Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Dave Freudenthal, Governor

John Corra, Director

9/15/08
Tom McLaughlin
11455 Rockville Pike
Maryland, 20852
Mail Stop T-8F5

RE: TFN 3 2/234, multiply reports for the ExxonMobile Highland Mine Site.

Dear Tom,

According to our verbal agreement during the inspection of 218C (ExxonMobile Highland Mine), I am sending you a review of three reports that were submitted to Land Quality Division (LQD) on 5/27/08. These reports include: Long term Geochemical Evolution of Highland Pit Lake; Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site, and Final Highland Pit Lake Ecological Risk Assessment. The review was sent to Mr. Mahesh Vidyasagar, ExxonMobile Environmental on 9/15/08.

Currently, Pit Lake is located within the 218C permit boundary which is regulated by the LQD. Is NRC planning to expand the area of responsibility to include Pit Lake and Box Creek areas? The LQD will gladly discuss any issues regarding Pit Lake, Box Creek/Boner brother's property including potential risk assessment, monitoring procedures, characterization of the ground water plum etc. The NRC will need to obtain a concurrence from the State of Wyoming to expand the area of responsibility. Please send us a copy of any reviews, reports regarding the Boner brother's property or Pit Lake areas.

If you have any questions, please contact Anna Krzyszowska-Waitkus at (307) 777-6284.

Sincerely,

Anna Krzyszowska-Waitkus
Soil Scientist
Land Quality Division

Attachment
Cc: Steve Ingle, LQD

Department of Environmental Quality

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Dave Freudenthal, Governor

John Corra, Director

September 16, 2008

Certified Mail 7007 1490 0001 0736 2115

Mr. Mahesh Vidyasagar
ExxonMobile Environmental
Services Company
16945 Northchase Drive
GSC-GP4-534
Houston, Texas 77060

RE: TFN 3 2/234, multiply reports for the ExxonMobile Highland Mine Site.

Dear Mr. Vidyasagar

The Land Quality Division (LQD) received three reports for Highland Pit Lake, Permit 218C (ExxonMobile Highland Mine Site) on 5/25/07. The report Long Term Geochemical Evolution of Highland Pit Lake and the Final Highland Pit Lake Ecological Risk Assessment was reviewed by Anna Krzyszowska-Waitkus (**AKW**). The Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site was reviewed by Steve Ingle (**SI**).

The information included in the attachment is the summary of the reviewers understanding of the reports. There are direct quotations from reports as well as specific comments and questions regarding reports. Please review and respond within 120 days or receipt of this letter to our comments and questions regarding the Pit Lake ecological risk assessment and long term geochemical evolution. It is apparent that Pit Lake is not suitable for sustaining aquatic or mammal habitat without cleaning. The LQD recommends a meeting to discuss the review. Please contact Anna Krzyszowska-Waitkus at (307) 777-6284 to arrange such meeting.

Sincerely,

Anna Krzyszowska-Waitkus
Soil Scientist
Land Quality Division

Attachment

Cc: Steve Ingle, LQD
Tom McLaughlin, NRC

RE: TFN 3 2/234, Multiply reports for the ExxonMobile Highland Mine Site

The three reports for the ExxonMobile Highland Mine Site were submitted on 5/25/07:

I. Long term Geochemical Evolution of the Highland Pit Lake

II. Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site

III. Final Highland Pit Lake Ecological Risk Assessment

The report Long Term Geochemical Evolution of the Highland Pit Lake and the Final Highland Pit Lake Ecological Risk Assessment was reviewed by Anna Krzyszowska-Waitkus (**AKW**). The Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site was reviewed by Steve Ingle (**SI**).

Information presented below is the summary of the reviewer's (AKW) understanding of the reports. There are direct quotations from reports. At the end of the review there are specific questions regarding the review.

I. Review of: Final report of Long Term Geochemical Evolution of the Highland Pit Lake by Tetra Tech.

Introduction

The Pit Lake began filling in 1984. It was found that, in addition to TDS and radium, concentration of natural uranium and selenium at times exceed the groundwater quality standards. Substantial revisions to the predicted groundwater flows indicate that the elevation of the Pit Lake will remained below the elevation of the regional discharge area into the North Fork of Box Creek and its tributaries. The Pit Lake will not discharge flows to the groundwater system. Littoral zone habitat that supports vegetation and benthic invertebrate communities comprises less than 2 acres of the 130 acre lake surface area.

The geochemical evolution of Pit Lake was based on the hydrological model using STELLA version 7.02, PHREEQC version 2.12 (geochemical model to quantify the effects of mineral precipitation on predictions of future water composition in the Pit Lake).

