MEMORANDUM

DATE: July 21, 2011

SUBJECT: **Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada (NDEP No.: H-000539)**

FROM: Shannon Harbour, Staff Engineer III, Special Projects Branch, BCA, NDEP

TO: Jim Najima, Bureau Chief, BCA, NDEP

THROUGH: William Knight, Supervisor, Special Projects Branch, BCA, NDEP

I. PURPOSE

The purpose of this memorandum is to document approval of the following removal actions described herein for the Nevada Environmental Response Trust (NERT) site, located outside of the City of Henderson, Clark County, Nevada, as defined in the NERT Settlement Agreement ("Henderson Property"):

1. The groundwater extraction and treatment system for the treatment of chromium and perchlorate and

2. Excavation of soil impacted with perchlorate, dioxins/furans, hexachlorobenzene, pesticides, metals, and/or other contaminants.

II. SITE CONDITIONS

History of Facility Production. The Henderson Property comprises approximately 452 acres located within the Black Mountain Industrial (BMI) complex in unincorporated Clark County and is surrounded by the city of Henderson, Nevada. The BMI complex was first developed by the U.S. government in 1942 as a magnesium plant for World War II operations. After the war, the portion of the BMI complex that now comprises the Henderson Property was leased to Western Electrochemical Company (WECCO). Pursuant to a contract with the U.S. Navy, WECCO constructed a facility in the early 1950's and the facility produced manganese dioxide, sodium chlorate, sodium perchlorate, and other perchlorates, in addition to ammonium perchlorate for the Navy for two decades.

WECCO merged with American Potash and Chemical Company (AP&CC) in 1956. In 1967, AP&CC merged with Kerr-McGee Corporation and began producing boron chemicals in early 1976 as well as continuing to produce ammonium perchlorate. Kerr-McGee Corporation operated onsite under the subsidiary and related entities,

Kerr-McGee Chemical Corporation, and Kerr-McGee Chemical, LLC (collectively, KMCC). The production processes utilized by KMCC included elemental boron, boron trichloride, and boron tribromide. The production of boron tribromide was discontinued in 1994 and the production of sodium chlorate and ammonium perchlorate was discontinued in 1997 and 1998, respectively. KMCC reclaimed perchlorate at the site until 2002 using on-site equipment. In 2004, Kerr-McGee Corporation spun off its chemical business into an entity named Tronox LLC (Tronox). Tronox continued to produce electrolytic manganese dioxide, elemental boron, boron trichloride, and boron fibers.

History of Environmental Response. During the 1970s, the U.S. Environmental Protection Agency (USEPA), the State of Nevada, and Clark County investigated potential environmental impacts from atmospheric emissions, groundwater and surface water discharges, and soil discharges from the various BMI companies. From 1971 to 1976, lined surface impoundments were constructed to recycle and evaporate industrial wastewater generated from the KMCC manufacturing processes. Zero discharge status was achieved for industrial wastewater in 1976. In 1980 USEPA issued a Clean Water Act Section 308 letter requesting information from the BMI companies regarding manufacturing and waste management practices. Commencing in 1981, KMCC began investigating potential source areas and extent of chromium contamination in the shallow water bearing zone. In 1987, the chromium groundwater treatment system commenced operation. KMCC completed a Phase I site Assessment in 1993, which was submitted to the NDEP. In 1994, NDEP issued a Letter of Understanding (LOU) to KMCC, which identified 69 areas that required some specified level of environmental investigation (Appendix B, Figures 16 and 17). A Phase II Site Assessment was completed in 1996 in accordance with a NDEP-approved Phase II Work Plan.

Based on sampling conducted by the Southern Nevada Water Authority and others in the Lower Colorado River system, the occurrence of perchlorate in the Lower Colorado River Basin system was determined to have originated in the Las Vegas Wash, and KMCC and former PEPCON facilities were suspected as the sources. NDEP and the Nevada Attorney General's Office responded by requiring soil and groundwater investigation for perchlorate commencing in 1999 with the signing of the July 26, 1999 Consent Agreement between KMCC and NDEP. Perchlorate loadings of up to 1,000 pounds per day were shown to be entering the Colorado River system during this time. In 1998, KMCC installed an on-site well field and constructed an 11-acre groundwater impoundment, GW-11. In 1999, KMCC began collecting groundwater from a seep discovered near the Las Vegas Wash, in which perchlorate had been detected. Additionally that year, KMCC constructed a temporary ion exchange system adjacent to the seep area for the treatment of the perchlorate-impacted groundwater. In 2001, KMCC constructed a subsurface slurry wall on-site for additional containment and enhanced capture of the on-site perchlorate plume and two off-site well fields were installed: Athens Road Well Field and Seep Well Field. After a failed remediation effort using ionic separation – perchlorate destruction module, KMCC expanded the temporary once-through ion exchange system in 2002. By the end of 2004, KMCC had constructed a fluidized

bed reactor (FBR) system for biological destruction of perchlorate and had completed transitioning from the temporary ion exchange system to the new FBR system. In 2006, Tronox expanded the FBR system by adding an additional reactor to manage the decommissioning of Pond AP-5. This expansion allowed for an increase in the treatment capacity of the treatment system. The hydraulic loading was held constant at 1,000 gallons per minute causing the retention time in each bioreactor to increase, thus allowing for the treatment of higher mass loading. The mass loading prior to the additional bioreactor was approximately 22,400 pounds per month and after the additional bioreactor became operational, the mass loading could be increased to 48,000 pounds per month.

