KERR-McGEE CHEMICAL LLC

Susan Crowley
Staff Environmental Specialist

(702) 651-2234
Fax (405) 228-6882
scrowley@kmg.com

September 29, 2005

Mr. Brian Rakvica, P.E.
Nevada Division of Environmental Protection
1771 East Flamingo, Suite 121-A
Las Vegas, NV 89119-0837

Subject: NDEP Facility ID H-000539 – Kerr-McGee ECA – *Upgradient Study Work Plan – Groundwater and Soils*

Dear Mr. Rakvica:

Kerr-McGee Chemical LLC (Kerr-McGee) has undertaken an Environmental Conditions Assessment (ECA) as directed by Nevada Division of Environmental Protection (NDEP). Integral to that investigation is understanding upgradient / background conditions associated with the site. In late March 2005, Kerr-McGee submitted a *Background Study Work Plan – Groundwater and Soils* (Work Plan), which once executed is intended to provide information associated with upgradient / background site conditions. NDEP provided comments regarding the Work Plan on May 6, 2005 and Kerr-McGee provided a response to NDEP's comments on July 20, 2005. NDEP provided further comment on July 28, 2005 and requested that our response to the collective NDEP comments be addressed in a revised copy of the Work Plan. The Work Plan has been revised to reflect Kerr-McGee's responses and is provided here.

Feel free to call me at (702) 651-2234 if you have any questions regarding this correspondence. Thank you.

Sincerely,

SMCrowley

Susan Crowley
Staff Environmental Specialist, CEM 1428

Overnight Mail

CC: Keith Bailey, Kerr-McGee
Jeff Johnson, NDEP
Public Repository

ECC: Jennifer Carr, NDEP
Barry Conaty, COH
Todd Croft, NDEP
Mitch Kaplan, EPA Region IX

8000 West Lake Mead Parkway, Henderson, Nevada 89015 • P.O. Box 55, Henderson, Nevada 89009

Val King, NDEP
Jim Najima, NDEP
Jon Palm, NDEP
Brenda Pohlmann, COH
Ron Sahu, BMI
Carrie Stowers, CCCP
Paul Sundberg, Montrose
Al Tinney, NDEP
Craig Wilkinson, TIMET
Keith Bailey, Kerr-McGee
Sally Bilodeau, ENSR
Pat Corbett, Kerr-McGee
John Dixon, Kerr-McGee
Dave Gerry, ENSR
Ed Krish, ENSR
Tom Reed, Kerr-McGee
Don Shandy, Kerr-McGee
Rick Stater, Kerr-McGee

Attachment

KERR-McGEE CHEMICAL LLC
HENDERSON, NEVADA FACILITY

UPGRADIENT INVESTIGATION WORK PLAN

Prepared for:
Nevada Division of Environmental Protection

Prepared by:
Kerr-McGee Chemical LLC

ENSR International

September 2005

Document No. 04020-023-150

UPGRADIENT INVESTIGATION WORK PLAN
Kerr-McGee Facility
Henderson, Nevada

ENSR Document No. 04040-023-150

September 2005

Prepared for
Nevada Division of Environmental Protection

Prepared for

Kerr-McGee Chemical LLC

Henderson, Nevada

ENSR International
1220 Avenida Acaso
Camarillo, California 93012

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Kerr-McGee Facility

Henderson, Nevada

Responsible CEM for this project

SMCrowley 9-26-05

Susan M. Crowley, CEM 1428 Date
Staff Environmental Specialist
Kerr-McGee Chemical LLC

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

Individuals who provided input to this document

9/28/05

David L. Gerry, CEM 1524 Date
Senior Program Manager
ENSR International

Edward J Krish 9/28/05

Ed Krish Date
Supervising Geologist
ENSR International

Brian D. Ho 9-28-05

Brian Ho Date
Project Scientist
ENSR International

EXECUTIVE SUMMARY

This work plan describes proposed activities to assess upgradient soil and groundwater conditions at the Kerr-McGee Chemical facility located at 8000 West Lake Mead Drive in Henderson, Nevada. The facility is owned and operated by Kerr-McGee Chemical LLC (Kerr-McGee). The work will be conducted by ENSR on behalf of Kerr-McGee in response to requests by the Nevada Division of Environmental Protection (NDEP). The original draft work plan has been revised in response to comments received from the NDEP dated May 6, 2005 and July 28, 2005. The purpose of this assessment is to characterize the local background geochemistry of the sediments in the different upgradient formations as well as to characterize the groundwater that moves through them.

The following scope of work has been identified:

- Soil borings will be drilled at six locations along the southern portion of the property.
- Sonic drilling techniques will be employed so that continuous cores can be obtained. Soil samples will be collected using a split-spoon sampler at selected intervals in each of the borings.
- Soil samples will be analyzed for perchlorate, Title 22 and other metals, volatile organic compounds (VOCs) including MTBE, total petroleum hydrocarbons (TPH) and radionuclides. Approximately 10 percent duplicate samples will be collected and analyzed.
- Two of the soil borings (M-116 and M-119) will be advanced to a depth of 50 feet below ground surface (bgs) and will be sampled at specified intervals to characterize the alluvium and portions of the Muddy Creek formation on the southeast and southwest edges of the property. The purpose of these borings is to provide upgradient geochemical soil conditions along a vertical profile from the ground surface downwards to (and including) the upper fine grained facies of the Muddy Creek formation (MCfg1). These borings will also refine the location of the pinch-out of the MCfg1 unit.
- Four of the soil borings will be completed as two-inch diameter PVC wells. Wells M-120 and M-121 will be 100 feet deep and will monitor the upper coarse grained facies of the Muddy Creek formation (MCcg1). Wells M-117 and M-118 will be 150 feet deep and will monitor the lower fine grained facies of the Muddy Creek formation (MCfg2). The purpose of these wells is to provide upgradient geochemical conditions along a vertical profile from the ground surface downwards to (and including) the MCfg2. In addition these wells will provide upgradient groundwater analytical data from both the MCcg1 and MCfg2.

- Consistent with historical purging and sampling methods, bailers will be used to collect groundwater samples from wells H-11, TR-9, TR-10, and M-103. These groundwater samples will be analyzed for perchlorate; Title 22 and additional metals, VOCs and MTBE, TPH, pH, electrical conductivity (EC), alkalinity, carbonate, bicarbonate, water chemistry ions and radionuclides.
- Dedicated micropurge pumps will be installed in the four new wells (M-117, M-118, M-120, M-121) as well as five existing on-Site wells (TR-7, TR-8, TR-9, TR-10 and M-103).
- Groundwater samples will be collected using micropurge methods from the nine wells with one duplicate sample and analyzed for perchlorate; Title 22 and additional metals, VOCs and MTBE, TPH, pH, EC, alkalinity, carbonate, bicarbonate, water chemistry ions and radionuclides.

The soil data will be used to characterize the upgradient soil chemistry within the alluvium and Muddy Creek formation to a maximum depth of 150 feet bgs. The groundwater data will be used to assess upgradient concentrations of the constituents in the MCfg1, MCcg1 and MCfg2. These soil and groundwater data will be compared to available on-Site and off-Site data. The groundwater analytical data collected by the micropurge pumps and bailers from wells TR-9, TR-10 and M-103 will be reviewed to determine the comparability of analytical results derived from the different sampling methods.

1.0 INTRODUCTION

This document presents a work plan to more fully assess upgradient soil and groundwater conditions at the Kerr-McGee Chemical facility located at 8000 West Lake Mead Drive in Henderson, Nevada. The facility is owned and operated by Kerr-McGee Chemical LLC (Kerr-McGee).

The Nevada Division of Environmental Protection (NDEP), in a letter dated February 11, 2004 (NDEP, 2004), indicated that the existing background data of soil and groundwater conditions at the Kerr-McGee Henderson facility were insufficient and that additional data should be collected. The work plan has been revised to respond to comments received from the NDEP dated May 6, 2005 and July 28, 2005. On July 20, 2005, Kerr-McGee provided a letter responding to the May 6, 2005 NDEP comments. Copies of the NDEP and Kerr-McGee correspondence are included in Appendix A.

This work plan sets out the objectives and scope of work for the collection and analyses of upgradient soil and groundwater data based on discussions between the NDEP and Kerr-McGee during meetings on March 16, 2005 and August 15, 2005. This investigation focuses on the upgradient background conditions that apply to the 452-acre Kerr-McGee facility in Henderson, Nevada (hereafter referred to as “the Site”), as shown in Figure 1. The purpose of this assessment is to characterize the local background geochemistry of the sediments in the different upgradient formations as well as to characterize the groundwater that moves through them.

The following EPA guidance documents were consulted during the preparation of this work plan:

US EPA 1989, Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A) interim final (EPA/540/1-89/002) December.

US EPA 1995, Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites, (EPA/540/s-96/500) December.

US EPA 2001, Guidance for Characterizing Background Chemicals in Soil at Superfund Sites, QSWER 9285.7-41 (EPA 540-R-01-003) June.

US EPA 2002, Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, OSWER Technology Innovation Office May.

This work plan is not intended to meet all of the objectives identified in these guidance documents as it is focused on soil and groundwater sampling immediately upgradient of the Site.

1.1 Site History

The BMI complex has seen operation since 1942 and was originally sited and operated by the U.S. government as a magnesium production plant. A portion of the complex was leased by Western Electrochemical Company (WECCO) in 1946. By August 1952, WECCO had purchased several portions of the complex, including six of the so-called Unit Buildings, in some of which it would produce sodium chlorate, sodium perchlorate, potassium perchlorate, manganese dioxide and boron trichloride. Between 1951 and 1953, pursuant to a contract with the U.S. Navy, WECCO constructed a plant to produce ammonium perchlorate on land purchased by the Navy. By 1953, that plant was producing ammonium perchlorate and WECCO operated it until 1956. In 1955-56, the Navy paid to install additional sodium chlorate production facilities in the Unit Buildings. In 1956, WECCO merged with American Potash and Chemical Company (AP&CC) and from 1956 to 1962 this company owned and operated certain sodium chlorate and sodium perchlorate facilities at the Site and also operated, as contractor, certain Navy-owned sodium chlorate facilities and the Navy-owned ammonium perchlorate plant at the Site. In 1962, AP&CC purchased the ammonium perchlorate plant from the Navy. AP&CC became a subsidiary of Kerr-McGee Corporation in 1967. Additional companies operate within the BMI complex; details regarding ownership and leases within the BMI complex are described in the 1993 Phase I ECA report (Kleinfelder, 1993).

During the 1970s, the USEPA, the State of Nevada and Clark County investigated potential environmental impacts from the BMI companies' operations including atmospheric emissions, groundwater and surface water discharges and soil impacts (Ecology and Environment, 1982). From 1971 to 1976, Kerr-McGee modified their manufacturing process and constructed lined surface impoundments to recycle and evaporate industrial wastewater. In 1976, Kerr-McGee achieved zero discharge status regarding industrial wastewater management. In 1980, the USEPA requested specific information from the BMI companies regarding their manufacturing processes and their waste management practices by issuing section 308 letters. In 1994, the NDEP issued a Letter of Understanding (LOU) that identified 69 specific areas or items of interest and indicated the level of environmental investigation they wanted Kerr-McGee to conduct.

Kerr-McGee has undertaken environmental investigations to assess specific impacts in the area. A detailed discussion of the specific areas or items of interest identified in the LOU and a list the products made, years of production and approximate waste volumes for WECCO, AP&CC and Kerr-McGee are found in the Conceptual Site Model document (ENSR, 2005).

1.2 Environmental Conditions Summary

Numerous investigations have been conducted to evaluate the nature, extent, and movement of contaminants on-Site and in downgradient and cross-gradient areas. A summary of the Site history, soil, and groundwater investigations is presented below.

In April 1991, Kerr-McGee was one of six companies that entered into a Consent Agreement with the NDEP (NDEP, 1991) to conduct environmental studies to assess Site-specific environmental conditions that are the result of past and present industrial operations and waste disposal practices. The six companies that entered into the Consent Agreement included those past or present entities that conducted business within the BMI complex. The Consent Agreement specified that the companies accomplish the following:

- Identify past industrial practices and waste products generated;
- Identify known or suspected waste management units or areas active on or after November 19, 1980;
- Identify known or suspected spills of any pollutant or contaminant;
- Identify all current and prior owners and operators of any part of the Site;
- Collect and summarize records or investigations that identify, document or address soil, surface water, groundwater, or air impacts; and
- Provide documentation of all measures that have been taken to monitor, characterize, mitigate or clean-up Site environmental impacts.

In April 1993, in compliance with the 1991 Consent Agreement, Kerr-McGee submitted the Phase 1 ECA (Kleinfelder, 1993) to the NDEP. The purpose of the report was to identify and document Site-specific environmental impacts resulting from past or present industrial activities. The Phase 1 ECA included a thorough assessment of the geologic and hydrologic setting, as well as historical manufacturing activities. The assessment identified 31 solid waste management units (SWMUs), 20 areas of known or suspected releases or spills and 14 miscellaneous areas where Site activities may have impacted the soil, air, or groundwater.