Rock units potentially influencing the geochemical evolution and rate of filling of Pit Lake include: Tailings Dam Sandstone, Tailings Dam Shale, and Ore Body Sandstone. Extensive uranium mineralization was found in the ore body sandstone. The modeling effort included inputs of uranium, radium, and selenium from the ore body sandstone and tailing seepage through backfill. Groundwater flows from east to west.

Assumption:

Pit Lake is chemically homogenous. In July 2003, water samples were collected from a depth of 0, 2, 35, 65, 85, and 109 feet. Uranium, selenium and radium-226 were in concentrations of 3.1, 0.12, and 3.4, respectively, spread homogenously in the water column profile. The monthly results were combined into yearly predictions of Pit Lake elevation and water quality.

Water inflow:

The following are sources of water inflow: perched aquifer flow= 74 gallons/minute; flow through the ore body sandstone= steady flow of 13 acre-ft/month; flow through the tailings dam sandstone= 4.5 acre-ft/month; mill tailings (slurry) basin seepage (TBS, Tailing Dam)= 4.03 acre-ft/month for 20 years.

Water outflow: Pit Lake is a hydrologic sink (occurring evapoconcentration of Pit Lake elements) with evaporation of 45.2"/year.

Uranium, Radium, and Selenium Calibration

Calibration was performed for Ore Body Sandstone and Tailings Dam Sandstone leaching. Concentrations of these elements were higher in water of the lake compared to the groundwater. This could be due to the high concentration of deposits adjacent to the pit walls. However, none of the current monitoring wells penetrate the un-mined ore body that occurred in close proximity to Pit Lake. Another source could be the tailing impoundment to the east of the Pit Lake.

The concentration of the specific elements in ground water was used to calibrate the concentration of elements in surface water. For example, 0.45-0.5 mg/L of selenium in the Ore Body Sandstone inflow were needed to match the observed selenium concentrations in the Pit Lake data.

It was assumed that the removal of selenium, radium and uranium from the water column of Pit Lake by sedimentation was not a significant process.

Long-term estimates

The primary source of the chemical mass entering Pit Lake is from the Ore Body Sandstone. Specially, uranium, radium, and selenium are leached from the remaining mineralized zone exposed in the pit walls. Also seepage from the Tailings Basin contributed 24% of the uranium and 11% of the selenium in Pit Lake.

Model simulation indicated that uranium and radium concentration will increase slowly to approximately 4.56 mg/L and 4.51 pCi/L, respectively, after 1000 years. The concentration of Se was predicted to increase from its current level of 0.09 mg/L to 0.14 mg/L after 1000 years. The very slow increase in concentration over the long time is due to the fact that after the initial

influx of uranium and radium from the Tailings Basin seepage, the hydrologic inflows have very low concentration.

Specific questions:

I. 1. Figure 3.6 Highland Mine Site and Monitoring Well Locations is missing. Please provide this Figure.

I.2. Section 4.3 Long-term estimates of selenium. It is stated that the concentration of selenium is predicted to increase from its current level of 0.09 mg/L to 0.14 mg/L after 1000 years. Does this mean that the concentration of Se will increase 35% in Pit Lake water after 1000 years? According to Table 3.10, the concentration of Selenium in Pit Lake at all depths was 0.1224 mg/L (2003 measurements). Please explain the use of 0.09 mg/l as the current level of Se concentration.

I.3. Section 6.0 Summary and conclusions. The predicted concentration of Selenium was not listed. Please add this information.

I.4. Using the average of three samples for the baseline surface water quality is not sufficient. The slow increase of the concentration of various elements over the time makes it important to use data from more collection sites to estimate the baseline. Please consider using more data to describe the current level specially selenium concentration.

I.5 . The results of the final report titled Final Highland Pit Lake Ecological Risk Assessment by ARCADIS showed that the median Se concentration in water samples collected in 2004/2005 was 0.11 mg/L as compared to 0.09 mg/l collected in 2003. This would be an increase of 18% over the period of one year. The model study indicates the increase of 36% in the Se concentration over a period of 1000 years (from 0.09 mg/L to 0.14 mg/L). Please validate the model if the calculation of the Selenium concentration increase over a period of one year was correct.

I.5. It is stated on Page 44, that "*Dissolved uranium and radium are not expected to be strongly affected by mineral precipitation, adsorption, or sedimentation processes within the Pit Lake that would remove these constituents from solution.*" Selenium and uranium sedimentation is the important process as it can be seen from the results of the Final Highland Pit Lake Ecological Risk Assessment by ARCADIS. The concentration of Se in the Pit Lake sediments varied from 1.7-84 mg/l (median 15 mg/l) and Ur range was detected between 17and 273 mg/l (median 153 mg/l). Therefore, the assumption that the removal of selenium, radium and uranium from the water column of Pit Lake by sedimentation is not an important process is incorrect. How will such an assumption affect model results?

II. Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site

Steve Ingle reviewed the groundwater model for Exxon Mobil's Highland Mine Pit Lake. The model is very similar to the previously approved 2003 model. One comment was generated regarding this model.

II.1 Pages 3 and 4 of Appendix A do not show the vertical permeability test results. The results appear on the table as ######, please correct the table to show the vertical permeability results.**(SI)**

III. Review of: Final Highland Pit Lake Ecological Risk Assessment by ARCADIS

The Ecological Risk Assessment (ERA) was performed to evaluate potential adverse effects to potential aquatic and terrestrial life in and around the lake.

The final two pits from the uranium operation were not completely backfilled and, in March 1984, groundwater from the surrounding aquifer was allowed to fill these pits forming Pit Lake. A functioning aquatic community did not exist in the lake during this period. Pit Lake is over 130 feet deep, and has a water level that was rising about 1 ft/year during the study period (2004/2005).

The analysis of the ERA was conducted using a tiered approach. Maximum concentrations of Se and Ur were screened against a concentration obtained from a small pond in Box Creek (2 km west of Pit Lake). The Tier 1 analysis includes a comparison of the maximum concentrations of selenium and uranium to the toxicity threshold based on the lower limits of the range having no adverse effect levels (NOAELs). The Tier 2 analysis includes a more realistic exposure estimate (i.e based on 95% upper confidence limits) and effects thresholds (i.e. based on mid range NOAEL and lowest observed adverse effect levels when available).

Data collected for the ERA

Field study data was initiated in September 2004 and completed in September 2005. Data collected included: biomass, cattails, copepods, benthic invertebrates, habitat/species observation, limnetic, littoral, near-shore terrestrial, avian (25 surveys over 2 years), chemical data, surface water, sediment, soil, and small mammal tissue. Selenium and uranium concentrations were measured in samples of species listed above.

Wildlife survey: a total of 1054 individual birds of 26 different species were observed over the 10 month period in the Pit Lake environments. Of the total, 37% were waterfowl and 55% were cliff swallow. Mule deer were observed 204 times and 7 times pronghorn.

Surface water: concentrations of dissolved selenium and uranium were measured in Sept. 2005 and June 2005. The means were based on locations and 2 depths (1/3 and 2/3 total water

column depth). The lake was well mixed both horizontally and vertically. Mean concentration of Se and Ur averaged 0.11 ppm and 3.0 ppm respectively. Se and Ur concentrations in water samples from Box Creek were not detectable.

Sediment (depth 2-3 inches): Selenium concentration averaged 21 mg/kg (50-150 times higher than corresponding samples from Box Creek) and uranium averaged 144 mg/kg (20-40 times higher than Box Creek).

Soil within 10 feet of the shoreline (to the depth of 6 inches): Median Se concentration was 0.97 ppm (10 to 30 times lower than in Pit Lake sediment). Ur concentration in the Pit Lake soil averaged about 5-8 times higher than those in soil from Box Creek.

Aquatic and terrestrial vegetation: Highest concentration of Se and Ur were measured in stonewort (algal species) and astragalus. Background levels of Se in vegetation from Box Creek were non-detectable. Ur concentration in background vegetation averaged at least an order of magnitude lower than that measured in vegetation from the Pit Lake.

Aquatic biota. Se and Ur were detected in benthic species in Box Creek and Pit Lake. Pit Lake concentrations were at least 50 times higher than corresponding data from Box Creek. Highest mean concentrations of Se were found in predators including leopard frogs, dragon/damsel fly larvae, and terrestrial spiders. Highest mean concentrations of Ur were measured in copeopods, snails, caddis fly larvae, and algae.

Constituents of potential ecological concerns (COPEC's), wildlife assessment endpoints

COPEC's: Uranium and selenium

The following species were selected to represent the wildlife assessment endpoints:

- survival, growth and reproduction of aquatic feeding omnivorous bird populations- lesser scaup

- survival, growth and reproduction of terrestrial herbivorous bird populations- red winged blackbird

- survival, growth and reproduction of terrestrial herbivorous mammal populations – meadow vole and mule deer

- survival, growth and reproduction of carnivorous bird populations- red tailed hawk

Risk analysis

Exposure point concentrations (EPC) were developed for both direct contact and food web-based exposure. EPC for aquatic invertebrates and amphibians were based on maximum detected concentrations of Se and Ur in water. EPC for benthic invertebrates were based on maximum detected concentration of selenium and uranium in sediment. EPC's for waterfowl was based on

modeled food web exposure. Exposure parameters for the selected receptors of concern were taken from the USEAP's Wildlife Exposure Factors Handbook (1993).