In 2006, Tronox conduct a focused Phase A soil characterization effort consisting of 27 borings in select potential source areas throughout the site. In 2009, Tronox conducted a large soil, groundwater, and soil gas sampling effort in order to characterize potential source areas consisting of over 150 sampling locations as part of a NDEP-approved Phase B Sampling and Analysis Plan. In 2010, Tronox reported the resulting data to the NDEP and this data combined with previous investigation data indicated wide-spread and varied soil contamination throughout the site. Contaminants identified include those listed in paragraph A.4. In response to the analytical results and Tronox's protracted schedule, NDEP issued a Finding of Alleged Violations and Order to Tronox on December 14, 2009 requiring source control by December 31, 2010. Tronox began excavation of contaminated soils at the site in August 2010 in accordance with four NDEP-approved Excavation Plans for Remediation Zones B through E (2010B – 2010H, NGEM).

Tronox filed for Chapter 11 bankruptcy in the Southern District of New York in January, 2009. Reorganized Tronox emerged from bankruptcy on February 14, 2011 with their environmental liabilities discharged. Through the bankruptcy, the Nevada Environmental Response Trust (NERT) was established to address these legacy environmental liabilities at the BMI Tronox facility. At the same time, the NERT assumed ownership of the site. Reorganized Tronox leased back the operations portion of the site and continues to operate the production processes for manganese dioxide, elemental boron, boron trichloride, and boron fibers. As of February 14, 2011, the NERT has assumed management of operations of the FBR system as well as assuming all soil excavation activities related to the legacy liabilities. The NERT is continuing the overall site remedial process under NDEP oversight and has scheduled a focused feasibility study (FFS) to address groundwater remediation.

A. Site Description

1. Removal site evaluation

Please see Appendix C for a table listing the 69 LOU Potential Source Areas identified by NDEP. NDEP identified an additional area during the Phase B Sampling and Analysis Plan planning in 2008. These potential source areas were investigated to characterize any soil and/or groundwater impacts.

Historic investigations focused on hexavalent chromium and perchlorate in groundwater.

The historic investigations prompted the removal action of construction of a groundwater treatment system for the removal of hexavalent chromium with following investigations prompting the construction of an additional groundwater treatment system (FBR system) for the removal of perchlorate. The Phase B Investigation prompted the excavation of over 500,000 cubic yards of impacted soils and tailings as well as the removal of the on-site Hazardous Waste Landfill.

2. Physical location

The Henderson Property (NDEP #: H-000539) is approximately 452 acres and is located approximately 13 miles southeast of the city of Las Vegas in an unincorporated area of Clark County, Nevada in Township 22 S, Range 62 E, Sections 1,12, and 13. This site is located within the Black Mountain Industrial (BMI) complex, which is surrounded by the City of Henderson, Nevada. The population of Henderson, NV is approximately 258,000 with the area immediately surrounding the site being industrial and commercial with some nearby residences. The dissolved perchlorate plume originating from the Henderson Property is impacting the Las Vegas Wash, which is located approximately 3.5 miles to the north. The Las Vegas Wash is a tributary to the Lake Mead and the Colorado River system, which affects approximately 15,000,000 end water users in Nevada, Arizona, and California.

3. Site characteristics

A portion of the site continues to be operated by Reorganized Tronox, now as a tenant of the Henderson Property, for the production of elemental boron, boron trichloride, and manganese dioxide. Another smaller portion of the site houses the groundwater treatment system and supporting components and On-site Well Field. Three lined surface impoundments currently exist on-site: GW-11 Pond associated with the groundwater treatment system for the storage of extracted groundwater as needed, WC-East and WC-West Ponds associated with the Tronox production processes. The remainder of the property is predominately unused.

4. Release or threatened release into the environment of a hazardous substance, or pollutant or contaminant

The following contaminants have been observed in soils at concentrations greater than the established applicable or relevant and appropriate requirements (ARARs) and, if left in place and uncontrolled, would exceed 10^{-4} incremental lifetime cancer risk (ILCR) and a hazard index (HI) of 1 (2008A, ENSR):

- Dioxins/Furans
- SVOCs
    - Hexachlorobenzene
    - Benzo(a)pyrene
    - Benzo(b)fluoranthene
    - Dibenzo(a,h)anthracene
- VOCs
    - Benzene
    - Chloroform
- Pesticides
    - 4,4-DDE
    - 4,4-DDT
    - Aldrin
    - Alpha-BHC
    - Beta-BHC
- PCBs
- Perchlorate
- Asbestos
- Metals
    - Arsenic
    - Chromium
    - Cobalt
    - Lead
    - Magnesium
    - Manganese

The following metals have been observed in soils at concentrations that may pose a leaching concern and potential to affect groundwater at concentrations above acceptable leaching soil screening levels (LSSLs) (2010I, NGEM):

