as a Bioassay Model of Effects of Total Dissolved Solids*, that provided evidence that TDS, in the composition similar to that present in the Red Dog Mine effluent, has impacts on fertilization success in salmonids.

Existing literature and research showed the fertilization stage is the most sensitive life stage to exposure to TDS in the composition similar to that present in the Red Dog Mine effluent. Work by Stekoll et al. (2003a, 2003b) demonstrated that adverse effects on spawning success vary widely from one salmonid species to another. The Lowest Observable Effects Concentration (LOEC) varied among salmonid species embryos: 750 mg/L for chum and steelhead and 250 mg/L for king, pink, and coho salmon. EPA believed that it was not possible to extrapolate the results from the species tested by Stekoll et al. to Arctic grayling.

EPA issued a 308 Information Request to Teck Cominco (July 17, 2003) that required Teck Cominco to conduct tests to determine the effects of Red Dog Mine effluent TDS on the spawning success of Arctic grayling. Effects of TDS on Dolly Varden were also conducted, as this species is present downstream of the mainstem Red Dog Creek with spawning habitat in Dudd and Ikalukrok Creeks. The purpose of this work was to obtain information adequate to establish the TDS effects limit that would be protective of Arctic grayling spawning in mainstem Red Dog Creek.

On February 2, 2006 ADEC submitted a new SSC for TDS for mainstem Red Dog Creek, applicable during the Arctic grayling spawning period. The February 2, 2006 submittal officially withdrew the 500 mg/L TDS SSC to protect Arctic grayling spawning and replaced it with a TDS SSC of 1,500 mg/L. The results from the 308 Information Request and subsequent TDS toxicity testing are the basis for this new TDS SSC.

Study Design and Methods

Fertilization success tests for Arctic grayling were designed and conducted by Ecotox Inc. at the Red Dog mine in 2004 and 2005 (Brix et al. 2004). EPA had substantial input into the development of the testing protocols along with ADEC; Alaska Department of Natural Resources, Office of Habitat Management and Permitting; and the Alaska

Department of Fish and Game. In the development of the study design, an effort was made to follow methods used in prior TDS fertilization tests (Stekoll et al. 2003a and 2003b) in order to have a basis of comparison with this previous work on salmonid fertilization. The methodologies used in the study are described in Brix et al. (2004) and were submitted prior to the testing in 2004.

During the 2004 testing, the researchers modified some of the methodologies as necessitated by the test conditions (Brix and Grosell 2005). The following modifications were noted:1) very small amounts of milt obtained from male Arctic grayling necessitated a modification to the technique of mixing the eggs, effluent, and sperm and 2) difficulty in capturing numbers of fish necessitated conducting the test with fewer fish than was desirable. In the 2005 testing the modification to the mixing procedure was retained but the number of fish used in the testing was consistent with the original methodologies.

The Arctic grayling fertilization Work Plan (Brix and Grosell 2004) called for adding 30 eggs to 50 ml test TDS solution effluent and then adding milt to achieve contact of eggs/milt, and therefore wet fertilization. As explained in the 2004 results paper (Brix et al. 2004), this method was not followed as the amount of milt available for each test was very small (0.02 mL). The method was modified so that eggs and milt were placed in a beaker (without touching so no contact of ovarian fluid with milt prior to mixing) and then adding 5 mL of the test TDS solution in a way that caused egg, milt, and test solution to mix resulting in egg/milt contact and wet fertilization.

This altered method varied from those used in Stekoll et al. (2003a and 2003b) in that the eggs were not pre-exposed to the test solution. In the original methods plan, this pre-exposure would have been a very short duration since the addition of the milt would immediately follow the addition of the test TDS solution. The reason for the rapid addition of the milt is that the micropyle (the pore where sperm can enter the egg) has been shown to close very rapidly in other salmonid species (e.g. 10-15 seconds in rainbow trout) once eggs are expelled by the female into the water (Hoysak and Liley 2001, Liley et al. 2002). Any delay in the addition of milt could result in decreased fertilization.

The modification to the method was in response to the low amount of milt that was available from sample male Arctic grayling. Because of the likely quick closure of the micropyle and the limited amount of milt available, EPA believes that the method used during these experiments to efficiently mix eggs, milt, and test TDS is reasonable. EPA notes that the Stekoll et al. (2003) work involved development of new test methods; therefore, deviation from this original methodology does not mean the methods used in the 2004-2005 Red Dog grayling studies are less sound.

It is difficult to speculate whether not having pre-exposure of eggs to the test TDS solution would have been a meaningful deviation from the methods used in previous research (Stekoll et al. 2003). Pre-exposure experiments were not conducted and it is not possible to say what would be the difference due to the change in methods. It is likely

that the difference would not be substantial as the short time period to closing of the micropyle dictates that any pre-exposure period be very short.

Statistical Analysis of Results

EPA also provided recommendations on the statistical treatment of the data in order to determine the TDS concentration that would cause an effect to fertilization success of Arctic grayling. The Species Mean Value (SMV) calculated from the geometric mean of the EC_{20} (the concentration causing a 20% effect) values of individual fertilization tests was selected as the statistical endpoint. Only tests that met the control performance criteria of at least 70% fertilization were included in statistical calculations. The use of this statistical endpoint and its calculation were considered appropriate and consistent with current EPA practices for setting water quality criteria (Stephan et al. 1985, USEPA 1999, USEPA 2001).