In response to the NDEP review of the Phase 1 ECA and discussions between the NDEP and Kerr-McGee, the NDEP prepared a Letter of Understanding (LOU) summarizing requirements for additional information and data collection (NDEP 1994). The LOU identified 69 items to be addressed further (see ENSR, 2005). Each of the LOU items was addressed by one or more of the following actions, as requested in the LOU by the NDEP.

1. Kerr-McGee provided additional information to the NDEP in a written response (35 items);
2. Kerr-McGee conducted field sampling and data collection (12 items);
3. Field investigation by the Henderson Industrial Site Steering Committee (2 items); or
4. “No further action required at this time” (20 items).

On October 2, 1996, Kerr-McGee submitted complete responses to the 35 LOU items requiring additional information or explanation (Kerr-McGee, 1996b).

In 1996 and 1997, Kerr-McGee conducted additional data collection as part of a Phase II ECA. The field investigations were conducted in compliance with a NDEP-approved work plan (Kerr-McGee 1996a). The Phase II ECA addressed the 12 LOU items that were identified as needing additional characterization. In August 1997, Kerr-McGee submitted the Phase II ECA (ENSR, 1997) report to the NDEP.

On June 10, 1998, the NDEP issued comments to the Phase II ECA report (NDEP, 1998) which conditionally approved the document subject to selected additional work and development of a Site conceptual model.

On November 9, 1998, Kerr-McGee submitted a response to the NDEP comments to the Phase II ECA report and included with the responses, a Supplemental Phase II ECA Work Plan (Kerr-McGee, 1998) designed to provide the supplemental data required by the NDEP for the Phase II ECA.

On December 17, 1998, the NDEP replied to Kerr-McGee in a letter regarding the Phase II ECA Response to Comments and Supplemental Phase II ECA Work Plan. NDEP correspondence indicated that they conditionally approved Kerr-McGee’s Response to Comments and the Supplemental Work Plan. According to the NDEP, the Work Plan was approved subject to “the development of a CSM for the Site and comparing the soil sample results that were and will be obtained to the Nevada cleanup standards and actual background values”.

In March and April 1999, the NDEP-approved field work for the supplemental Phase II ECA was conducted. In April 2001, Kerr-McGee prepared a report of the findings of the field work and submitted them to the NDEP as the Supplemental Phase II ECA (ENSR, 2001).

In February 2004, the NDEP provided a response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that additional work would be required including identification of all potential contaminants associated with the Site, background sampling, assessment of Site-specific action levels, and identification of data gaps.

March 29, 2005 the Background Investigation Work Plan was submitted by Kerr-McGee and May 6, 2005 the NDEP provided 25 comments on the document. Kerr-McGee met with the NDEP and discussed how they planned to address the comments. Kerr-McGee submitted a letter responding to the comments dated July 20, 2005. In a letter dated July 28, 2005, the NDEP provided additional comments and suggested that they be discussed in a meeting then addressed in the revised work plan. Copies of these correspondence are provided in Appendix A.

1.3 Upgradient Investigation Objectives

The objective of the upgradient investigation is to gather sufficient soil and groundwater chemistry data to provide a more thorough understanding of upgradient conditions at the Site and provide a baseline of chemistry data from which subsequent environmental assessments can be compared.

1.4 Work Plan Organization

The upgradient investigation work plan is organized as follows:

- **Section 1** is the Introduction and presents a brief history of the Site and summarizes the environmental conditions and upgradient investigation objectives at the Site;
- **Section 2** discusses the physical setting of the Site;
- **Section 3** contains a description of the project approach and data quality objectives of this assessment;
- **Section 4** describes the field methods that will be used to perform the Upgradient Investigation;
- **Section 5** describes the procedures by which the laboratory data will be evaluated and a description of the resulting report;
- **Section 6** contains a brief description of the project personnel and their roles and responsibilities for the Upgradient Investigation.
- **Section 7** provides a bibliographic list for each of the references cited in this work plan.

Several appendices are included in this document including the following:

- **Appendix A** contains correspondence between the NDEP and Kerr-McGee;
- **Appendix B** contains the Site-specific Health and Safety Plan (HASP) that has been prepared for the Upgradient Investigation;
- **Appendix C** contains examples of field documentation forms that will be used during the performance of the Upgradient Investigation.

2.0 SITE INFORMATION – PHYSICAL SETTING

2.1 Site Location

The Site is approximately 452 acres in size and is located 13 miles southeast of Las Vegas in an unincorporated section of Clark County, Nevada (Figure 1). It is completely surrounded by the incorporated area comprising the City of Henderson. The Site is in Township 22S, Range 62E and covers portions of Sections 1, 12 and 13. The approximate center of the Site is longitude 36°02’45” W and latitude 115°00’20” N. The upgradient soil and groundwater investigation is focused on gathering information from the southern portion of the Site depicted on Figure 2.

2.2 Topography

Elevations across the Site range from 1,677 to 1,873 feet above mean sea level. The land surface across the Site slopes toward the north at a gradient of approximately 0.023 foot per foot (ft./ft.). The developed portions of the Site have been modified by grading to accommodate building foundations, surface impoundments and access roads.

2.3 Climate

The climate of the Las Vegas Valley is arid, consisting of mild winters and dry hot summers. Average annual precipitation as measured in Las Vegas from 1971 to 2000 was 4.49 inches. Precipitation generally occurs during two periods, December through March and July through September. The winter storms generally produce low intensity rainfall over a large area. The summer storms generally produce a high intensity rainfall over a smaller area for a short duration. These violent summer thunderstorms account for most of the documented floods in the Las Vegas area. Temperatures can rise to 120^{O} F in the summer and average relative humidity is 20 percent. The mean annual evaporation from lake and reservoir surfaces ranges from 60 to 82 inches per year.

Winds frequently blow from the southwest or northwest and are influenced by nearby mountains. Strong winds in excess of 50 miles per hour are experienced occasionally.

2.4 Geology

2.4.1 Regional Geology

The Las Vegas Valley occupies a topographic and structural basin trending northwest-southeast and extending approximately 55 miles from near Indian Springs on the north to Railroad Pass on the south. The valley is bounded by the Las Vegas Range, Sheep Range and Desert Range to the north; by Frenchman and Sunrise Mountains to the east; by the McCullough Range and River Mountains to the south and southeast, and the Spring Mountains to the west. The mountain ranges bounding the east, north and west sides of the valley consist primarily of Paleozoic and Mesozoic sedimentary rocks (limestones, sandstones, siltstones, and fanglomerates), whereas the mountains on the south and southeast consist primarily of Tertiary volcanic rocks (basalts, rhyolites, andesites and related rocks) that lie directly on Precambrian metamorphic and granitic rocks (Bell, 1981).

In the Las Vegas Valley basin-fill consists of Tertiary and Quaternary sedimentary and volcanic rocks and unconsolidated deposits which can be up to 13,000 feet thick (Langenheim et al, 1998). The valley floor consists of fluvial, paludal (swamp) and playa deposits surrounded by more steeply sloping alluvial fan aprons derived from erosion of the surrounding mountains. Generally, the deposits grade finer with increasing distance from the source area and with decreasing elevation. The structure within the Quaternary and Tertiary-age basin-fill is characterized by a series of generally north-south trending fault scarps. The origin of the faults is somewhat controversial; they may be tectonic in origin or may be the response to compaction and subsidence within the basin due to groundwater withdrawal.

A detailed discussion of the geology of the Site and surrounding area is found in the Conceptual Site Model document (ENSR, 2005).

2.4.2 Local Geology

The local geology and hydrology are defined by data collected from the numerous borings and wells that have been installed in the area.

Alluvium. The Site is located on Quaternary age alluvial deposits that slope north toward Las Vegas Wash. The alluvium consists of a reddish brown heterogeneous mixture of well-graded sand and gravel with lesser amounts of silt, clay and caliche. Clasts within the alluvium are primarily composed of volcanic material. Boulders and cobbles are common. Due to their mode of deposition, no distinct beds or units are continuous over the area.

A major feature of the alluvial deposits is the stream-deposited sands and gravels that were laid down within paleochannels that were eroded into the surface of the Muddy Creek formation during infrequent flood runoff periods. These deposits are thickest within the paleochannel boundaries, which are narrow and linear. These sand and gravel deposits exhibit higher permeability than the adjacent, well-graded deposits. In general, these paleochannels trend northeastward.

The thickness of the alluvial deposits ranges from less than a foot to more than 50 feet beneath the Site. Soil types identified in boreholes on-Site include poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand and silty sand. The thickness of the alluvium, as well as the surface of the underlying Muddy Creek formation, was mapped to locate these paleochannels.

Muddy Creek Formation. The Muddy Creek formation of Miocene and Pliocene(?) age occurs in Las Vegas Valley as valley-fill deposits that are coarse grained near mountain fronts and progressively finer grained toward the center of the valley (Plume, 1989).

Where encountered beneath the Site the Muddy Creek formation is composed of at least two thicker units of fine grained sediments of clay and silt (the first and second fine-grained facies, respectively) interbedded with at least two thinner units of coarse-grained sediments of sand, silt and gravel (the first and second coarse-grained facies, respectively). Everywhere beneath the Site, except for the southern 1,000 feet, the first fine-grained facies (MCfg1) separates the first coarse-grained facies (MCcg1) from the overlying Quaternary alluvium. Within the southern 1,000 feet of the Site, the Muddy Creek formation's fine-grained facies pinches out and the coarse-grained facies directly underlies the Quaternary alluvium.

The Muddy Creek formation represents deposition in an alluvial apron environment near the mountain borders grading into fluvial, paludal (swamp), playa and lacustrine environments further out into the valley. On Site the Muddy Creek does not crop out but instead subcrops beneath a veneer of Quaternary alluvium (Figure 3).

In on-Site borings, the contact between the Quaternary alluvium and the Muddy Creek formation is typically marked by the appearance of a well-compacted moderate brown silt to sandy silt or a stiff clay to sandy clay, whereas near the Las Vegas Wash, the contact is marked by gray-green to yellow-green gypsiferous clays and silts.

2.5 Local Hydrogeology

Alluvial Aquifer. The first groundwater encountered beneath the northern half of the Site occurs within the Quaternary-age alluvium and is more than 30 feet below ground surface (bgs) beneath the Site on the south, and is at or near the ground surface at Las Vegas Wash on the north. The flow direction of the potentiometric surface mimics the ground surface and is to the north-northeast with minor variations.

Muddy Creek Aquifer. The first groundwater encountered beneath the southern half of the Site occurs within units of the upper Muddy Creek formation and can be more than 70 feet below ground surface (bgs) as documented in readings obtained from well M-103. The flow direction of the potentiometric surface in the upper Muddy Creek also mimics the ground surface and is to the north-northeast with minor variations. As shown on the two hydrogeologic sections B-B' and C-C' (Figures 4 and 5, respectively) the top of saturation occupies stratigraphically higher facies proceeding northward.

Within the Las Vegas Valley groundwater also occurs within the deeper coarse-grained facies of the Muddy Creek formation. Deep wells drilled into the Muddy Creek formation all exhibit artesian conditions with some wells flowing at the surface. Most shallow wells drilled into the shallow Muddy Creek also demonstrate an upward hydraulic gradient.

3.0 UPGRADIENT INVESTIGATION RATIONALE

3.1 Project Approach

The general scope of work consists of an evaluation of upgradient soil and groundwater conditions at the Site. To assess upgradient soil conditions, six new upgradient soil borings will be drilled near the southern boundary of the Site as shown on Figure 2. The boreholes will be advanced using sonic drilling techniques to obtain a continuous core of subsurface materials. During drilling, soil samples will be collected using a split-spoon sampler at selected intervals for geologic description and laboratory analyses.

To evaluate upgradient groundwater conditions at the Site, monitoring wells will be installed in four of the six soil borings. The four new wells will complement the six existing monitoring wells near the southern boundary of the Site. Data collected from these ten wells will provide a more thorough assessment of upgradient groundwater conditions across the Site.

Once the four new wells are developed, groundwater samples will be collected from the ten upgradient wells for laboratory analyses. Selected soil samples and all groundwater samples will be analyzed for perchlorate, major ions, metals, volatile organic compounds (VOCs) including MTBE, total petroleum hydrocarbon (TPH), and radionuclide constituents.

A report summarizing the results of the fieldwork and analyses will be prepared and submitted to the NDEP.

The soil data will be used to assess upgradient concentrations of the constituents in the alluvium and Muddy Creek formation. The groundwater data will be used to assess upgradient concentrations of the constituents in the upper fine grained facies of the Muddy Creek formation (MCfg1), the upper coarse grained facies of the Muddy Creek Formation (MCcg1) and the lower fine grained facies of the Muddy Creek formation (MCfg2). These data will be compared to available on- and off-Site data.