- Antimony
- Arsenic
- Boron
- Cadmium
- Chromium VI
- Copper
- Magnesium
- Manganese
- Nickel
- Uranium
- Zinc

The following contaminants have been observed in groundwater at concentrations above USEPA drinking water Maximum Contaminant Levels (MCLs), BCLs, or Las Vegas Wash Beneficial Use Standards (2010I, NGEM):

- Pesticides
  - Aldrin
  - Alpha-BHC
  - Beta-BHC
  - Gamma-BHC (Lindane)
  - Heptachlor epoxide
  - Toxaphene
- SVOCs
  - 1,4-Dioxane
  - Benzo(a)anthracene
  - Benzo(b)fluoranthene
  - bis(2-Ethylhexyl)Phthalate
  - dibenzo(a,h)anthracene
  - Indeno(1,2,3-cd)pyrene
- VOCs
  - 1,1-Dichloroethane
  - 1,1-Dichloroethene
  - 1,2,3-Dichloropropane
  - 1,2,4-Dichlorobenzene
  - 1,2-Dichlorobenzene
  - 1,2-Dichloroethane
  - 2,2-Dichloropropane
  - Benzene
  - Bromodichloromethane
  - Bromoform
  - Carbon tetrachloride
  - Chlorobenzene
  - Chloroform
  - Dibromochloromethane
  - Hexachlorobutadiene
  - Methylene chloride
  - Tetrachloroethene
  - Trichloroethene
- Perchlorate
- Cyanide
- Metals
  - Arsenic
  - Boron
  - Chromium VI
  - Iron
  - Magnesium
  - Manganese
  - Strontium
  - Uranium
- Ammonia

The following contaminants have been identified as exceeding the upper screening limits for the EPA version of the Johnson and Ettinger Model for indoor air vapor intrusion based on soil gas sampling results (2010I, NGEM):

- Carbon tetrachloride
- Chloroform
- Tetrachloroethene
- Trichloroethene

5. Maps, pictures and other graphic representations

The following Maps and Figures are found in Appendix B of this document.

B1. "Site Location Map" – Figure 1 from Site Management Plan (2011, ENVIRON)

B2. "Site Features" – Figure 2 from Site Management Plan (2011, ENVIRON)

B3. "Tronox Sale Parcels" – Figure 3 from Site Management Plan (2011, ENVIRON) – contains all Assessor Parcel Numbers for the site

B4. "Tronox Due Diligence Henderson Facility Site Map" – Drawing A-00-1-169 from Single Tenant Industrial Lease between Le Petomane XXVII, Inc. and Tronox LLC (2011, Lease)

B5. "Remediation Zone A" – Figure 2 from Errata to Revised Human Health Risk Assessment for Remediation Zone A Tronox LLC Henderson, Nevada (2010B, NGEM) – illustrates soil remediation zones

B6. "Remediation Zone A Soil Sample Locations – Figure 3 from Errata to Revised Human Health Risk Assessment for Remediation Zone A Tronox LLC Henderson, Nevada (2010, NGEM)

B7. "RZ-B Excavation Areas and Nature and Extent of Contamination" – Figure 1 from Errata to RZ-B and RZ-D Figures Tronox Facility, Henderson, Nevada (2010, NGEM)

B8. "Remediation Zone C-West and -South Excavation" – Figure 2a from Revised Excavation Plan for Phase B Soil Remediation of RZ-C Tronox LLC Henderson, Nevada (2010, NGEM)

B9. "Remediation Zone C-North Excavation" – Figure 2b from Revised Excavation Plan for Phase B Soil Remediation of RZ-C Tronox LLC Henderson, Nevada (2010, NGEM)

B10. "Remediation Zone C-East Excavation" – Figure 2c from Revised Excavation Plan for Phase B Soil Remediation of RZ-C Tronox LLC Henderson, Nevada (2010, NGEM)

B11. "RZ-D Excavation Areas and Nature and Extent of Contamination" – Figure 1 from Errata to RZ-B and RZ-D Figures Tronox Facility, Henderson, Nevada (2010, NGEM)

B12. "RZ-E Excavation Area and Nature and Extent of Contamination" – Figure 1 from Excavation Plan for Phase B Soil Remediation of RZ-E, Addendum to the Removal Action Work Plan Tronox LLC Henderson, Nevada (2010, NGEM)

B13. "Groundwater Perchlorate Map Shallow Water-Bearing Zone, Second Quarter 2010" – Plate 7 from Annual Remedial Performance Report for Chromium and Perchlorate, July 2009 – June 2010, Tronox LLC, Henderson, Nevada (2010A, NGEM)

B14. "Groundwater Perchlorate Map, Shallow Water-Bearing Zone, Second Quarter 2002" – Plate 7a from Annual Remedial Performance Report for Chromium and Perchlorate, July 2009 – June 2010, Tronox LLC, Henderson, Nevada (2010A, NGEM)

B15. "Groundwater Total Chromium Map Shallow Water-Bearing Zone Second Quarter 2010" – Plate 6 from Annual Remedial Performance Report for Chromium and Perchlorate, July 2009 – June 2010, Tronox LLC, Henderson, Nevada (2010A, NGEM)

