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FROM: Jamie Oakley
DATE: April 4, 2006
FILE: 15209-001-00
SUBJECT: Summary and Recommendations for Kennecott Mine Historical Hydrocarbon Releases

INTRODUCTION

GeoEngineers conducted a review of the historical hydrocarbon investigations for the Kennecott Mine townsite buildings located in Kennicott, Alaska. The following documents were provided for the purposes of this study: "Kennecott Mine – Site Investigation Final Report, Volume 1," dated August 1992, prepared by American North/EMCON (AN/E), Inc.; "Kennicott Pre-Acquisition Environmental Site Assessment (ESA)," dated December 1996, prepared by U.S. Department of Interior, National Park Service (NPS), Wrangell-St. Elias National Park and Preserve.

BACKGROUND SUMMARY

During site investigation activities conducted in the summers of 1991 and 1992 by AN/E, four areas of hydrocarbon-impacted soil were identified as follows: 1) west of the Power Plant near three aboveground storage tanks (ASTs); 2) stained area on the north side of the mill building; 3) stained soil at the Bonanza, Erie and Glacier mines, and 4) a reported used-oil disposal pit located next to a generator at Cottage 24. In addition, contaminated soils were noted along the utility corridor for AST Tank 4. For the purpose of this study, we understand that the focus is on the hydrocarbon-impacted soil associated with the Kennicott townsite; in particular, the mill building, power plant and associated ASTs and piping. The 1996 NPS Pre-Acquisition ESA states that the Environmental Protection Agency (EPA) evaluated the site in regards to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List (NPL) from 1994 through 1995. Results of the EPA investigation concluded that the site did not warrant any further actions under the Federal Superfund Program. Jurisdiction of the site was transferred from EPA to the Alaska Department of Environmental Conservation (ADEC). The March 10, 1995, letter from ADEC (Kennecott Mine, 1994 Remediation Activities Report, Review) addressed the department's comments regarding the site. The department in this letter indicated that no further investigation or cleanup was needed for either the pooled "Bunker C" located west of the power plant or the spill located at the mill building. ADEC listed remaining concerns with the following hydrocarbon impacted areas at the site: the miscellaneous oil spills at the Erie, Bonanza and Glacier mines, the spill north of the mill building and along the utility corridor for AST Tank 4. The other remaining concerns listed by ADEC were not related to hydrocarbon releases. It should be noted that the miscellaneous spills listed as remaining concerns were also listed as "no further action" items due to the type of contamination, apparent low risk to human exposure, access issues and the necessity to maintain the historical integrity of the site.

Historical soil analytical results collected for analysis of hydrocarbon-impacted soil as reported in the 1996 NPS Pre-Acquisition ESA are summarized in Table 1 (attached). The hydrocarbon releases at the mill and power plant have been identified as heavy fuel oil, similar to a Bunker C, with tar-like viscosity. We understand that stained soil at the Bonanza, Erie and Glacier mines are not to be addressed at this time. The

following is a list of our findings for the three townsite areas of hydrocarbon-impacted soil, as identified in the 1991 and 1992 AN/E site investigation:

WEST OF THE POWER PLANT NEAR THREE ASTS

Previous site investigations appear to have partially delineated the release of fuel oil around the power plant and adjacent ASTs. Limited horizontal delineation by soil sampling and visual observation of the spill area around the ASTs indicates an impacted spill area of approximately 40 feet by 120 feet, according to the NPS Pre-Acquisition ESA. The August 1992 Site Investigation Final Report prepared by AN/E indicates that the stained or free product pooled on ground surfaces covers a total area of approximately 79,000 square feet. Review of both these reports does not indicate that the vertical extent of the fuel oil release has been defined, and thus an estimated volume of the fuel oil/"Bunker C" release does not appear to have been calculated. In addition, there is mention of potential fuel oil remaining in the buried piping and utilidoros connecting the ASTs, including one AST (Tank 4) not located on NPS property, and the power plant. Sampling along the AST Tank 4 utilidor corridor indicated several locations of fuel oil/"Bunker C" impacted soils. Residual fuel oil/"Bunker C" in four ASTs (three located northwest of the power plant and one located off NPS property to the north) is reported to have been removed from the Kennecott townsite during remedial activities conducted in 1994.