3.2 Rationale for Proposed Drilling Locations

Historic and current manufacturing activities including product and waste storage have been conducted on the northern portion of the Site. Historically, very little industrial activity has occurred along the southern portion of the Site along an area extending from the southern Site boundary northward, for approximately 1,000 feet. It is within this area that the drilling locations are proposed. Seven existing monitoring wells (M-10, M-103, well cluster TR-9 and TR-10, well cluster TR-7 and TR-8) and H-11 are located in this area.

A summary of the recent groundwater sampling data for wells TR-7, TR-8, TR-9, TR-10, M-10, M-103 and H-11 is included in Table 6. Well M-10 monitors the MCfg1 unit and is located 500 feet south of manufacturing Units 4 and 5. In general, this well exhibits the highest concentrations of the constituents listed on Table 6. The concentration of perchlorate in MW-10 was 21,000 µg/l in May 2005. For this reason, well MW-10 has not been included in the upgradient investigation work plan. Wells TR-8, TR-10, M-103 and H-11 monitor the MCcg1 unit and groundwater from these wells exhibits lower concentrations of the constituents listed than M-10. As shown on Table 6, the concentration of perchlorate in these wells ranged from 47 to 1,000 µg/l for the dates listed. Wells TR-7 and TR-9 monitor the MCfg2 unit. In general, groundwater from these wells exhibit the lowest concentrations for the constituents monitored. Perchlorate concentrations in these wells were 4.4 to 7.6 µg/l in February 2005.

Figure 2 is a map of the southern part of the facility showing topographic features, the location of the pinchout of the first fine-grained facies of the Muddy Creek formation and the location of existing and proposed upgradient soil borings and monitor wells. Six new upgradient boring locations are shown on Figure 2: Boring M-116, Well M-117, Well M-118, Boring M-119, Well M-120 and Well M-121. Table 1 presents a summary of the rationale for the installation of each of the borings and monitoring wells.

Hydrogeologic cross sections A-A', B-B' and C-C' (Figures 3, 4 and 5, respectively), show the third dimensional view of this area. The lithologies beneath the east-west section, A-A', (Figure 3) consist of Quaternary alluvium overlying MCcg1 at a depth of 40 to 45 feet bgs, MCfg2 to a depth of 102 to 107 feet bgs, and MCcg2 at a depth of 121 feet bgs. Four upgradient wells (M-117, M-118, M-120 and M-121) will be sited along this traverse. Two of the wells, M-120 and M-121, will be screened at depths of about 80 to 100 feet bgs within the MCcg1 unit. The other two wells, M-118 and M-117 will be screened at depths of about 130 to 150 feet bgs within the MCfg2. The purpose of these wells is to provide upgradient geochemical conditions along a vertical profile from the ground surface to the MCfg2. In addition these wells will provide upgradient groundwater analytical data from both the MCcg1 and MCfg2.

Figure 4, the eastern north-south hydrogeologic dipping section B-B', shows the pinchout of the first fine-grained facies (MCfg1) which northward separates the alluvium from the first coarse-grained facies (MCcg1). Existing well M-10 is screened in this fine-grained facies and contained 23 milligrams per liter (mg/l) of perchlorate (ClO_4) in February, 2005. As shown in the section, an upgradient soil boring (M-116) is proposed to be located between existing monitoring wells M-103 and M-10. The purpose of this boring is to provide upgradient geochemical soil conditions along a vertical profile from the ground surface to the MCfg1 unit. This boring will also refine the location of the pinch-out of the MCfg1 unit. This boring will not be completed as a monitoring well in this unit because groundwater is not encountered until the underlying MCcg1 unit.

Figure 5, the western north-south hydrogeologic dipping section C-C', also shows a pinch out of the first fine-grained facies (MCfg1) which northward separates the alluvium from the first coarse-grained facies. As in section B-B', the MCfg1 unit is dry so boring

M-119 will not be completed as a monitoring well in this unit. As with boring M-116, the purpose of this boring is to provide upgradient geochemical soil conditions along a vertical profile from the ground surface to the MCfg1 unit. Although it would be advantageous to complete an upgradient monitor well in the MCfg1 unit, it cannot be accomplished because the unit only becomes saturated northward beneath the historic and/or current manufacturing and storage facilities on the Site.

Dip sections B-B' and C-C' show that the top of saturation occupies stratigraphically higher facies proceeding northward.

3.3 Rationale for Proposed Sampling Parameters

Selected soil samples and groundwater samples will be analyzed for perchlorate, major ions, metals, volatile organic compounds (VOCs) including MTBE, total petroleum hydrocarbons (TPH), and radionuclide constituents as shown on Tables 2, 3 and 4.

Perchlorate was selected because it is a Site-related chemical that has been detected on-Site and in the surrounding areas. Perchlorate will be analyzed from the 0.5 and 5 foot soil samples collected from each borehole location. The 10 foot and 30 foot soil samples will be held until the results of the 0.5 and 5 foot samples are received. If perchlorate is detected above the practical quantitation limit in either the 0.5 or 5 foot samples, the 10 foot sample will be analyzed. If perchlorate is present in the 10 foot sample the 30 foot sample will be analyzed. Soil samples below the highest expected water table, or 42 feet bgs, will not be analyzed for perchlorate. Groundwater from all of the upgradient wells will be analyzed for perchlorate.

The general water chemistry and major ions selected for groundwater analysis are calcium, magnesium, arsenic, sodium, potassium, chloride, sulfates, nitrates (as nitrate), alkalinity, bicarbonate, carbonate, pH, TDS and electrical conductivity. These parameters were selected because they are Site-related chemicals and they provide data that characterizes the water chemistry typical of the area. Some of these are metals that are also listed within the metals analysis section below. Groundwater from all of the upgradient wells will be analyzed for these parameters.

The metals selected for soil and groundwater analysis are aluminum, antimony, arsenic, barium, beryllium, boron, calcium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, titanium, tungsten, vanadium, and zinc. These metals were selected because they are Site-related metals and are also naturally occurring metals. Samples from 0.5, 5 and 10 feet will be analyzed for metals. From 10 feet bgs to the bottom of the borings samples will be collected at 10 foot intervals and analyzed for metals to provide a vertical profile of the metal concentrations in soil, alluvium and the Muddy Creek formation. Hexavalent chromium samples will be analyzed from 0.5, 10, 30, 50, 70, 90 and 130 feet bgs depending on the total depth of the boring. Since the City of Henderson background samples did not detect any hexavalent chromium in soil samples, sampling more frequently for this constituent was not considered necessary. The main purpose of sampling for hexavalent chromium is to verify the presence or absence of the constituent and, if it is present, to evaluate the ratio of hexavalent chromium to total chromium.

TPH, VOCs and MTBE were selected because there was a gasoline station located to the south of the Site across Lake Mead Drive. These constituents are not naturally occurring in the area, however, the upgradient characterization will include them to determine if they are present or potentially migrating towards the Site from the south. The suite of VOCs that will be included in the analysis is shown on Tables 3 and 5. The TPH analysis will include the full carbon range. Fuel oxygenates and alcohols will be included in response to a request from the NDEP.

Radionuclides were selected to identify levels of activity in this portion of the Site. The elements selected for analysis are lead-210, lead-212, isotopic uranium, total uranium, radium-226, radium-228, and isotopic thorium. The broader suite of radionuclides sampled in the City of Henderson’s background study were also reviewed and, at this time, additional radionuclide analysis is not planned for the upgradient study.

4.0 FIELD SAMPLING PLAN

The following sections describe the sampling strategy, investigative methods and procedures, sample analysis program, sample handling, decontamination procedures, and management of investigation-derived wastes (IDW).

4.1 Pre-Field Activities

The following activities will be performed prior to the start of field activities:

The proposed drilling locations will be marked and three-days before the start of drilling activities Underground Services Alert (USA) (1-800-642-2444) will be notified of the intent to drill. USA will contact the utility owners of record within the Site vicinity and notify them of our intention to conduct a subsurface assessment in proximity to buried utilities. All utility owners of record, or their designated agents, will be expected to clearly mark the position of their utilities on the ground surface throughout the area designated for this assessment.

If necessary (and only after consultation with on-Site Kerr-McGee staff and after reviewing as-built plans of underground utilities), an underground utility locating service will be contracted to mark underground utilities that may be near the proposed boring locations.

Because monitoring wells will be installed, the drilling contractor will file a Notice of Intent (NOI) to install monitoring wells (along with the Affidavit of Intent to Abandon Monitoring Wells) as required by the Nevada Department of Water Resources under Nevada Administrative Code (NAC) 534.320.

4.2 Field Activities

Six soil borings will be drilled and soil samples will be collected at regular intervals for laboratory analyses. Monitoring wells will be installed in four of the six borings (the remaining two borings will be abandoned); the new monitoring wells will be developed and groundwater samples collected for laboratory analyses. A description of the field activities is presented below.

4.2.1 Soil Borings

Six soil borings M-116, M-117, M-118, M-119, M-120 and M-121 will be drilled near the southern boundary of the Site at the locations shown on Figure 2. The soil borings will be drilled using sonic drilling technology from which continuous cores can be obtained for lithologic examination and logging purposes.

Borings M-116 and M-119 are being installed to develop analytical data for the alluvium and to identify the southern extent of the MCfg1 unit. These borings will be drilled through the Quaternary Alluvium until the MCfg1 is encountered – a depth estimated to be about 50 feet. The boreholes will be backfilled upon completion and the surface restored to match the surrounding grade.

Borings M-117 and M-118 are being drilled to develop analytical data for the alluvium, MCcg1 and MCfg2 units. They will be drilled through the Quaternary Alluvium (Qal) and the underlying the MCcg1 until the MCfg2 is encountered – a depth estimated to be about 130 to 150 feet. These borings will be converted into monitoring wells and will be used to sample groundwater from the MCfg2 unit.

Borings M-120 and M-121 are being drilled to develop analytical data for the alluvium and MCcg1 units. They will be drilled through the Quaternary Alluvium (Qal) and into the underlying the MCcg1 – a depth estimated to be about 80 to 100 feet. These borings will be converted into monitoring wells and will be used to sample groundwater from the MCcg1 unit

During drilling operations, organic vapors will be monitored with a Photovac™ microtip-photo-ionization detector (PID). The boring logs will record the following sampling information: boring number and location; sample identification numbers; date and time; sample depth; lithologic description in accordance with the Unified Soils Classification System (USCS); description of any visible evidence of soil contamination (i.e., odor, staining); and organic vapor monitor readings. An example of a boring log form is included in Appendix C.

The following section describes the soil sampling methodology that will be used at the Site.

4.2.2 Soil Sampling

When the target sample depth is reached, a modified split-spoon sampler mounted to a steel pipe will be inserted through the center of the hollow sonic drill pipe and the split-spoon sampler will be driven 18-inches into the soil below the sonic drill bit in order to obtain samples of undisturbed soil for laboratory analyses. The sampler will be driven into the soil by the repeated percussive action of a 130-lb. hammer falling approximately 30-inches onto the steel rod/split-spoon assembly. The split-spoon sampler will be fitted with three 6-inch-long brass or stainless steel liners (sleeves). As the split-spoon is advanced downward, soil is driven into the sleeves.

As soon as the split-spoon sampler is removed from the borehole and disassembled, the sleeve corresponding to the target sample depth will be chosen for analysis by an off-Site laboratory. Teflon™ sheets will be placed on both ends of the sleeve; the sleeve will then be capped, labeled, and placed on ice inside an ice chest for delivery to the laboratory (under chain-of-custody protocol). As an alternative, soil samples designated for analyses for non-volatile constituents may be placed in a laboratory-supplied glass jar and sent to the laboratory. An example of a chain-of-custody form is included in Appendix C.

Soil samples designated for VOC and TPH-gasoline (i.e., C_4–C_{12}) analysis will be taken from the chosen sleeve and preserved in the field using both sodium bisulfate and methanol preservatives, as prescribed under EPA Method 5035. A new, disposable syringe (T-handle) will be used to collect a roughly 5-gram aliquot directly from the sample sleeve. The sample will be placed into 40-milliliter glass vials containing pre-weighed amounts of liquid sodium bisulfate or methanol. Two vials of sodium bisulfate-preserved soil and one vial of methanol-preserved soil will be collected at each sample depth for TPH-g or VOC analyses.

If a soil sample is designated for both TPH and VOC analyses, then one set of vials (two vials with sodium bisulfate, one vial with methanol) will be collected for TPH analyses and a second set of vials will be filled for VOC analyses. The label on the filled vials will be filled out, and the vials placed in Ziploc™ plastic bags, and placed on ice in a cooler along with the rest of the samples pending delivery to the analytical laboratory. The pre-filled VOA vials containing the sodium bisulfate and methanol preservatives will be provided by the analytical laboratory. A new T-handle syringe will be used to obtain 5 mg aliquots of soil at each sample depth and then discarded to the trash.