B16. "Phase B Area I LOUs" – Figure 3 from Phase B Source Area Investigation Work Plan Area I (Northern LOUs), Tronox LLC Facility, Henderson, Nevada (2008A, ENSR)

B17. "Phase B Area IV LOUs" – Figure 3 from Phase B Source Area Investigation Work Plan Area IV (Western and Southern LOUs), Tronox LLC Facility, Henderson, Nevada (2008D, ENSR)

B. Other Actions to Date

1. Previous actions

Perchlorate in groundwater: KMCC operated a temporary ion exchange system for the removal of perchlorate from 1999 through 2004. KMCC attempted to operate a full-scale ion separation-perchlorate destruction module system but after several attempts the perchlorate destruction module would not operate as designed and reverted back to the temporary ion exchange system. (2002A, ENSR; 2010D, NGEM)

2. Current actions

Groundwater: Chromium VI in groundwater is treated at the Athens Road and Seep Well Fields with ferric chloride to precipitate chromium out of solution as well as an on-site chromium groundwater treatment system. Perchlorate is removed via biological reduction in fluidized bed reactors from groundwater collected from the On-Site (aka Interceptor), Athens, and Seep Well Fields. (2010A, NGEM)

Soils: Any contaminants that exceeded the established action levels have been scheduled for removal through excavation and disposal off-site (2010C, NGEM). Over 500,000 cubic yards of on-site contaminated soil has been removed based on exceedance of an ARAR or risk-based screening criteria.

III. THREATS TO PUBLIC HEALTH OR WELFRE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

A. Threats to Public Health or Welfare

Groundwater: Perchlorate originating from what is now the Henderson Property has been observed in the Lower Colorado River Basin system, which affects the drinking water supply of approximately 15,000,000 people in Nevada, Arizona, and California. To date, USEPA has not promulgated a MCL for perchlorate; however, perchlorate has historically and is currently present in the Las Vegas Wash at concentrations greater than the NDEP provisional action level of 18 µg/L. Historical surface water sampling in the Las Vegas Wash demonstrated that 850 – 1,000 pounds of perchlorate per day were moving through the Las Vegas Wash and into Lake Mead Recreational Area and the rest of the downstream Colorado River system.

Chromium VI originating from what is now the Henderson Property has been detected in groundwater both on-site and off-site at concentrations greater than the MCL for total chromium of 100 µg/L and had the potential to migrate into the Las Vegas Wash and the Lower Colorado River Basin system; thereby, potentially impacting the drinking water supply of approximately 15,000,000 people, recreationalists in the Lake Mead Recreational Area and other downstream uses, such as irrigation, in the Lower Colorado River Basin system in Southern Nevada, Arizona, and Southern California.

Soil: Contaminants in surface and near-surface on-site soils that exceeded their respective BCLs were scheduled for excavation per a NDEP-approved series of Phase B Excavation Plans. These soils had the potential of becoming air-born dust and impacting nearby workers and residents. Additionally, these soils had the potential to impact site construction and utility workers.

B. Threats to the Environment

Groundwater: Historically detected perchlorate groundwater contamination had migrated to the Las Vegas Wash and was impacting the Lower Colorado River Basin system. Additionally historically detected chromium VI groundwater

contamination had the potential to reach the Las Vegas Wash, which would have lead to the contamination of the downstream Colorado River system.

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of pollutants and contaminants from this site, if not addressed by implementing the response actions selected in this Action Memorandum, may have presented an imminent and substantial endangerment to public health, or welfare, or the environment.

V. SELECTED ACTIONS

B. Selected Actions

1. Selected action description

Groundwater: Based on the historic surface water (Las Vegas Wash) and groundwater sampling, KMCC constructed a FBR treatment system to treat extracted groundwater for perchlorate from one on-site and two off-site well fields. The FBR treatment system was added to the existing chromium groundwater treatment system. An additional reactor was later added to the FBR system to increase hydraulic and mass loading capacities of the treatment system. In 2004, Tronox took over operations of the groundwater treatment system. Upon the emergence of Reorganized Tronox from bankruptcy, the NERT assumed operations of the groundwater treatment system on February 14, 2011. The groundwater treatment system currently operates under NPDES permit NV0023060 (*for the discharge of the effluent from the groundwater treatment system*), zero discharge permit NEV2001515 (*for the operation of GW-11*), and UIC permit UNEV94218 (*for operation of the onsite recharge trenches*).

Installation and operation of the FBR treatment system greatly reduced the mass loading to the Las Vegas Wash from a historic high of 1,000 pounds per day in 1999 to approximately 70 pounds per day in 2011. This decreased the intake of perchlorate in the drinking water supply for the residents of Southern Nevada, Arizona, and Southern California.

Further pilot testing and optimization studies will be needed to determine whether additional treatment systems will be necessary. Such efforts will be pursued as part of the FFS process for groundwater.

Extent of contamination will be monitored on a regular schedule to ensure capture and extent of perchlorate and chromium VI plumes.