In 1994, it is also reported that remedial efforts were made to stabilize an area of pooled fuel oil/"Bunker C" by mixing sand and gravel into the pooled oil to make an asphalt cap. In the 1996 NPS Pre-Acquisition ESA, it was observed that the asphalt cap was cracked and a pool of fresh oil was observed. The pooled oil and seep were still present during a 2005 site visit conducted by Med-Tox Northwest. The continued activity of this seep suggests that the fuel oil/"Bunker C" is still migrating from an upgradient source.

STAINED AREA ON THE NORTH SIDE OF THE MILL BUILDING

This stained area was reported to be approximately 50 square yards up a steep slope on the north side of the mill building. Four soil samples were collected in June 1992 by AN/E from the stained area located north of the mill building. The soil samples were submitted for analysis of total petroleum hydrocarbons (TPH). Comparison to the current ADEC Method Two cleanup levels would suggest that all four sample locations were reported at concentrations greater than the applicable cleanup levels. The NPS Pre-Acquisition ESA states that due to the historic aspects of this spill location, mitigation of the spill would be controlled through controlling access to the spill by workers and visitors. The March 10, 1995, letter from ADEC "Kennecott Mine, 1994 Remediation Activities Report, Review" stated that no further action was needed for the spill located at the mill building.

REPORTED USED OIL DISPOSAL PIT LOCATED NEXT TO A GENERATOR AT COTTAGE 24

The only evidence of previous investigation of the reported used oil disposal pit at Cottage 24 was found in the NPS Pre-Acquisition ESA as a soil sample collected in 1990, adjacent to Building 24. The soil sample was submitted for analysis of polychlorinated biphenyls (PCBs) and TPH. The two analyses exhibited concentrations less than the current ADEC Method Two cleanup levels. We did not find any further discussion regarding this reported used oil disposal pit at Cottage 24.

RECOMMENDATIONS

Prior to full development and submittal of a work plan for the recommendations discussed below, we would refine our recommendations in consideration of any additional information presented in acquisition, research and review of the following documentation relating to previous studies at the Kennicott townsite:

Kay, S., and R.E. Miller. 1990. Kennicott – A hazardous waste audit; School of Engineering, University of Alaska Anchorage.

ADEC. September 1992. Preliminary Report for Kennicott Mine Site, Kennicott, Alaska; ADEC; Juneau, Alaska.

EMCON Alaska, Inc. January 1995. "1994 Remediation Activities Report Kennicott Mine, Kennicott, Alaska."

Weston. April 1995, Site Inspection Report, Kennicott Mine, Kennicott, Alaska. EPA Region X.

Based on the information provided for this study, we have compiled the following recommendations and action items to address potential residual fuel oil contamination at each of the three above-mentioned Kennicott townsite locations:

WEST OF THE POWER PLANT NEAR THREE ASTS

Although ADEC has previously issued a letter of no further action regarding remediation of this pooled oil, it is likely that the continued activity of oil seep would initiate ADEC to request further investigation and stabilization of the fuel oil/"Bunker C" source. Additional site investigation is recommended for the power plant, ASTs and associated piping, utilidor corridors and outfalls. Site investigation activities should be conducted with the following goals:

1. Confirm that remedial efforts conducted in 1994 were effective at removing the entire contributing fuel oil/"Bunker C" source from the ASTs and associated piping, utilidor corridors and outfalls.
2. Delineate the horizontal and vertical extent of the fuel oil/"Bunker C" plume at the power plant, adjacent ASTs (including the utilidor corridor from AST Tank 4 where it travels through NPS property) and associated piping, utilidor corridors and outfalls. Delineation would be accomplished through the combined use of ground penetrating radar (GPR), test pits and hand augering, dependant on the limiting factors of the investigation including maintaining historical integrity and access limitations due to steep slopes and vegetated terrain.
3. Update historical analytical data with current ADEC-approved analytical methods for the contaminants of concern.
4. Develop a risk based remediation and closure approach based on the results of the site investigation activities.

The general concept of this approach is to confirm removal of all source material and determine if the existing fuel oil/"Bunker C" release is stable. With the integrity of the historical preservation in mind, options may be explored to actively or passively remediate any areas of existing free product (i.e. observed fuel oil seep). After it is determined that the fuel oil/"Bunker C" sources have been removed and that the existing plume is

stable, a risk-based closure approach would be pursued. A risk-based approach will likely best suit the unique challenges associated with this site. Active remediation to meet ADEC Method Two site closure criteria is likely not a suitable option due to the historical preservation that needs to be intact at the site, the complexity and relative inaccessibility of the plume located on a steep vegetated slope with potentially shallow bedrock, and the relative difficulties associated with remediation of heavy "Bunker C" type fuel oil contamination.