The remaining unused portion of the soil core will be used for lithologic description and screening for VOCs with a PID. For headspace analysis by the PID, approximately 200 grams of soil will be removed from the sampling tube and placed in a zip lock plastic bag. Care will be taken to select soil from the middle portion of the sampling tube. Once sealed in the bag the soil will broken apart and allowed to equilibrate for about 20 minutes. The probe tip of the PID will be inserted into the plastic bag and a reading obtained. These organic vapor readings will be recorded on boring logs prepared by the field geologist during drilling activities. The PID will be calibrated to 100 ppm isobutylene each day prior to its use.

4.2.3 Soil Sample Handling

Soil samples for laboratory analyses will be placed on ice in an ice chest for shipping to the laboratory. The soil samples will be logged on a Chain-of-Custody form and the samples will be shipped to the laboratory at the end of each day of sampling. Analytical methods, types of containers, and holding times are discussed in Section 4.5.1 – Soil Testing Analytical Program.

4.2.4 Borehole Abandonment

Two boreholes (M-116 and M-119) will be abandoned once the target depth has been reached and the necessary soil samples obtained. The boreholes will be abandoned by backfilling each borehole with a bentonite/neat cement grout that will be placed into the borehole with a tremie pipe. The bentonite/neat cement grout will be placed from the bottom of the borehole to within five feet of the ground surface. A surface plug consisting of neat cement, cement grout, or concrete grout will be placed from a depth of five feet to the ground surface.

4.2.5 Monitoring Well Installation and Well Development

Four soil borings (M-117, M-118, M120 and M-121) will be completed into upgradient groundwater monitor wells. The wells will be constructed following the requirements of the Nevada monitor well completion statutes.

Each monitoring well will be constructed of 2-inch diameter Schedule 40 PVC blank casing and screen (0.020-inch slot size). The filter pack will consist of Lonestar # 3 sand or an appropriate size similar to the formation material across from the screened interval of the saturated zone. The screened interval will be 20 feet long, pending Site-specific conditions. The screen length and depth placement will be selected by the field geologist, pending the lithologic interpretation of the soil core.

In general, the sand pack, bentonite seal, and sanitary (grout) seal will be placed into the annular space using a tremie pipe. The top of the sand pack will extend approximately one to two feet above the top of the well screen. Following emplacement of the sand pack, a three to five-foot-thick layer of bentonite pellets will be placed on top of the sand pack. The pellets will by hydrated with potable water. A sanitary seal will be formed by placing bentonite-cement grout on top of the bentonite seal; the sanitary seal will extend upwards to within three to five feet of the ground surface.

A steel protective casing will be cemented in-place around the well. The well casing and steel protective casing will extend at least one foot above the ground surface. A cement pad will be placed on the ground surface, around the steel protective casing. An example of a monitoring well construction detail log form is included in Appendix C.

Once installation has been completed, M-117, M-118, M-120 and M-121 will be used along with the five on-Site monitoring wells (TR-7, TR-8, TR-9, TR-10, and M-103) to characterize and monitor the groundwater present in the southern portion of the Site. Monitoring well H-11 is a well located on the adjacent Pioneer Chemical facility, near the southwestern corner of the Kerr-McGee facility and is also considered to be an upgradient well. For the purposes of the Upgradient Investigation, groundwater samples will also be collected from H-11 for laboratory analyses. Table 1 lists the rational for selecting these wells. Although groundwater within some of these wells is impacted, the data collected from sampling them will provide valuable information regarding chemistry and gradient of groundwater present in the southern portion of the Site.

Each monitoring well will be developed to remove sediments from the well and to improve the hydraulic communication between the well and the aquifer formation. A minimum 24 hours after the wells have been installed they will be developed by surging with a surge-block composed of inert materials such as rubber. After surging, each monitoring well will be purged using a bailer or using an electric submersible pump during which water quality parameters (e.g., specific conductivity, pH, turbidity, and temperature) will be monitored. Monitoring well development will proceed until the water quality parameters have stabilized (to within 10 percent variance). An example of a well development record form is included in Appendix C. The water generated from well development activities will be placed into U.S. Department of Transportation (DOT)-approved 55-gallon drums and temporarily stored in a secure area on the Site. The water generated from well development activities will be placed in the GW-11 pond and treated on-Site. Materials and or equipment that comes in contact with soil or groundwater will be decontaminated before use, between each well and after the sampling event is complete.

4.2.6 Groundwater Sampling

Wells TR-9, TR-10, and M-103 will be purged of three to five well volumes and sampled using bailers. Sampling methods used will be similar to the historic methods used to sample on and off-Site wells. Following the sampling event, dedicated micropurge pumps will be installed in the four new wells, M-117, M-118, M-120 and M-121, and five existing wells TR-7, TR-8, TR-9, TR-10 and M-103. These nine wells will be sampled for the same suite of constituents using micropurge methods. The groundwater analytical data collected by the micropurge pumps and bailers from the same wells will be reviewed to determine the comparability of analytical results derived from the different sampling methods. The sampling procedures are described below.

4.2.6.1 Groundwater Elevation Measurement

Water levels will be measured with an electric sounder prior to sampling the well. The well sounder will be equipped with an indicator light, audible buzzer or other mechanism to indicate when the water table has been contacted. The electric sounder will be decontaminated by rinsing with de-ionized water after each use. The typical procedure for obtaining depth to water is to check the sounder for audible or light activation by pressing the test button. The sounder is then carefully lowered into the well until it contacts the surface of the water and the buzzer sounds. The sampler than raises the sounder and lowers it again to verify the depth to water as measured at the marked measuring point on the well casing. When two consecutive readings are the same the sampler records the depth to water on the sampling and purging form.

Depth to water is recorded from the top of the casing reference point to the nearest 0.01 foot on the well sampling field form. The casing reference point is marked by a small notch in the top of the casing. The groundwater elevation at each monitoring well is calculated by subtracting the measured depth to water from the surveyed elevation of the top of the well casing. Total well depths for those wells scheduled for sampling are measured by lowering the sensor to the bottom of the well. Total well depth, used to calculate purge volumes and to determine whether the well screen is partially obstructed by sediment, is recorded to the nearest 0.5 foot on the sampling and purging form.

4.2.6.2 Monitoring Well Purging

Each well will be purged by one of two methods: 1) low-flow purging using bladder pump, or 2) by electric submersible pump (or bailer) based on well volume calculations (i.e., removing three to five well volumes).

When low-flow purging is performed, the bladder pump will be placed approximately mid way along the screened interval. The water intake will be at least two feet from the top and one foot from the bottom of the screen. Dedicated pumps will be installed in each well. The pump will be lowered slowly into the well to minimize disturbance of the formation and the water level will be allowed to equilibrate prior to purging and sampling. The water will be evacuated at 100 to 500 ml per minute. The water level will be monitored either on a continuous or periodic basis and should not vary more than 4 inches. The water quality parameters will be monitored using a periodic or continuous meter. The flow-through cell is preferred although a standard meter is also acceptable. Stabilization of water quality parameters is indicated when the following criteria are met in the final three consecutive readings: the pH is within 0.1 unit, temperature is within 1 degree Celsius and the following parameters are within 5 percent: electric conductivity, turbidity, and dissolved oxygen (Figure 4). If field parameters do not stabilize within 30 minutes, the deviation will be noted on the field sampling field sheet and a sample will be collected. An example of a low-flow groundwater sample collection record field form is included in Appendix C.

For the wells that are purged based on well volume calculations, the standing water in the casing and sand pack will be purged from the well using an electric submersible pump. The amount of water purged will be from three to five casing volumes so that stagnant groundwater is removed from the well and that water representative of the aquifer is obtained for analysis. If field parameters do not stabilize, one additional well volume will be purged, the deviation will be noted on the field sampling field sheet and a sample will be collected.

Some wells may be pumped dry before the removal of three casing volumes. If this occurs, the wells will be allowed to recharge sufficiently prior to sampling. For parameters sensitive to volatilization, samples will be collected as soon as the wells have recharged to a level sufficient for sample collection. For the remaining parameters, samples will be collected within 24 hours of evacuation to dryness. If a well has not recharged within the 24-hour period, it will be recorded as dry, and not sampled during the event.

When evacuating wells screened in high yield formations (wells capable of yielding three or more casing volumes) precautions will be taken so that recharge water is not cascading down the wells. To prevent cascading, the pumps installed for purging those wells will be placed above the screened interval of the well. During purging, water will be drawn into the well and move upward through the screen eliminating the possibility of cascading. For wells that are not monitoring confined aquifers, a vent hole will be present so water levels are equilibrated with atmospheric pressure.

Groundwater parameter field measurements obtained during sampling will be recorded on a Groundwater Sample Collection Record field log form, an example of which is included in Appendix C. Field data sheets will be reviewed for accuracy and completeness by the sampling coordinator after the sampling event is completed. Copies of the field sheets will be included in the monitoring report.

The pH, electric conductivity, turbidity, DO and temperature meters or flow through cells will be calibrated each day before beginning field activities. The calibration will be checked once each day to verify meter performance. The field meter calibrations will be recorded on an Instrument Calibration sheet. Copies of the calibration sheets will be included in the monitoring report.

4.2.6.3 Collection of Groundwater Samples

Upon completion of well purging, a representative groundwater sample will be withdrawn from the well. Samples will be placed in containers in the order of decreasing volatilization sensitivity. Thus, the individual containers for analyses will be filled in the following order:

1. VOCs/MTBE
2. TPH-light fraction (C_4-C_{12});
3. TPH-heavy fraction (C_{13+})
4. Metals (including Hexavalent Chromium)
5. Perchlorate
6. General Water Chemistry/Anions/Ions
7. pH
8. Radionuclides

If well purging is performed using low-flow bladder pump, then the bladder pump may be used to dispense the water samples into the appropriate sample container as long as static water level is maintained for the duration of bottle-filling activities.

Otherwise, groundwater samples can be collected using a bailer. In this procedure, a bailer would be lowered into the well to a depth that is equivalent to the mid-point, or lower, within the well screen. The bailer will be removed from the well and discharge directly into sample containers. When taking samples for VOCs or TPH-gasoline analyses, containers will be filled to produce a positive meniscus over the lip of the container. Upon capping, the VOC sample bottles will be inverted and tapped to check for bubbles. If bubbles are observed, a new sample will be obtained.

4.2.6.4 Groundwater Sample Containers and Preservatives

Sample containers required for the specified analyses will generally be provided by the laboratory immediately prior to the sampling event. The containers will be pre-cleaned and will not be rinsed prior to sample collection. Preservatives, if required, will have been added to the containers by the laboratory prior to shipment of the sample containers to the sample collector.

Analytical methods, number of samples, types of containers, preservative, and holding times are summarized in Section 4.5.2 - Groundwater Analytical Testing Program.

4.2.6.5 Sample Packaging and Shipment

To identify and manage samples obtained in the field, a sample label will be affixed to each sample container. The sample labels will include the following information:

- Project number
- Site name
- Boring number
- Sample identification number
- Sampler's initials
- Date and time of collection
- Preservative

Following collection and labeling, samples will be immediately placed in a sample cooler for temporary storage. The following protocol will be followed for sample packaging:

- Sample containers will be placed in clear, plastic, leak-resistant bags prior to placement in the ice chest. Screw caps will be checked for tightness prior to placing the sample in the bag.

- Samples to be shipped will be placed in the cooler and packed with packaging materials to minimize the potential for disturbance and/or breakage of the sample containers.

- Ice or "Blue Ice" packs will be placed in leak-resistant plastic bags and included in the coolers to keep samples at a chilled temperature during storage and transport to the analytical laboratory. When ice is used, the drain plug of the cooler will be secured with fiberglass tape to prevent melting ice from leaking out of the cooler.

- The COC form will be placed in a water-resistant plastic bag and taped on the inside of the lid of the cooler.

A temperature blank consisting of a 40-milliliter glass vial of distilled water will be included in each cooler sent to the analytical laboratory. The purpose of the temperature blank is to allow the analytical laboratory to obtain a representative measurement of the temperature of samples enclosed in a cooler without disturbing the actual samples. The field team will package and label the temperature blank like a regular water sample; however, the analytical laboratory will only measure the temperature of the blank.

Every effort will be made to transport the samples to the analytical laboratory at the end of each sampling day. However, if sampling runs late and the laboratory is closed, samples will be stored overnight in a secured location under appropriate COC procedures, and the samples will be shipped to the laboratory the next day. Prior to overnight storage, the cooler(s) will be restocked with new ice or blue ice to maintain the samples in a chilled state. The temperature blank inside each cooler will be checked by the sample collector at the beginning of the evening and in the morning and the temperature readings will be recorded in the field logbook.