NDEP has established a procedure for any groundwater extraction / dewatering permitting that includes a map and database search for any known LUST and Corrective Action sites in the vicinity of the permit request. The

project officer(s) for the identified site(s) is contacted for comment and input for monitoring, sampling, and disposal of the extracted groundwater.

Soil: Based on contaminant concentration results from the Phase B sampling as reported in the Removal Action Work Plans for Remediation Zones A through E, excavation of soil with contaminant concentrations greater than respective BCLs was approved and commenced during 2010. Excavation depth was predetermined based on the Phase B sampling results. Additional pre-confirmation sampling was conducted to further refine the planned extent of excavation. Visually impacted soil was discovered in several excavations and in some cases the visually impacted soil continued past the predetermined excavation limits. Sampling and excavation of these visually impacted soils was conducted. Excavation of the visually impacted soils has greatly increased the original scope of soil removal and, to date, is still ongoing. Excavation of these impacted soils greatly reduced the risks to site workers and nearby residents from exposure via inhalation and direct contact. Additional soil characterization will need to be conducted to fully assess residual risks and inform the site FS. Leaching and soil gas evaluations may also be indicated depending on the results of the remaining soil characterization subsequent to the ongoing soil removal.

2. **Contribution to remedial performance**

While the final remedy has not been selected for this site, the groundwater and soil removal actions will, at a minimum, greatly contribute to the long-term effectiveness of the final remedy selected.

3. **Applicable or relevant and appropriate requirements (ARARs)**

Federal ARARs determined to be practicable for this site are as follows:

- Safe Drinking Water Act (SDWA)
- Toxic Substances Control Act (TSCA)

State and local ARARs determined to be practicable for this site are as follows:

- NAC 445A.200 – 201 (Las Vegas Wash Beneficial Use Standards for Confluence of Las Vegas Wash with Lake Mead to Telephone Line Road).
- NAC 445A.226 – 22755 (Action Levels for Contaminated Sites)
    - Basic Comparison Levels (BCLs): These values are risk-based media concentrations to provide for an initial screening evaluation to assist in risk assessment components such as the evaluation of data usability, determination of extent of contamination, identification of chemicals of potential concern, and identification of preliminary remediation goals. The BCL

values are derived as specified in NAC 445A.2272 and using equations from U.S. Environmental Protection Agency (USEPA) guidance, USEPA toxicity criteria, and USEPA exposure factors.

- NAC 459.970 – 9729 (Certification of Certain Consultants and Contractors)
- NAC 445A.228 – 263 (Discharge Permits)
- NAC 444.965 – 976 (Disposal of Asbestos)
- NAC 445A.810 – 925 (Underground Injection Control)
- NRS 533.437 – 4377 (Groundwater Appropriations – Environmental Permits)
- NRS 535 (Dams and Other Obstructions)
- NAC 534 (Underground Water and Wells)
- Clark County Air Quality Regulations

4. Project schedule

Groundwater: the chromium treatment system was constructed and operational in 1987. The fluidized bed reactor system for the treatment of perchlorate was constructed and operational in 2004 and, to date, continues to operate.

Soils: excavation of soils greater than ARARs or BCLs commenced in August 2010 and is on-going at the time of this action memo. Excavation is expected to be complete by August 2011.

VI. EXPECTED CHANGE IN THE SITUATION IF ACTION HAD BEEN DELAYED OR NOT TAKEN

Groundwater: Chromium and perchlorate groundwater contamination would have continued to migrate unimpeded. Perchlorate concentrations in the Colorado River system and the drinking water of approximately 15,000,000 persons may have been impacted at greater than existing ARARs.

Soil: Site workers and nearby residents would have continued to be potentially exposed to contaminants in excess of the ARARs in the surficial and near-surface soils of the site through inhalation of wind-blown dust and direct contact with these soils during construction and/or utility work.

VII. OUTSTANDING POLICY ISSUES

- EPA promulgation of a perchlorate maximum contaminant level (MCL): the timing and value of a perchlorate MCL is unknown at the finalization of this action memorandum.

- EPA promulgation of a chromium VI MCL: the timing and value of a chromium VI MCL is unknown at the finalization of this action memorandum.

VIII. ENFORCEMENT

The potentially responsible parties (PRPs) have been identified for this site. At the time of finalization of this action memorandum the PRPs are the Nevada Environmental Response Trust (NERT) and the Department of Defense (perchlorate contamination only). Reorganized Tronox's obligations for legacy liabilities have been discharged through the bankruptcy, effective February 14, 2011. There is a pending lawsuit to determine what, if any, responsibility for the costs of remediation KMCC and its parent company, Anadarko, have for these legacy liabilities.

IX. RECOMMENDATIONS

This memorandum documents NDEP's decision to compel the above-described groundwater and soil removal actions for the Henderson Property, in Clark County, Nevada, developed in accordance with CERCLA as amended, and not inconsistent with the NCP. This decision is based on the administrative record for the site located in the NDEP-Las Vegas Office.

Soil and groundwater conditions at the site meet the NCP section 300.415(b)(2) criteria for a removal and I recommend approval of the removal actions that have been and are currently being implemented as described in this action memorandum.