Study Outcome

The eight toxicity tests conducted for Arctic grayling fertilization success during 2004-2005 yielded EC_{20} values ranging from 202mg/L to >2,782 mg/L. Pooling the eight EC_{20} values from the two years of Arctic grayling testing, four EC_{20} values from 2004 (202, 748, >921, >1,381 mg/L) and four EC_{20} values from 2005 (all >2,782 mg/L), yields a geometric mean value of 1,357 mg/L. All but three of the individual Arctic grayling toxicity test results exceed this mean value with all the 2005 tests far exceeding this mean value (>2,782 mg/L). In the 2004 results, one very low value of 202mg/l was recorded. Because there was no basis for concluding that the 202 mg/L result was due to errors occurring during the field collection, laboratory processing and handling, or toxicity testing procedures, this value was not excluded from the calculation. Also, none of the data points can be considered statistical outliers (based on Dixon's test calculations).

The researchers noted issues that could have influenced the inconsistent results seen in the 1st year of study (Brix and Grosell 2005). These include sperm holding times that may have been excessive and using gametes collected from the very end of the spawning period. However, tests were not conducted to substantiate that these factors actually affected the Arctic grayling results. The researchers believe that the experimental procedures followed in 2005 eliminated these concerns and the 2005 results were more consistent (>2,782 mg/L for all tests), supporting this hypothesis.

Dolly Varden were also tested. For Dolly Varden, seven tests were completed with EC_{20}values that ranged from >1,704 to >1,817mg/L.

Determination

The purpose of the tests was to determine the TDS criterion that would protect the spawning life history phase of Arctic grayling in mainstem Red Dog Creek. The results of this study are an acceptable basis for a determination of a water quality criterion for the protection of Arctic grayling because:

- -the laboratory methods and quality assurance measures were reasonable and adequate,
- -quantity of data was sufficient,

-methods used to analyze the data and to derive the endpoint were acceptable, and
-test species and test water were specific to the Red Dog mine.

ADEC submitted a new SSC for TDS for mainstem Red Dog Creek, applicable during the Arctic grayling spawning period, to EPA on February 2, 2006. The new TDS SSC is 1,500 mg/L. EPA believes that 1,500 mg/L is appropriate to use as the year-round water quality criterion in Red Dog Creek based on several considerations. EPA believes a weight of evidence approach provides a reasonable basis to interpret the available TDS toxicity data to Arctic grayling. All of the 2005 data explicitly support an SSC of 1,500 mg/L and half of the 2004 data support a TDS SSC in excess of the maximum TDS concentration tested (> 921 and > 1,381 mg/L). The consistency of the results from the 2005 Arctic grayling all demonstrate no effect on reproduction at TDS concentrations in excess of the maximum TDS concentration tested (2,782 mg/L). Dolly Varden toxicity test results also support 1,500 mg/L which will protect downstream spawning populations.

Citations

Brix, K.V., M. Grosell, and D.K. DeForest. 2004. Work plan for assessing the effects of total dissolved solids on Arctic grayling and Dolly Varden. Prepared for Teck Comino, Red Dog Mine. EcoTox, Coral Gables, FL.

Brix, K.V., and M. Grosell. 2005. The effects of total dissolved solids on Arctic Grayling and Dolly Varden fertilization success. Prepared for Teck Comino, Red Dog Mine. EcoTox, Coral Gables, FL.

Hoysak, D. J. and N. R. Liley (2001). "Fertilization dynamics in sockeye salmon and a comparison of sperm from alternative male phenotypes." J. Fish Biol. 58: 1286-1300.

Liley, N. R., P. Tamkee, R. Tsai and D. J. Hoysak (2002). "Fertilization dynamics in rainbow trout (Oncorhynchus mykiss): effect of male age, social experience, and sperm concentration and motility on in vitro fertilization." Can. J. Fish. Aquat. Sci. 59: 144-152.

Stekoll, M., W. Smoker, I. Wang and B. Failor. 2003a. Final report for ASTF grant #98-1-012. Salmon as a bioassay model of effects of total dissolved solids. Juneau, Alaska, University of Alaska - Fairbanks.

Stekoll, M., W. Smoker, I. Wang and W. Hayes. 2003b. Final report on the effects of total dissolved solids on fertilization rates of salmonids in the Red Dog Mine area. Juneau, Alaska. University of Alaska-Fairbanks.

Stephan, C. E., D. I. Mount, D. J. Hansen, J. H. Gentile, G. A. Chapman and W. A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. U.S. Environmental Protection Agency, Environmental Research Laboratory. Duluth, MN. 98 pp.

USEPA (1999). 1999 update of ambient water quality criteria for ammonia. U.S. Environmental Protection Agency, Office of Water. Washington, D.C. 147 pp.

USEPA (2001). 2001 update of ambient water quality criteria for cadmium. U.S. Environmental Protection Agency, Office of Water. Washington, D.C. 159 pp.