4.3 Field Documentation

4.3.1 Field Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. Logbooks will be bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in black ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions or other terminology that might prove inappropriate. If an error is made, corrections will be made by crossing a line through the error and entering the correct information. Corrections will be dated and initialed. No entries will be obliterated or rendered unreadable.

Entries in the field logbook will include at a minimum the following for each sample date:

- Site name and address
- Recorder's name
- Team members and their responsibilities
- Time of Site arrival/entry on-Site and time of Site departure
- Other personnel on-Site
- A summary of any on-Site meetings
- Deviations from sampling plans and Site safety plans
- Changes in personnel and responsibilities as well as reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number.

At a minimum, the following information will be recorded during the collection of each sample:

- Sample identification number
- Sample location and description
- Site sketch showing sample location and measured distances
- Sampler’s name(s)
- Date and time of sample collection
- Designation of sample as composite or grab
- Type of sample (i.e., matrix)
- Type of preservation
- Type of sampling equipment used
- Field observations and details important to analysis or integrity of samples (e.g., heavy rains, odors, colors, etc.)
- Instrument readings (e.g., PID, etc.)
- COC form numbers and COC seal numbers
- Transport arrangements (courier delivery, lab pickup, etc.)
- Recipient laboratory(ies).

4.3.2 Boring Logs

A lithologic description of the materials encountered and collected will be maintained on boring logs compiled by the field geologist. Soils will be classified in accordance with the USCS, and descriptions will include soil type, particle size and distribution, color, moisture content, and evidence of contamination (discoloration, unusual odors, etc.). The soil samples will be screened in the field for the presence of elevated organic vapor concentrations using a PID, and the measurements will be recorded on the boring log.

4.3.3 Chain-of-Custody Records

Chain-of-Custody (COC) records are used to document collection and shipment of samples to the laboratory for analyses. All sample shipments for analyses will be accompanied by a COC record. Form(s) will be completed and sent with the samples for each laboratory and each shipment. If multiple coolers are sent to a single laboratory on a single day, COC form(s) will be completed and sent with the samples for each cooler. The COC record will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone’s custody if it is either in someone’s physical possession, in someone’s view, locked up, or kept in a secured area that is restricted to authorized personnel. Until receipt by the laboratory, the custody of the samples will be the responsibility of the sample collector. An example of a COC form is provided in Appendix C.

The shipping containers in which samples are stored (usually sturdy picnic cooler or ice chest) will also be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

4.4 Analytical Testing Program

4.4.1 Soil Analytical Testing Program

The proposed soil analytical plan is shown in Table 2. Sample containers, analytical methods, and holding times for the various analytes that the soil samples will be tested for are shown on Table 3. Appendix D contains the method detection limits (MDLs), reporting limits (RLs) and quality control (QC) limits provided by EMAX laboratories. It should be noted that achieving these limits is dependant on the sample matrix and the concentrations of other constituents that may be present. EMAX is a Nevada Certified laboratory that will be performing most of the soil analysis. For the other analytical methods, MDLs and RLs can be provided once they are received from the laboratories selected to perform them.

4.4.2 Groundwater Analytical Testing Program

For the Upgradient Investigation, groundwater samples will be collected from a total of ten monitoring wells. Nine wells are on the Kerr-McGee facility (TR-7, TR-8, TR-9, TR-10, M-103, M-117, M-118, M-120, and M-121) and the tenth well (H-11) is located just outside the southwest corner of the Kerr-McGee property boundary. The groundwater analytical program is summarized on Table 4. Sample containers, analytical methods, and holding times for the various analytes that the groundwater samples will be tested for are shown on Table 5. Appendix D contains the MDLs, RLs and QC limits provided by EMAX laboratories. It should be noted that achieving these limits is dependant on the sample matrix and the concentrations of other constituents that may be present. EMAX is a Nevada Certified laboratory that will be performing most of the groundwater analysis. For the other analytical methods, MDLs and RLs can be provided once they are received from the laboratories selected to perform them.

4.5 Equipment Decontamination

Drilling equipment will be decontaminated prior to the beginning of each boring by steam cleaning in a designated area on-Site. All non-disposable soil sampling equipment (e.g., split-spoon samplers, etc.) will be disassembled and decontaminated prior to the collection of each sample. This equipment may be decontaminated by either steam cleaning or by washing with a non-phosphate detergent solution (Alconox or similar) followed by rinsing with distilled/deionized water. Decontamination fluids will be temporarily stored on-Site in Department of Transportation (DOT)-approved 55-gallon steel drums pending results of the soil analyses.

If non-dedicated groundwater sampling equipment is used to collect groundwater samples, the equipment will be decontaminated by circulating a solution of water and detergent (e.g., Alconox) through the equipment followed by rinsing with distilled water.

4.6 Management of Investigation-Derived Wastes

Soil cuttings (including unused cores), and other solid or liquid wastes (decontamination fluids, development water and purged groundwater) will be temporarily stored in DOT-approved 55-gallon drums or roll-off boxes, as appropriate. Each container will be marked with water-proof labels and water-proof markers. Each container will receive a unique identification number and will be cataloged for waste containment documentation purposes. The IDW will be disposed of in an appropriate manner based on the results of the chemical analyses. It is anticipated that groundwater and decontamination liquids will be placed in GW-11 and treated on-Site.

4.7 Surveying

Soil borings M-116 and M-119 along with the new monitoring wells M-117, M-118, M-120 and M-121 will be surveyed to an accuracy of 0.01-foot vertical and 0.1-foot horizontal relative to USGS elevation and Nevada Coordinate System datums.

4.8 Quality Assurance/Quality Control Program

An integral part of the Upgradient Investigation sampling and analysis plan is the quality assurance/quality control (QA/QC) program to ensure the reliability and compatibility of all data generated during this assessment. The following section describes the QA/QC program that will be implemented as part of the Upgradient Investigation at the Site.

4.8.1 Field QA/QC Samples

Field QA/QC procedures will be followed to ensure viability and integrity of sample analytical data. The field investigative team will be responsible for submitting QA/QC samples to the laboratory. QA/QC samples include field duplicates, trip blanks, equipment decontamination blanks and field blanks.

4.8.1.1 Duplicate Samples

One field duplicate will be taken for every 10 samples submitted for analysis. For duplicate groundwater samples, two sets of sample containers will be filled and both submitted for analysis.

4.8.1.2 Trip Blanks

Trip blanks are provided by the laboratory. One pair of VOA trip blanks will be included in each cooler. One trip blank per day will be analyzed for the VOCs scheduled for analysis. The trip blanks for water samples will consist of laboratory reagent water shipped to and from the sample Site in the same type of sample containers and with the same preservative as the collected samples. Trip blanks will not be opened or exposed to the atmosphere in the field.

4.8.1.3 Equipment Decontamination Blanks

Equipment decontamination blanks will consist of reagent water rinsed through sampling devices. This will include the soil sampling equipment and groundwater sampling equipment used in the investigation. A minimum of one equipment blank per day of sampling will be collected and analyzed for the same set of parameters as the samples collected that day (except for analyses such as general water chemistry, anions, cations, pH, EC, of which an equipment blank will not be collected). If a non-dedicated groundwater pump is used, a pump decontamination blank will be obtained for each pump used before and after use for the groundwater sampling event.

4.8.1.4 Field Blanks

Field blanks consist of the source water used in the decontamination of sampling equipment. At a minimum, one field blank from each event or work period will be collected and analyzed for the same set of parameters as samples collected during the event.

All of the above mentioned QA samples will be sent to the laboratory as blind samples with sample numbers sequenced in with actual Site samples.

4.8.2 Laboratory QA/QC Procedures

Laboratory QC measures will be taken to confirm the integrity of the laboratory data generated during the upgradient investigation program. The procedures used to assess laboratory data quality are described in this section.

Method blanks will be analyzed daily to assess the effect of the laboratory environment on the analytical results. Method blanks will be performed for each parameter analyzed.

Each sample to be analyzed for organic parameters will contain surrogate spike compounds. The surrogate recoveries will be used to determine if the analytical instruments are operating within limits. Surrogate recoveries will be compared to control limits established and updated by the laboratory based on its historical operation.

Matrix spikes will be analyzed at a frequency of approximately 10 percent of the project samples submitted. Matrix spike results will be evaluated to determine whether the sample matrix is interfering with the laboratory analysis and provide a measure of the accuracy of the analytical data. Matrix spike recoveries will be compared to control limits established and updated by the laboratory based on its historical operation.

Laboratory duplicates will be analyzed at a frequency of approximately 10 percent. Spike duplicate results will be evaluated to determine the reproducibility (precision) of the analytical method. Reproducibility values will be compared to control limits established and updated by the laboratory based on its historical operation.

Laboratory QC data will be included with the analytical results. This QC data will include method blanks, surrogate spike recoveries (for organic parameters only), matrix spike recoveries, and matrix spike duplicates.

Prior to submitting analytical results to Kerr-McGee/ENSR, the supervising chemist will check the entire data package so that the data is acceptable. These checks include:

- Project requirements for precision, accuracy and detection limits
- Analytical procedure blanks, duplicates, matrix spike recoveries, and EPA QC results
- Instrument standardization and response factors

If the data is acceptable, a written report is generated and reviewed by the senior chemist before submission to Kerr-McGee/ENSR.

4.8.3 Quality Assurance Program

Specific quality assurance objectives for measurement are defined by precision, accuracy, representativeness, reproducibility and completeness.

Specific requirements for data accuracy, precision, and completeness are based on standard laboratory and data validation methods. Definitions of accuracy, precision, and completeness as they pertain to analytical data and standard methods used to assess accuracy, precision, and completeness are given below.

4.8.3.1 Definitions

Accuracy. The degree of agreement of a measured value with the true or expected value of the quantity of concern. Accuracy measures the bias in a measurement system.

Precision. The degree of mutual agreement characteristic of independent measurements as the result of repeated application of the process under specified conditions. It is concerned with the "closeness of results", i.e., the reproducibility of measurements under a given set of conditions.

Completeness. The percentage of measurements made which are judged to be valid measurements. The completeness goal is the same for all data uses that a sufficient amount of valid data be generated to accomplish the objectives of the study.

Standard methods of evaluation will be used to assess accuracy and precision data. Completeness can be quantitatively assessed simply by calculation of the percentage of valid data obtained. Specific methods of assessing accuracy and precision will be as follows:

Accuracy will be evaluated using percent recovery data. Percent recovery is defined as:

$$\% \text{ Recovery} = (R\ S) \text{ X } 100$$

where:
S = spiked concentration
R = reported concentration

Percent recovery limits are analyte-specific.

Precision will be evaluated using duplicate samples and expressed as relative percent difference (%RPD) or relative standard deviation (%RSD). These quantities are defined as follows:

$$\%RPD = (A_1 – A_2)/(A_1 + A_2)/2 \text{ X}100$$

where A_1 and A_2 are the reported concentrations for each duplicate sample.

4.8.3.2 Requirements

Specific data accuracy and precision goals for laboratory analyses that are necessary to fulfill the intended use of the data are described below. The goals listed are based on EPA data, laboratory-specific data, or both. Historical data on which to set specific completeness requirements for individual methods are not yet available (EPA, 1987).

4.8.4 Comparison of Data Sets

Representativeness is defined by the U.S. EPA as the degree to which sample data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is mostly concerned with the proper design of the sampling program (i.e., that the number and locations of samples are sufficient for the purposes of the investigation). Measures can be taken to achieve a high degree of representativeness. Such measures will include but are not necessarily limited to the following:

- Obtaining samples over a range of environmental conditions. In the case of groundwater sampling, this would include (a) the systematic collection of samples over time to account for temporal variations and (b) an adequate number of, and appropriately located sampling locations to account for spatial variations.
- Use of previously collected Site-specific data to guide the selection of appropriate sampling locations and chemical parameters.
- Use of appropriate sample collection procedures.

Details of the sampling program design and sample collection procedures are presented in Section 4.3.

5.0 DATA EVALUATION AND REPORTING

5.1 Data Review

Data will be evaluated to verify that soil, groundwater and QA/QC samples were collected in compliance with the specifications contained in the work plan. The laboratory certified analytical reports will be reviewed to determine if samples were analyzed within holding times and that laboratory QA/QC samples, such as matrix spikes and matrix spike duplicates were within the laboratory specific acceptable ranges. Deviations, if any, will be identified. Ten percent of the laboratory packages will be undergo full level IV data validation review. As appropriate, the following statistical tests may be applied to the data: Gehan Modification of the Wilcoxon Rank Sum Test; Quantile Test; Slippage Test; and side by side plots.

5.2 Reporting of Results

A report will be prepared that presents the results of the upgradient soil and groundwater sampling. The report will include a description of the field methods employed, analytical methods, analytical results, data evaluation methods, and a scale map containing the locations of the soil borings and monitoring wells installed. Typed boring logs and well completion diagrams will be included in the report. The results of laboratory analysis will be presented on tables. The laboratory certified analytical reports will be provided in Adobe Acrobat (.pdf) electronic form on a CD in an appendix. A Nevada Certified Environmental Professional will sign the report.