☑ **Approval** ☐ **Disapproval**

August 4, 2011

Jim Najima
Bureau Chief
Bureau of Corrective Actions
Nevada Division of Environmental Protection

Date

APPENDIX A

REFERENCES

(1985, KMC) Geohydrological Investigation Kerr-McGee Chemical Corporation Henderson Facility, Kerr-McGee Corp. (July 1985)

(1985, NDEP) "Enforcement Action for Failure to Complete Approved Site Remediation Activities, and Show Cause Meeting, Tronox LLC, (Tronox) Henderson, Nevada, NDEP Facility ID Number 8-000539," NDEP Letter. (December 14, 2009).

(1987, KMC) Chromium Mitigation Program Performance Report, Kerr-McGee Corp. Engineering Services (November 18, 1987).

(1993, KMC) Groundwater Interception System Evaluation Report, Chromium Mitigation Program Kerr-McGee Chemical Corporation Henderson, Nevada, Kerr-McGee Corp. (September 15, 1993).

(1994, NDEP) "Phase II Letter of Understanding Between NDEP and Kerr-McGee Chemical Corporation (KMCC)", NDEP Letter. (August 15, 1994).

(1997, ENSR) Phase II Environmental Conditions Assessment, Kerr-McGee Chemical Corporation, Henderson, Nevada, ENSR International. (August 1997).

(1998A, KMC) Phase II Groundwater Perchlorate Investigation Report, Kerr-McGee Chemical LLC Henderson, Nevada Facility, Kerr-McGee Chemical LLC. (July 15, 1998).

(1998B, KMC) Preliminary Report on a Hydrogeologic Investigation of Channel-Fill Alluvium at the Pittman Lateral, Henderson, Nevada, Kerr-McGee Safety and Environmental Affairs Division. (October 19, 1998).

(1999, ENSR) Work Plan for the Long-Term Groundwater Perchlorate Removal Action Henderson, Nevada, ENSR. (September 1999).

(2001, KMC) Seep Area Groundwater Characterization Report Kerr-McGee Chemical LLC Henderson Nevada Facility, Kerr-McGee Chemical LLC. (January 18, 2001).

(2001, ENSR) Supplementary Phase II Environmental Conditions Assessment Located at Kerr-McGee Chemical LLC, Henderson, Nevada, ENSR. (April 2001).

(2002, ENSR) Dye Injection Study of the Las Vegas Wash, Nevada, ENSR International, Inc. (March 2002).

(2005, ENSR) Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada, ENSR International. (February 2005).

(2007A, ENSR) Phase A Source Area Investigation Results, Tronox Facility, Henderson, Nevada, Report Figures, Tables, and Plates (2 Volumes), ENSR International. (September 2007).

(2007B, ENSR) Phase B Source Area Investigation Soil Gas Survey Work Plan, Tronox LLC Facility Henderson, Nevada, ENSR Corp. (March 2007).

(2008A, ENSR) Phase B Source Area Investigation Work Plan Area I (Northern LOUs), Tronox LLC Facility, Henderson, Nevada, ENSR International, Inc. (April 2008).

(2008B, ENSR) Phase B Source Area Investigation Work Plan Area II (Central LOUs), Tronox LLC Facility, Henderson, Nevada, ENSR International, Inc. (June 2008).

(2008C, ENSR) Phase B Source Area Investigation Work Plan Area III (Eastern LOUs), Tronox LLC Facility, Henderson, Nevada, ENSR International, Inc. (June 2008).

(2008D, ENSR) Phase B Source Area Investigation Work Plan Area IV (Western and Southern LOUs), Tronox LLC Facility, Henderson, Nevada, ENSR International, Inc. (May 2008).

(2008E, ENSR) Revised Documents for Phase B Area IV Work Plan Tronox LLC, Henderson, Nevada, ENSR International. (July 11, 2008)

(2010A, NGEM) Annual Remedial Performance Report for Chromium and Perchlorate, July 2009 – June 2010, Tronox LLC, Henderson, Nevada, Northgate Environmental Management, Inc. (August 27, 2010).

(2010B, NGEM) Errata to RZ-B and RZ-D Figures Tronox Facility, Henderson, Nevada, Northgate Environmental Management, Inc. (November 29, 2010).

(2010C, NGEM) Excavation Plan for Phase B Soil Remediation of RZ-E, Addendum to the Remedial Action Work Plan Tronox LLC Henderson, Nevada, Northgate Environmental Management, Inc. (November 3, 2010).

(2010D, NGEM) Removal Action Work Plan for Phase B Soil Remediation of Remediation Zones RZ-B through RZ-E, Tronox LLC, Henderson, Nevada, Northgate Environmental Management, Inc. (May 4, 2010).

(2010E, NGEM) Revised Excavation Plan for Phase B Soil Remediation of RZ-B, Tronox LLC, Henderson, Nevada, Northgate Environmental Management, Inc. (August 20, 2010).

(2010F, NGEM) Revised Excavation Plan for Phase B Soil Remediation of RZ-C, Tronox LLC, Henderson, Nevada, Northgate Environmental Management, Inc. (September 1, 2010).