STAINED AREA ON THE NORTH SIDE OF THE MILL BUILDING

In the March 10, 1995, letter from ADEC, the stained area located north of the mill building was stated to have no further action planned. This determination appears to have been issued based on the potential health risk of the spill, and on the assumed limited volume and the nature of the contamination to be characterized as lubricating type oil. In addition, it was stated that cleanup efforts at this location would be limited due to access on the steep slopes of the spill. The NPS Pre-Acquisition ESA stated that mitigation of this spill area would be accomplished through controlling access to the spill by workers and visitors. Despite the above information, we would recommend the visual observation and collection of up to two additional soil samples to provide a current status of the soil contaminant concentration in relation to current analytical and regulatory criteria.

REPORTED USED OIL DISPOSAL PIT LOCATED NEXT TO A GENERATOR AT COTTAGE 24

Further discussion on the previous investigation and collection of one soil sample should be researched through review of the 1990 hazardous waste audit completed by the University of Alaska, Anchorage. We do not have any further recommendations for this location at this time.

Attachment: Table 1. Historical Soil Analytical Results

Disclaimer: Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

TABLE 1 (Page 1 of 2)
HISTORICAL SOIL ANALYTICAL RESULTS
KENNECOTT MINE, ALASKA
GEOENGINEERS JOB #15209-001-00

| ID | Date | Sampler | Location | Media | Description | PCBs ¹ (mg/kg) | TPH ² | Diesel ³ | BETX ⁴ (mg/kg) | | | |
|------|-------|---------|----------------------|-------|---------------|------------------------------|------------------|---------------------|------------------------------|-------|-------|-------|
| | | | | | | | | | B | E | T | X |
| PH01 | 07/91 | EMCON | W of fuel tank 4(2) | soil | vis oil stain | -- | 2,970 | -- | <0.05 | <0.05 | <0.05 | <0.05 |
| PH02 | 07/91 | EMCON | W of Bldg 38 | soil | no oil stain | -- | 3,600 | -- | -- | -- | -- | -- |
| PH03 | 07/91 | EMCON | W of Bldg 38 | soil | no oil stain | -- | 170 | -- | <0.05 | <0.05 | <0.05 | <0.05 |
| PH04 | 07/91 | EMCON | W of fuel tank 4(2) | soil | oil stain | -- | 61,000 | 30,000 | <0.05 | <0.05 | <0.05 | <0.05 |
| PH05 | 07/91 | EMCON | W of sewer pipe | soil | oil stain | -- | 9,900 | -- | -- | -- | -- | -- |
| PH06 | 07/91 | EMCON | W of Bldg 38 | soil | oil stain | -- | 2,600 | -- | <0.05 | <0.05 | <0.05 | <0.05 |
| PH07 | 07/91 | EMCON | S of Bldg 38 | soil | oil stain | -- | 110,000 | -- | -- | -- | -- | -- |
| PH08 | 07/91 | EMCON | W of power house | soil | asphalt stain | -- | 490 | -- | <0.05 | <0.05 | <0.05 | <0.05 |
| PH09 | 07/91 | EMCON | W of power house | soil | oil saturated | -- | 28,000 | -- | -- | -- | -- | -- |
| PH10 | 07/91 | EMCON | W of oil pools | soil | no oil stain | -- | 97 | -- | -- | -- | -- | -- |
| PH11 | 07/91 | EMCON | W of fuel tank 4(3) | soil | no oil stain | -- | 118 | -- | -- | -- | -- | -- |
| PH12 | 07/91 | EMCON | W of fuel tank 4(3) | soil | no oil stain | -- | 97 | -- | <0.05 | <0.05 | <0.05 | <0.05 |
| PH13 | 07/91 | EMCON | W of oil pools | soil | oil sludge | -- | 620,000 | 270,000 | <0.05 | <0.05 | <0.05 | <0.05 |
| PH15 | 07/91 | EMCON | Dup of PH10 | soil | dup of PH10 | -- | 91 | -- | -- | -- | -- | -- |
| PH16 | 07/91 | EMCON | Bonanza Mine, transf | soil | oil stain | <1 | 37,200 | -- | -- | -- | -- | -- |
| PH17 | 07/91 | EMCON | Nr fuel tank 4(1) | soil | oil stain | -- | 28,000 | -- | -- | -- | -- | -- |
| PH18 | 07/91 | EMCON | Nr fuel tank 4(1) | soil | no stain | -- | 3,500 | -- | -- | -- | -- | -- |
| PH19 | 07/91 | EMCON | Nr fuel tank 4(1) | soil | oil stain | -- | 120,000 | 54,000 | <0.05 | <0.05 | <0.05 | <0.05 |
| PH20 | 07/91 | EMCON | Utilidor | soil | oil stain | -- | 320,000 | 250,000 | <0.05 | <0.05 | <0.05 | <0.05 |
| PH21 | 07/91 | EMCON | Utilidor | soil | no stain | -- | 240 | -- | -- | -- | -- | -- |
| PH22 | 07/91 | EMCON | Utilidor | soil | oil stain | -- | 37,000 | -- | -- | -- | -- | -- |
| PH23 | 07/91 | EMCON | Utilidor | soil | oil stain | -- | 110,000 | -- | -- | -- | -- | -- |
| PH24 | 07/91 | EMCON | Nr Bldg 13c | soil | no stain | -- | 940 | -- | -- | -- | -- | -- |
| PH30 | 07/91 | EMCON | N of Mill Bldg | soil | oil stain | -- | 100,000 | -- | -- | -- | -- | -- |