6.0 PROJECT MANAGMENT PLAN

The overall organization of the project includes the following individuals and agencies.

This work is being conducted as part of the Environmental Conditions Assessment under agreements with the Nevada Division of Environmental Protection. The NDEP project manager is Mr. Brian Rakvica.

The Kerr-McGee project manager is Susan Crowley. Ms. Crowley is a Nevada Certified Environmental Manager and is the person who serves as the point of contact for regulatory and environmental issues pertinent to the Site. She is located at the Kerr-McGee Henderson Facility. Her telephone number is (702) 651-2234. Ms. Crowley manages the subcontractors that will be performing the tasks described in this work plan.

ENSR International is Kerr-McGee's environmental consultant. Mr. David Gerry, Senior Program Manager, Sally Bilodeau, Senior Geologist, Edward Krish, Field Manager, Brian Ho, Quality Assurance Officer, and Reina Foxx, Staff Geologist will be assisting with this project. Ms. Elizabeth Martinez and Mr. Arrie Bachrach will be responsible for quality assurance and quality control of documents.

MWH Laboratories (MWH) is the laboratory contractor selected by Kerr-McGee for this project. MWH is certified with the State of Nevada as an environmental testing laboratory. Andrew Eaton, Ph.D., is the point of contact at MWH. Laboratory data will be provided to Kerr-McGee in hard copy format as well as electronic data deliverable (EDD) format. The laboratory will provide sample receipt notification following samples receipt at the laboratory.

The implementation of the work plan is the shared responsibility of the ENSR Senior Program Manager, the Field Manager, the Quality Assurance Officer, the field and office personnel, and the contractor personnel. The Senior Program Manager's responsibilities include:

- Providing the field personnel with a copy of the work plan;
- Notifying the laboratory regarding Site specific data quality requirements;
- Checking Chain of Custody and field logs to verify sample collection; and
- Taking corrective action if necessary.

The responsibilities of the Quality Assurance Officer and Senior Geologist include:

- Reviewing the field and laboratory data to determine if the data quality objectives were met;
- Preparing a summary of quality assurance/quality control (QA/QC) data; and
- Conducting audits and implementing corrective action as necessary.

The responsibilities of the Field Manager include:

- Noting work plan progress and corrective actions taken on daily field logs.
- Collecting and compiling the daily field logs from field personnel and providing them to the Senior Program Manager within two days.
- Keeping the Kerr-McGee Project Manager advised of project status daily.

The responsibilities of the office and field personnel include:

- Reviewing and implementing the work plan and quality assurance quality control plan;
- Field calibration of measurement and test equipment, as needed;
- Maintaining required documentation of activities;
- Collection, labeling, handling, storage, shipping and filling out Chain of Custody forms for environmental samples collected;
- Maintaining control of samples until they are appropriately released; and
- Notifying the PM if there are deviations from or problems implementing the work plan or quality assurance procedures.

The responsibilities of the QA/QC of Documents team include:

- Review of reports for formatting, spelling, editorial and references.

The responsibilities of the laboratory subcontractor include:

- Provide appropriate sample containers, preservatives and coolers to the Site;
- Advise the PM of delays experienced in analyzing the samples;
- Advise the PM upon receipt of samples if there are questions regarding the analysis requested or if there are quality or sample integrity issues that need to be addressed;
- Perform the requested analyses under SW-846 and/or state approved protocol;
- Conduct the required instrument calibration and QA/QC protocols specified in the laboratories internal quality assurance plans.

The responsibilities of the drilling subcontractor include:

- Provide appropriate drilling equipment and trained personnel as specified in the subcontract agreements.

7.0 REFERENCES

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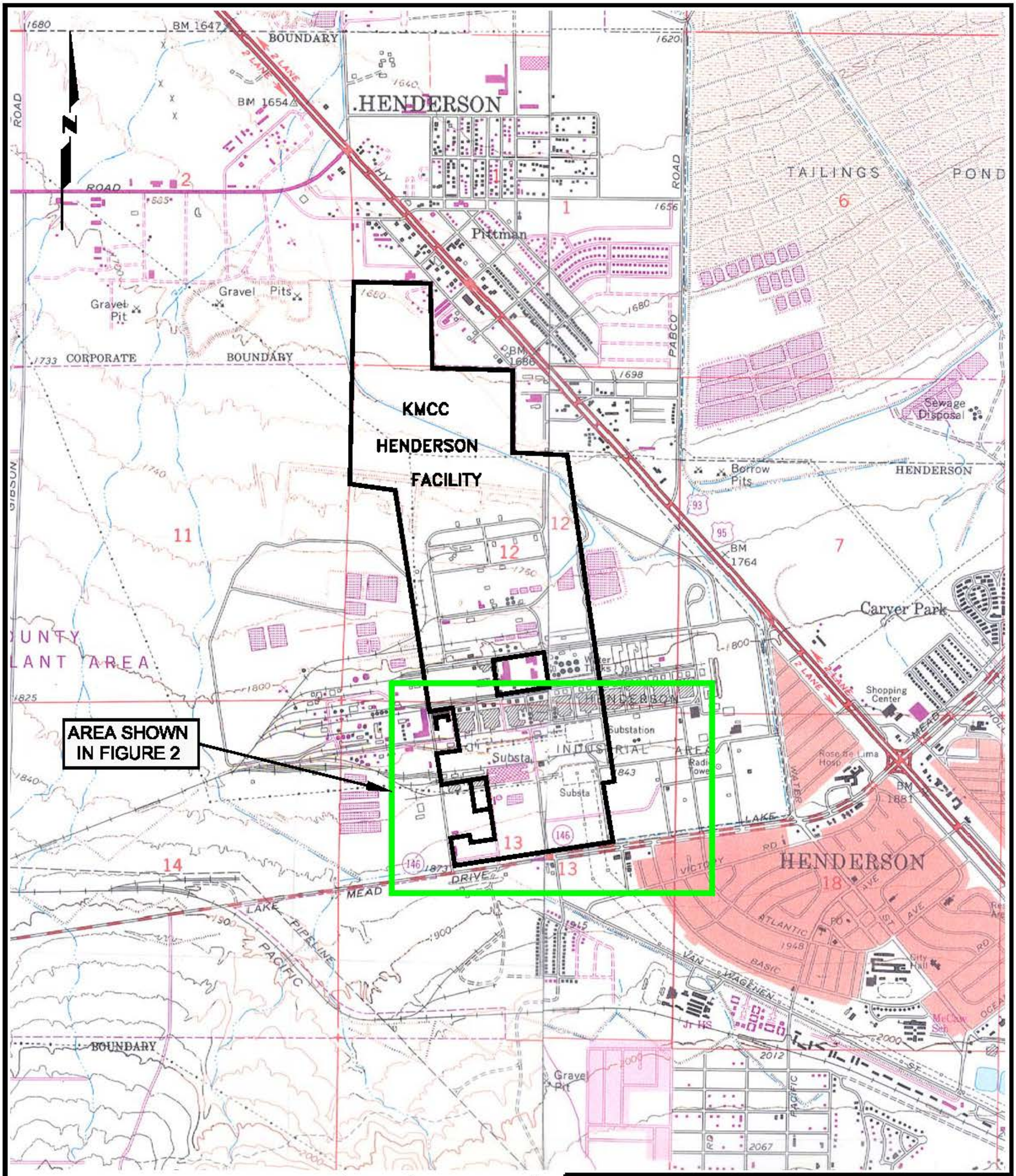
FIGURES



QUADRANGLE LOCATION

SOURCE: USGS 7.5 Minute Topographic Quadrangle, Las Vegas SE, Nevada, 1967, Photorevised 1984

Henderson, Nevada, 1970, Photorevised 1983

FIGURE 1

SITE LOCATION MAP

Kerr-McGee Chemical LLC Facility
Henderson, Nevada

DRAWN: T. Burke	DATE: 03/28/2005	PROJECT NO. 04020-023-150	REV. 2
FILE NO. SiteLoc2Map	CHK BY: R. Foxx		

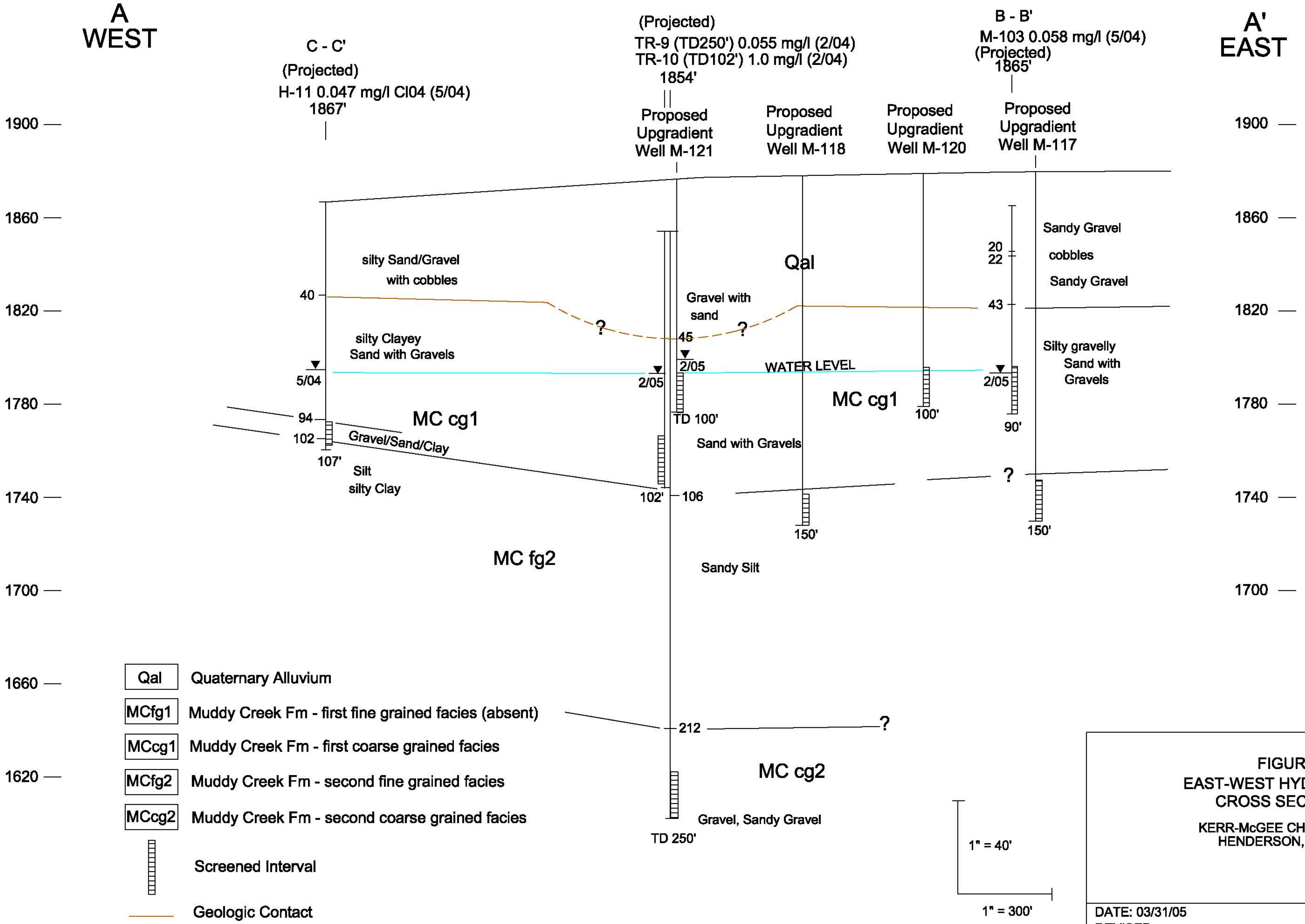
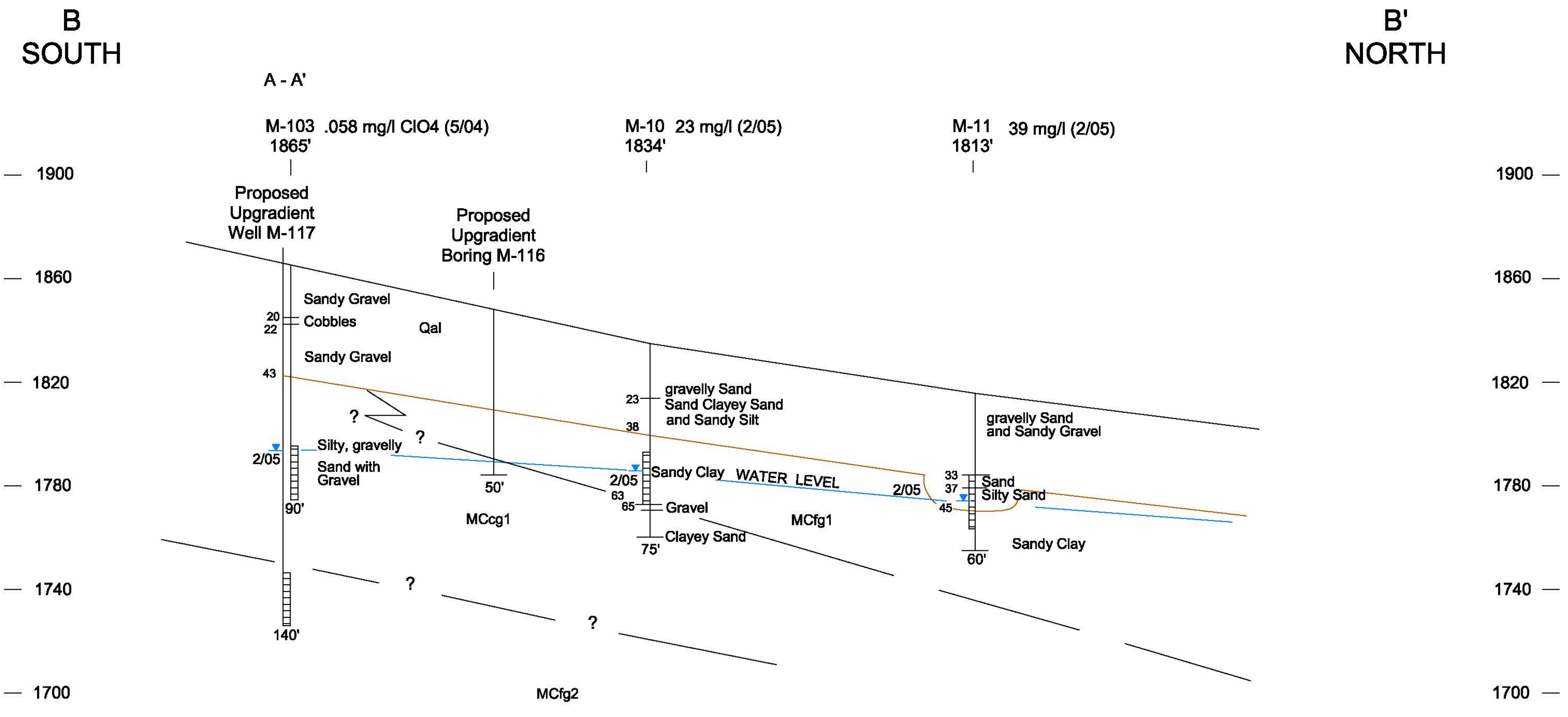