(2010G, NGEM) Revised Excavation Plan for Phase B Soil Remediation of RZ-D, Tronox LLC, Henderson, Nevada, Northgate Environmental Management, Inc. (August 31, 2010).

(2010H, NGEM) Revised Excavation Plan for Phase B Soil Remediation of RZ-E, Tronox LLC, Henderson, Nevada, Northgate Environmental Management, Inc. (November 3, 2010).

(2010I, NGEM) "Site-Wide Data Meeting (provided draft data and figures)," Northgate Environmental Management, Inc. (February 5, 2010).

(2011, ENVIRON) Site Management Plan (SMP) Nevada Environmental Response Trust Site, Henderson, Nevada, ENVIRON International Corp. (March 2011).

(2011, Lease) "Single Tenant Industrial Lease", Le Petomane XXVII, Inc. and Tronox LLC. (February 14, 2011).

APPENDIX B

FIGURES

APPENDIX C

TABLES

LOU Identification and Associated Contaminants		
LOU #	**Name**	**Identified Potential Contaminants**
1	Trade Effluent Settling Ponds	Muriatic acid Hydrochloric acid VOCs (benzene derivatives) SVOCs DDT Hexavalent Chromium Perchlorate Chlorate Ammonia Specific composition unknown waste streams acidic and caustic process liquors solids from waste neutralization processes hydrochloric acids liquid wastes metal containin liquid wastes
2	Open area south of Trade Effluent Settling Ponds area	Specific composition unknown acidic and caustic process liquors solids from waste neutralization processes hydrochloric acids liquid wastes metal containin liquid wastes
3	Air emissions associated with industiral processes	Not identified
4	Hardesty Chemical Company site	Muriatic acid Hydrochloric acid Sulfuric acid VOCs (benzene derivatives) SVOCs Arsenic DDT
5	On-Site portion of Beta Ditch + diversion ditch north of Pond C-1	Metals Hexavalent chromium Perchlorate Cyanide Sulfates Carbonates Phosphates Chloride Sulfide Ammonia Organochlorine pesticides
6	Unnamed drainage ditch segment	Not identified
7	Old Pond P-2 and associated conveyance facilities	Hexavalent chromium Chloride Chlorate Perchlorate Ammonia
8	Old P-3 Pond and associated conveyance facilities	Hexavalent chromium Chloride Chlorate Perchlorate Ammonia

LOU #	Name	Identified Potential Contaminants
9	New P-2 and associated piping	Hexavalent chromium Chloride Chlorate Perchlorate Ammonia
10	On-Site Hazardous Waste Landfill	Sulfuric acid Metals Hexavalent Chromium Boron Manganese Chloride Chlorate Perchlorate Sodium hexametaphosphates Ammonia
11	Sodium chlorate filter cake holding area	Hexavalent chromium
12	Hazardous Waste Storage Area	Hexavalent chromium
13	Pond S-1	Metals Hexavalent chromium Boron Manganese Chlorate Perchlorate Ammonia Sodium hexametaphosphates Sulfuric acid
14	Pond P-1 and associated conveyance piping	Metals Hexavalent chromium Boron Manganese Chlorate Perchlorate Ammonia Sodium hexametaphosphates Sulfuric acid
15	Platinum drying unit	Metals Platinum Hexavalent chromium Chlorate Perchlorate Ammonia
16 / 17	Ponds AP-1, AP-2, and AP-3 and associated transfer lines	Metals Hexavalent chromium Magnesium Sulfates Carbonates Sulfide Perchlorate Chlorate Ammonia

LOU #	Name	Identified Potential Contaminants
18	Pond AP-4	Metals Hexavalent chromium Magnesium Sulfates Carbonates Sulfide Perchlorate Chlorate Ammonia
19	Ponds AP-5 & AP-6	Metals Hexavalent chromium Perchlorate Chlorate Ammonia
20	Pond C-1 and associated piping	Metals Hexavalent chromium Boron VOCs SVOCs Chlorate Perchlorate Phosphates Sulfates Carbonates Borates Boron trichloride Boron tribromide
21	Pond Mn-1 and associated piping	Metals Magnesium Manganese Manganese dioxide Boron Hexavalent chromium Perchlorate Chlorate Sodium hexametaphosphate
22	Pond WC-W and associated piping	Metals Magnesium Manganese Manganese dioxide Boron Hexavalent chromium Perchlorate Chlorate Sodium hexametaphosphate Hypochlorite

LOU #	Name	Identified Potential Contaminants
23	Pond WC-E and associated piping	Metals Magnesium Manganese Manganese dioxide Boron Hexavalent chromium Perchlorate Chlorate Sodium hexametaphosphate Hypochlorite
24	Leach beds, associated conveyance facilities and Mn tailings area	Metals Manganese Trace heavy metals
25	Process hardware storage area	Metals Hexavalent chromium Chlorate residue Perchlorate residue Ammonia residue
26	Trash storage area	Metals Chlorate Perchlorate Ammonia
27	PCB storage area	PCBs
28	Hazardous Waste Storage Area	Metals Hexavalent chromium Perchlorate VOCs SVOCs
29	Solid waste dumpsters	Metals Perchlorate
30	AP Plant area - Pad 35	Hexavalent chromium Perchlorate Chlorate Ammonia
31	Drum recycling area	Metals Perchlorate Chlorate
32	Groundwater remediation unit	Metals Hexavalent chromium Total chromium Iron Perchlorate
33	Sodium perchlorate platinum by-product filter	Metals Chromium Platnium Perchlorate Chlorate Ammonia