Notes appear on page 2 of 2.

TABLE 1 (Page 2 of 2)

| ID | Date | Sampler | Location | Media | Description | PCBs ¹ (mg/kg) | TPH ² | Diesel ³ | BETX ⁴ (mg/kg) | | | |
|-------------------|-------|--------------|---------------------|-------|-----------------------|------------------------------|------------------|---------------------|------------------------------|-------|------|-------|
| | | | | | | | | | B | E | T | X |
| PH31 | 07/91 | EMCON | N of Mill Bldg | soil | oil stain | -- | 55,000 | -- | -- | -- | -- | -- |
| PH32 | 07/91 | EMCON | N of Mill Bldg | soil | oil stain | -- | 500 | -- | -- | -- | -- | -- |
| PH33 | 07/91 | EMCON | N of Mill Bldg | soil | oil stain | -- | 500 | -- | -- | -- | -- | -- |
| KM16 ⁵ | 1990 | Kay & Miller | Bldg 4, oil tank | soil | soaked in oil leak | -- | 121,000 | -- | <0.05 | 0.292 | 0.1 | 0.451 |
| KM17 ⁵ | 1990 | Kay & Miller | Oil tank by Bldg 38 | soil | soaked in oil leak | -- | 52,900 | -- | 0.16 | 0.284 | 1.66 | 1.01 |
| KM19 | 1990 | Kay & Miller | Bldg 46 | soil | 1-inch depth | <0.02 | 115 | -- | -- | -- | -- | -- |
| KM20 | 1990 | Kay & Miller | Adj Bldg 24 | soil | 6-inch depth | <0.02 | 15 | -- | -- | -- | -- | -- |
| KM49 | 1990 | Kay & Miller | Adj Bldg 37 | soil | | <1 | 454 | -- | -- | -- | -- | -- |
| SP5 | 09/91 | EMCON | Downhill seep | water | pooled water over oil | -- | 16.8 | 6.9 | -- | -- | -- | -- |

Notes:

¹PCBs = polychlorinated biphenyls

²TPH = Total Petroleum Hydrocarbons analyzed by U.S. Environmental Protection Agency (EPA) Method 418.1 (mg/kg for soil and mg/l for water).

³Diesel analyzed by EPA Methods 3550/8100 (mg/kg for soil and mg/l for water).

⁴BETX = benzene, ethylbenzene, toluene, total xylenes; analyzed by EPA Methods 5030/5020.

⁵Also ran chlorobenzene; 1,4-dichlorobenzene; 1,3 dichlorobenzene and 1,2 dichlorobenzene. All were not detected at <(0.1)

mg/kg = milligrams per kilogram

"--" = sample was not submitted for analysis of this parameter.

mg/l = milligrams per liter