FIGURE: 3
EAST-WEST HYDROGEOLOGIC
CROSS SECTION A - A'

KERR-McGEE CHEMICAL LLC
HENDERSON, NEVEDA

DATE: 03/31/05 REVISED:	SCALE: 1" = 300' (H) 1" = 40' (V)



Qal	Quaternary Alluvium
MCfg1	Muddy Creek Fm - first fine-grained facies
MCcg1	Muddy Creek Fm - first coarse-grained facies
MCfg2	Muddy Creek Fm - second fine-grained facies
▥	Screened Interval
—	Geologic Contact

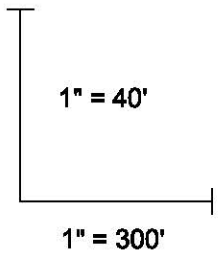


FIGURE: 4

NORTH-SOUTH HYDROGEOLOGIC CROSS SECTION B -B'

KERR-McGEE CHEMICAL LLC
HENDERSON, NEVADA

DATE: 3/31/05 REVISED:	SCALE 1" = 300' (H) 1" = 90' (V)

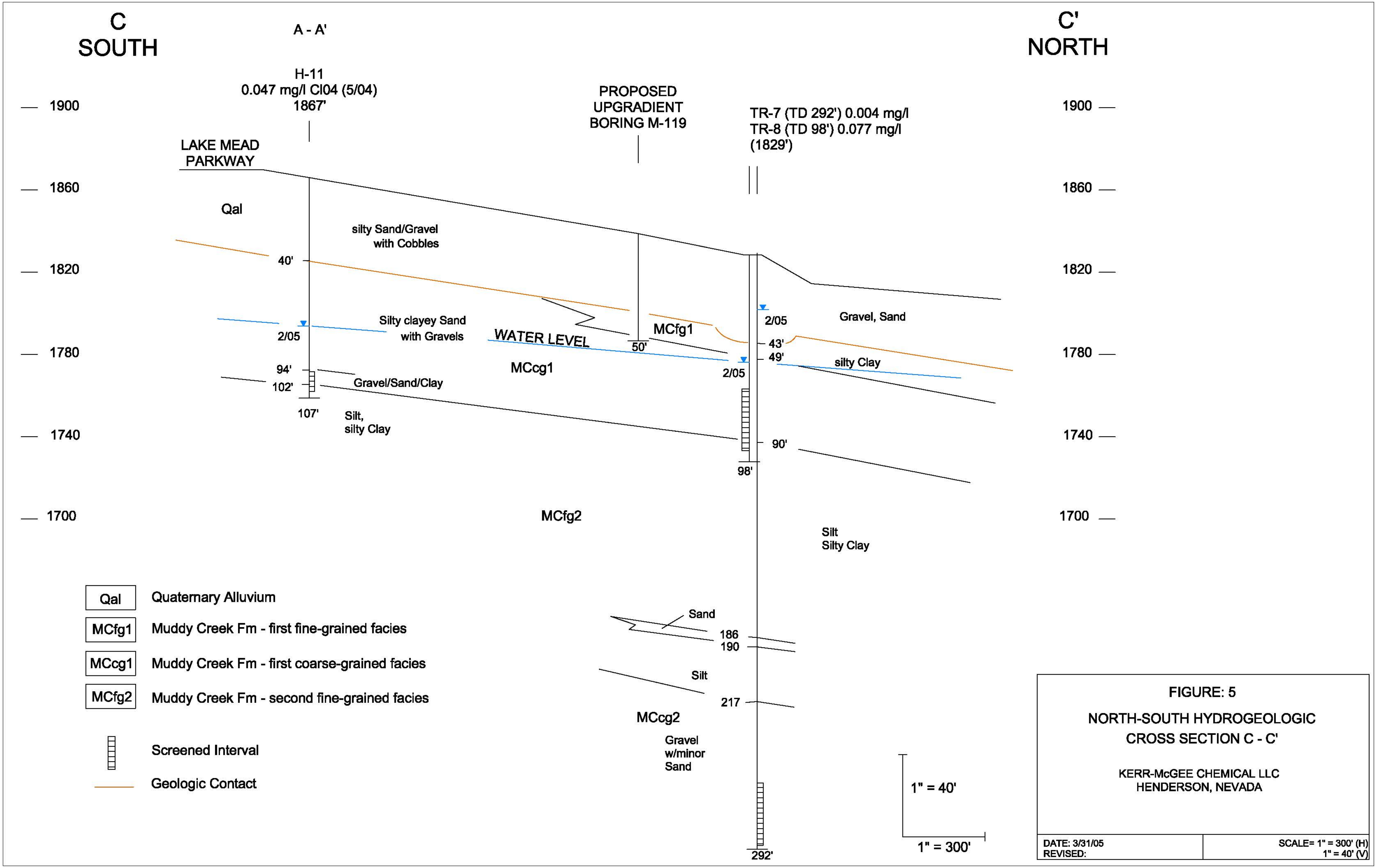


FIGURE: 5

NORTH-SOUTH HYDROGEOLOGIC
CROSS SECTION C - C'

KERR-McGEE CHEMICAL LLC
HENDERSON, NEVADA

DATE: 3/31/05
REVISED:

SCALE= 1" = 300' (H)
1" = 40' (V)

TABLES

Table 1
List of Upgradient Borings and Monitoring Wells to be Sampled
Upgradient Investigation, Kerr-McGee Facility, Henderson, Nevada

Well ID	**Formation Screened**	**Screened Interval** (ft. bgs)	**Total Depth** (ft. bgs)	**Rationale**
M-116*	boring	boring	50 est.	To develop analytical data for the alluvium and to identify the southern extent of the MCfg1 unit.
M-117*	MCfg2	130-150 est.	150 est.	To develop analytical data for the alluvium, MCcg1 and MCfg2 and to establish an upgradient well to sample groundwater from MCfg2.
M-118*	MCfg2	130-150 est.	150 est.	To develop analytical data for the alluvium, MCcg1 and MCfg2 and to establish an upgradient well to sample groundwater from MCfg2.
M-119*	boring	boring	50 est.	To develop analytical data for the alluvium and to identify the southern extent of the MCfg1 unit.
M-120*	MCcg1	80-100 est.	100 est.	To develop analytical data for the alluvium and MCcg1 and to establish an upgradient well to sample groundwater from MCcg1.
M-121*	MCcg1	80-100 est.	100 est.	To develop analytical data for the alluvium and MCcg1 and to establish an upgradient well to sample groundwater from MCcg1.
H-11	MCcg1	95-105	107	To collect off-Site groundwater data from the MCcg1 to compare to on-Site data.
M-103	MCcg1	69.5-89.5	90	To compare with data collected from other locations within the MCcg1.
TR-7	MCcg2	260-290	290	To compare with data collected from other locations within the MCcg2.
TR-8	MCcg1	63-93	93	To compare with data collected from other locations within the MCcg1.
TR-9	MCcg2	230-250	250	To compare with data collected from other locations within the MCcg2.
TR-10	MCcg1	80-100	101	To compare with data collected from other locations within the MCcg1.

* New upgradient boring or monitoring well
ft. bgs = feet below ground surface
MCfg = Muddy Creek fine grained facies
MCcg = Muddy Creek coarse grained facies

Table 2
Proposed Soil Sample Analytical Plan
Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Boring Location	Sample ID Number	Sample Depths (ft, bgs)	Perchlorate (314.0)	TPH-FF (8015M/5035**)	VOCs / MTBE & Fuel Alcohols (8260B/5035)	Title 22 Metals$^{2.}$ (6010B)	Hexavalent Chromium (7196 or 7199)	Radio-nuclides$^{1.}$ (various)
M-116	M116-0.5	0.5	X	X	X	X	X	X
	M116-0.5D	0.5	--	X	X	X	X	X
	M116-5	5	X	X	X	X	--	X
	M116-10	10	hold	X	X	X	X	hold
	M116-20	20	--	--	--	X	--	--
	M116-30	30	hold	X	X	X	X	--
	M116-40	40	--	--	--	X	--	--
	M116-50	50	--	X	X	X	X	X
M-117	M117-0.5	0.5	X	X	X	X	X	X
	M117-5	5	X	X	X	X	--	X
	M117-10	10	hold	X	X	X	X	hold
	M117-20	20	--	--	--	X	--	--
	M117-20D	20	--	--	--	X	--	--
	M117-30	30	hold	--	--	X	X	--
	M117-40	40	--	--	--	X	--	--
	M117-50	50	--	X	X	X	X	--
	M117-60	60	--	--	--	X	--	--
	M117-70	70	--	--	--	--	--	--
	M117-80	80*	--	X	X	X	X	--
	M117-80D	80*	--	X	X	X	X	--
	M117-90	90	--	--	--	--	--	--
	M117-100	100	--	X	X	X	X	--
	M117-110	110	--	--	--	--	--	--
	M117-120	120	--	X	X	X	--	--
	M117-130	130	--	--	--	--	--	--
	M117-140	140	--	X	X	X	--	X
M-118	M118-0.5	0.5	X	X	X	X	X	X
	M118-5	5	X	X	X	X	--	X
	M118-10	10	hold	X	X	X	X	hold
	M118-20	20	--	--	--	X	--	--
	M118-20D	20	--	--	--	X	X	--
	M118-30	30	hold	--	--	X	X	--
	M118-40	40	--	--	--	X	--	--
	M118-50	50	--	X	X	X	X	--
	M118-60	60	--	--	--	--	--	--
	M118-70	70	--	--	--	--	--	--
	M118-80	80*	--	X	X	X	--	--
	M118-90	90	--	--	--	--	--	--
	M118-100	100	--	X	X	X	X	--
	M118-110	110	--	--	--	--	--	--
	M118-120	120	--	X	X	X	--	--
	M118-130	130	--	--	--	--	--	--
	M118-140	140	--	X	X	X	--	X
M-119	M119-0.5	0.5	X	X	X	X	X	X
	M119-0.5D	0.5	X	X	X	X	X	X
	M119-5	5	X	X	X	X	--	X
	M119-10	10	hold	X	X	X	X	hold