LOU #	Name	Identified Potential Contaminants
34	Former Mn tailings area	Metals Manganese Heavy metals Sulfuric acid
35	Truck emptying/dumping site	Unknown - reportedly "inorganic wastes"
36	Former satellite accumulation point - Maintenance Shop	Metals Acid wastes VOCs Caustics
37	Former satellite accumulation point - Unit 6 Maintenance Shop	Metals VOCs SVOCs
38	Former satellite accumulation point - AP Change House & Laboratory	Metals Hexavalent chromium Perchlorate Chlorate Ammonia Acids Caustics VOCs Alcohols Dilute formaldehyde titrant
39	Satellite accumulation point - AP maintenance shop	Metals Perchlorate VOCs
40	PCB transformer spill	PCBs VOCs SVOCs
41	Unit 1 tenant stains	VOCs SVOCs
42	Unit 2 salt conveyor	Sodium chloride
43	Unit 4 and old Sodium Chlorate Plant decommissioning	Metals Hexavalent chromium Manganese Boron Perchlorate Chlorate Ammonia
44	Unit 6 basement	Metals Manganese Sodium hexametaphosphate
45	Diesel storage tanks	Metals VOCs SVOCs

LOU #	Name	Identified Potential Contaminants
46	Former old main cooling tower and recirculation lines	Metals Manganese Hexavalent chromium Boron Sulfates Carbonates Phosphates Chloride Sulfide Perchlorate Chlorate Ammonia
47	Leach Plant area Mn ore piles (current & historic)	Metals Manganese
48	Leach Plant analyte tanks	Manganese sulfate Manganese dioxide Sulfuric acid
49	Leach Plant area sulfuric acid storage tanks	Sulfuric acid Acid solutions
50	Leach Plant area leach lines	Metals
51	Leach Plant area transfer lines	Metals Acid solutions
52	AP Plant area Screening Building, Dryer Building, and associated sump	Metals Hexavalent chromium Perchlorate Chlorate Ammonia
53	AP Plant area Tank Farm	Metals Hexavalent chromium Perchlorate Chlorate Ammonia Caustics
54	AP Plant area Change House / laboratory spetic tank	Metals Perchlorate Ammonia Chlorate
55	Area affected by July 1990 fire	
56	AP Plant area old builing D-1 washdown	Perchlorate
57	AP Plant area transfer lines to sodium chlorate process	Metals Hexavalent chromium Iron Perchlorate Ammonia
58	AP Plant area New D-1 Building washdown	Perchlorate

LOU #	Name	Identified Potential Contaminants
59	Storm sewer system	Metals Hexavalent chromium Magnesium Platinum Barium Zinc Nickel Lead Manganese Perchlorate Chlorate Ammonia Sodium Borate Sulfide Sulfuric acid
60	Acid drain system	Magnesium Hexavalent chromium Boron Barium Arsenic Cadmium Lead Selenium Sodium hydroxide Hydrochloric acid Sulfuric acid Boric acid Chlorides Phosphates Hexametaphosphates Sodium Sulfite ions Borate ions Borax Soda ash Pickle liquor (iron sulfate) Chlorides Perchlorate Ammonia Chlorate Sulfates
61	Unit 5 basement & old Sodium Chlorate Plant decommission	Metals Hexavalent chromium Boron Manganese Perchlorate Chlorate Ammonia

LOU #	Name	Identified Potential Contaminants
62	State Industries, Inc site	Metals Iron Total chromium Barium Lead VOCs SVOCs Sulfuric acid (spent) Borax Soda ash Phosphate chemicals cyanide (spent)
63	J.B. Kelley Trucking Inc. site	Metals Barite Magnesium VOCs SVOCs Soda ash Lime Magnesium chloride brine Ferric chloride Hydrochloric acid Sodium hydrosulfide Sodium hydroxide Titanium tetrachloride
64	Koch Materials Company site	Metals VOCs SVOCs
65	Nevada precast concrete products, Green Ventures International, Buckles Construction Company, and Ebony Construction sites	Metals Barite Magnesium VOCs SVOCs Soda ash Lime Magnesium chloride brine Ferric chloride Hydrochloric acid Sodium hydrosulfide Sodium hydroxide Titanium tetrachloride
66	Above-ground diesel storage tank leased by Flintkote Company on Chemstar property	VOCs SVOCs
67	Delbert Madsen and estate of Delbert Madsen site	Not identified
68	Southern Nevada Auto Parts site	Not identified
69	Dillon Potter site	Not identified

LOU #	Name	Identified Potential Contaminants
70	US Vanadium Leasehold	Metals Tungsten Alluminum Molybdenum Iron Boron Cobalt Ammonia Acids