Effects Assessment: Toxicity Reference Values were based on both no adverse effect levels (NPAEL) and lowest observed adverse effects levels (LOAEL).

Risk characterization

Aquatic Life Assessment Endpoints were selected to ensure that Se and Ur concentrations do not adversely impact populations of aquatic plants, aquatic invertebrates, benthic invertebrates, amphibians or water fowl. Risk assessments based on a modeled daily dose and conservative toxicity threshold indicated that risk is not likely for water fowl due to the small amount of time these species would forage in or around the lake. Risk estimates for all other aquatic assessment endpoints indicate that risk is possible for aquatic plants, aquatic and benthic invertebrates and amphibians. Based on the 2004 and 2005 observations, there is little prey base in or around the lake to sustain a population of invertebrates or amphibians. Plant species in the littoral zone appear to be limited by the available suitable habitat.

The low benthic invertebrate and copepod productivity likely explains why none of the 45,000 fish stocked in the lake survived.

Conclusions:

Risk estimates for aquatic biota exceeds 1 for selenium using WDEQ chronic (HQ=22) and acute (HQ=5.4) water quality criteria indicating the potential for unacceptable risk to aquatic life (i.e., plants, amphibians, and invertebrates) and that contaminated-related factors may contribute to the limited water column invertebrate communities in the Pit Lake.

Based on the current lack of habitat for benthic invertebrates and aquatic plants, and the lack of a significant prey base for the upper trophic-level receptors (birds and mammals), it can be concluded that current conditions in Pit Lake are resulting in acceptable risk to these receptor groups. However, it is unknown if concentrations of selenium and uranium in the Pit Lake may be slowing or preventing succession based on the establishment of a water column prey base (e.g., plankton and water column invertebrates), which could in turn support the establishment of a fish community, providing a food source for higher trophic level receptors.

Specific Questions:

III. 1. It is stated on Page 1-1 that WDEQ water quality standards for selenium and uranium are 0.005ppm and <1.4 ppm respectively. Please provide the reference and correct values of the WDEQ water quality standards for selenium and uranium.

General comments/questions

1. The selenium concentration in water of Pit Lake is at a higher level than WDEQ water standards. According to the results of the "Long Term Geochemical Evolution of the Highland Pit Lake by Terra Tech", the concentration of selenium and uranium will slowly increase with time. The goal of the report Final Highland Pit Lake Ecological Risk Assessment by ARCADIS was achieved and the model provided the risk assessment analysis for 2004/2005 data. However, it is unknown if wildlife will be protected from the slowly rising concentration of Se and Uranium in the future. Please provide such analysis and evaluation.

2. It was stated in the Summary of the "Final Highland Pit Lake Ecological Risk Assessment by ARCADIS" that, "*...it is unknown if concentrations of selenium and uranium in the Pit Lake may be slowing or preventing succession based on the establishment of a water column prey base (e.g. plankton and water column invertebrates, which could in turn support the establishment of a fish community...*" It would be valuable to provide more detailed results of the water column toxicity test species as mentioned on Page 5-13 while referring to two independent studies. Please provide the references to these two independent studies. To obtain the best result, it would be necessary to analyze the water column invertebrate toxicity test species using water from Pit Lake. Please consider such studies.

3. Results of the "Final Highland Pit Lake Ecological Risk Assessment by ARCADIS" are not very conclusive. The lack of significant aquatic communities might be due to the high concentration of Ur and Se that will rise over years (according to "Long Term Geochemical Evolution of the Highland Pit Lake by Terra Tech") or might be due to the young ecosystem formed in 1984. However, according to the report results, due to lack of productivity in Pit Lake, particularly for plankton, invertebrates, and fish there is a limited impact on the upper trophic-level receptors (birds and mammals). Please elaborate.

4. The results of the "Long Term Geochemical Evolution of the Highland Pit Lake by Terra Tech" indicated the slow increase of the selenium and uranium concentration from already high level of these contaminants. The current concentration of Se in water (median of 0.11 ppm) in the Pit Lake was 5.5 times higher than acute concentration for aquatic life and 22 times higher than the chronic value for aquatic life (WDEQ, Chapter 1). Please provide possible options on how to clean the water of the Highland Pit Lake to acceptable levels based on the current references.

5. What's the reclamation land use of the lake? If it is livestock or fishing- there is a need to change it.