Table 2

Proposed Soil Sample Analytical Plan

Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Boring Location	Sample ID Number	Sample Depths (ft, bgs)	Perchlorate (314.0)	TPH-FF (8015M/5035**)	VOCs / MTBE & Fuel Alcohols (8260B/5035)	Title 22 Metals[2.] (6010B)	Hexavalent Chromium (7196 or 7199)	Radio-nuclides[1.] (various)
M-119 cont'd	M119-20	20	--	--	--	X	--	--
	M119-30	30	hold	X	X	X	X	--
	M119-40	40	--	--	--	X	--	--
	M119-50	50	--	X	X	X	X	X
M-120	M120-0.5	0.5	X	X	X	X	X	X
	M120-5	5	X	X	X	X	--	--
	M120-10	10	hold	X	X	X	X	--
	M120-20	20	--	--	--	X	--	--
	M120-30	30	hold	X	X	X	X	--
	M120-40	40	--	--	--	X	--	--
	M-120-40D	40	--	--	--	X	--	--
	M120-50	50	--	X	X	X	X	X
	M120-60	60	--	--	--	X	--	--
	M120-70	70	--	--	--	--	--	--
	M120-80	80	--	X	X	X	--	--
	M120-90	90	--	--	--	--	--	--
	M120-100	100	--	X	X	X	X	X
M-121	M121-0.5	0.5	X	X	X	X	X	X
	M121-5D	5	X	X	X	X	X	X
	M121-5	5	X	X	X	X	X	hold
	M121-10	10	--	X	X	X	X	--
	M121-20	20	--	--	--	X	--	--
	M121-30	30	hold	X	X	X	X	--
	M121-40	40	--	--	--	X	--	--
	M121-50	50	--	X	X	X	X	--
	M121-60	60	--	--	--	X	--	--
	M121-70	70	--	--	--	--	--	--
	M121-80	80	--	X	X	X	--	--
	M121-90	90	--	--	--	--	--	--
	M121-100	100	--	X	X	X	X	X

Notes:

*	Soil sample to be collected at a depth just above the capillary fringe.
**	Samples for TPH-gasoline analysis will be preserved in the field using sodium bisulfate and methanol preservatives.
1.	Includes: Lead-210, lead-212, uranium (isotopic), radium-226, radium-228, and thorium (isotopic) by method EML HASL 300, and uranium-(total) by method EML ASTM D5174.
2.	Includes: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc; and aluminum, boron, iron, manganese, titanium, and tungsten.
X	Sample to be collected and analyzed.
--	Sample will not be analyzed.
M116-0.5D	Duplicate soil sample of M116-0.5.
TPH-FF	Total Petroleum Hydrocarbons - Full Carbon Range (C_4 - C_{23+})

Table 3
Sample Containers, Analytical Methods and Holding Times for Soil Samples
Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Analyte	Method	Container (Minimum Volume)	Holding Time
Perchlorate	EPA 314.0/ Prep method 1:10 Di leach	4-oz. glass jar	None
Metals* + B, Mn, Al, Ca, Fe, Mg, Na, K, Ti and Tungsten	EPA 6020 / 6010	4-oz. glass jar	6 months
Hexavalent Chromium	EPA 7196 by colorometric	4-oz. glass jar	30 days for digestion
VOCs/MTBE	EPA 8260B/5035	(3) Encore capsules.	14 days
Fuel Alcohols (Methanol & Ethanol)	EPA 8015	4-oz. glass jar	14 days
TPH – Full Carbon Range	EPA 8015M (EPA 5035 for TPH-G fraction)	(3) Encore capsules for TPH-G; metal sleeve or glass jar for TPH D and higher.	7 days
Ethylene glycol	EPA 8015	4-oz. glass jar	14 days
Radionuclides:			
Lead-210	DOE 4.5.2.3 (Gamma)	4-oz. poly jar, no preservative	6-months
Lead-212	DOE 4.5.2.3 (Gamma)	4-oz. poly jar, no preservative	6-months
Uranium (Isotopic)	DOE U-02 (Alpha Spectroscopy)	4-oz. poly jar, no preservative	6-months
Uranium (Total)	DOE U-02 (Alpha Spectroscopy)	4-oz. poly jar, no preservative	6-months
Radium-226	SW846 9320 (Emanation)	4-oz. poly jar, no preservative	6-months
Radium-228	SW846 9320 (proportional counting)	4-oz. poly jar, no preservative	6-months
Thorium (Isotopic)	ACW-03 (Alpha Spectroscopy)	4-oz. poly jar, no preservative	6-months

Note:

* Title 22 Metals: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, and Zinc.

B = Boron, Mn = Manganese, Al = Aluminum, Ca = Calcium, Fe = Iron, Mg = Magnesium, Na = Sodium, K = Potassium, and Ti = Titanium.

From Above:

List of Analytes for VOC 8260B Analysis (from EMAX Lab)

Analyte	Analyte
1,1,1,2-Tetrachloroethane	Chloroethane
1,1,1-Trichloroethane	Chloroform
1,1,2,2-Tetrachloroethane	Chloromethane
1,1,2-Trichloro-1,2,2-trifluoroethane	cis-1,2-Dichloroethene
1,1,2-Trichloroethane	cis-1,3-Dichloropropene

Table 3
Sample Containers, Analytical Methods and Holding Times for Soil Samples
Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Analyte	Analyte
1,1-Dichloroethane	Cyclohexane
1,1-Dichloroethene	Dibromochloromethane
1,1-Dichloropropene	Dibromomethane
1,2,3-Trichlorobenzene	Dichlorodifluoromethane
1,2,3-Trichloropropane	DIPE
1,2,4-Trichlorobenzene	ETBE
1,2,4-Trimethylbenzene	Ethyl Methacrylate
1,2-Dibromo-3-chloropropane	Ethylbenzene
1,2-Dibromoethane	Hexachlorobutadiene
1,2-Dichlorobenzene	Iodomethane
1,2-Dichloroethane	Isopropyl Benzene
1,2-Dichloropropane	m,p-Xylene
1,3,5-Trimethylbenzene	Methyl Acetate
1,3-Dichlorobenzene	Methylcyclohexane
1,3-Dichloropropane	Methylene Chloride
1,4-Dichlorobenzene	MTBE
1-Chlorohexane	Naphthalene
2,2-Dichloropropane	n-Butylbenzene
2-Butanone (MEK)	n-Propylbenzene
2-Chloroethyl Vinyl Ether	o-Xylene
2-Chlorotoluene	p-Isopropyltoluene
2-Hexanone	sec-Butylbenzene
4-Chlorotoluene	Styrene
4-Methyl-2-Pentanone (MIBK)	TAME
Acetone	t-Butanol
Acrolein	Tert-Butyl Formate
Acrylonitrile	tert-Butylbenzene
Benzene	Tetrachloroethene
Bromobenzene	Toluene
Bromochloromethane	trans-1,2-Dichloroethene
Bromodichloromethane	trans-1,3-Dichloropropene
Bromoform	trans-1,4-Dichloro-2-butene
Bromomethane	Trichloroethene
Carbon Disulfide	Trichlorofluoromethane
Carbon Tetrachloride	Vinyl Acetate
Chlorobenzene	Vinyl Chloride

Table 4
Proposed Groundwater Analytical Plan
Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Well Cluster	Well ID	Sample ID Number	Screened Interval (ft, bgs)	Perchlorate (314.0)	TPH-FF (8015M)	VOCs / MTBE & Fuel Alcohols (8260B)	Title 22 Metals[3.] (6010/7000)	Hexavalent Chromium (7196)	Radio-nuclides[1.] (various)	General Water Chemistry[2.] (various)
1	TR-7	TR-7	260-290	X	X	X	X	X	X	X
	TR-8	TR-8	63-93	X	X	X	X	X	X	X
		TR-8 Dupe	--	X	X	X	X	X	X	X
2	TR-9	TR-9	230-250	X	X	X	X	X	X	X
	TR-10	TR-10	80-100	X	X	X	X	X	X	X
--	M-103	M-103	69.5-89.5	X	X	X	X	X	X	X
--	M-117	M-117	130-150	X	X	X	X	X	X	X
--	M-118	M-118	130-150	X	X	X	X	X	X	X
--	M-120	M-120	80-100	X	X	X	X	X	X	X
--	M-121	M-121	80-100	X	X	X	X	X	X	X
--	H-11	H-11	95-105	X	X	X	X	X	X	X

Notes:

1. Includes: Lead-210, lead-212, uranium (isotopic), radium-226, radium-228, and thorium (isotopic) by method EML HASL 300, uranium-(total) by method EML ASTM D5174, and radon-222 by Method ASTM D5072.
2. Includes: Calcium, magnesium, sodium, potassium, chloride, sulfates, nitrates, nitrites as N, alkalinity, bicarbonate, carbonate, pH, and electrical conductivity.
3. Includes: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc; and aluminum, boron, iron, manganese, titanium, and tungsten.

X	Sample to be collected and analyzed.
TR-8D	Duplicate groundwater sample
TPH-FF	Total Petroleum Hydrocarbons - Full Carbon Range (C_4 - C_{23+})

Table 5
Sample Containers, Analytical Methods and Holding Times for Groundwater Samples
Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Analyte	Method	Container (Minimum Volume)	Holding Time
Perchlorate	EPA 314.0	(1) 125-ml plastic bottle	28 days
Metals* + B, Mn, Al, Ca, Fe, Mg, Na, K, and Ti	EPA 6010B / 6020B	(1) 500-ml plastic bottle	6 months
Tungsten	EPA 6020, NV does not certify	Same container as above	6 months
Hexavalent Chromium	EPA 7196A, EPA 218.6	(1) 250-ml plastic bottle	24 hours
VOCs/MTBE (see list below)	EPA 8260B	(3) 40-ml VOA vials	14 days
TPH – Full Carbon Range	EPA 8015M	(3) 40-ml VOA vials	7 days
Alkalinity	EPA 310.1	500-ml plastic no preservative	14 days
Bicarbonate	EPA 310.1	Same as above	14 days
Carbonate	EPA 310.1	Same as above	14 days
pH	EPA 9040	125-ml plastic no preservative	7 days
TDS	EPA 160.1	125-ml plastic no preservative	28 days
Electrical Conductivity	EPA 9050	125-ml plastic no preservative	28 days
General Water Chemistry Ions			
Chlorate	EPA 300.0	125-ml plastic bottle/ no preservative	28 days
Chloride	EPA 9056	**(2) liter plastic bottles	28 days
Cyanide	EPA 9012	(1) 500-ml plastic bottle w/ NAOH	14 days
Nitrate	EPA 9056	**Use same bottles	48 hours
Nitrite as N	EPA 9056	125-ml plastic no preservative	48 hours
Phosphate	EPA 365.1 (total)	125-ml plastic bottle, no preservative	48 hours
Sulfate	EPA 300.0	**Use same bottles	28 days
Sulfide (Total)	EPA 376.2	500-ml plastic bottle w/NaOH/Zn acetate	7 days
Radionuclides:			
Lead, Pb-210	SCA-321 (Alpha Spectroscopy)	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	6 months
Lead, Pb-212	DOE 4.5.2.3	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	Half-life = 10 hrs.
Uranium (Isotopic)	DOE U-02 (Alpha Spectroscopy)	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	
Uranium (total)	DOE U-02 (Alpha Spectroscopy)	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	
Radium-226	SW846 9320 (Emanation)	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	
Radium-228	SW846 9320 (proportional counting)	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	
Radon-222	SM7500-RN-B, NV does not certify	(1) VOA vial, no preservative	72 hrs.
Thorium (Isotopic)	ACW-03 (Alpha Spectroscopy), NV does not certify	(1) 1-liter poly bottle (must be full), Preservative pH <2 HNO3	

Note:

* Title 22 Metals: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, B = Boron, Mn = Manganese, Al = Aluminum, Ca = Calcium, Fe = Iron, Mg = Magnesium, Na = Sodium, K = Potassium, and Ti = Titanium.

** Chloride, Nitrate, Perchlorate, and Sulfate use same bottle for all these samples. Sample containers are (2) liter plastic bottles.

From Above:

List of Analytes for VOC 8260B Analysis (from EMAX Lab)

Analyte	Analyte
1,1,1,2-Tetrachloroethane	Chloroethane
1,1,1-Trichloroethane	Chloroform
1,1,2,2-Tetrachloroethane	Chloromethane
1,1,2-Trichloro-1,2,2-trifluoroethane	cis-1,2-Dichloroethene
1,1,2-Trichloroethane	cis-1,3-Dichloropropene
1,1-Dichloroethane	Cyclohexane
1,1-Dichloroethene	Dibromochloromethane
1,1-Dichloropropene	Dibromomethane
1,2,3-Trichlorobenzene	Dichlorodifluoromethane
1,2,3-Trichloropropane	DIPE
1,2,4-Trichlorobenzene	ETBE
1,2,4-Trimethylbenzene	Ethyl Methacrylate
1,2-Dibromo-3-chloropropane	Ethylbenzene

Table 5
Sample Containers, Analytical Methods and Holding Times for Groundwater Samples
Upgradient Investigation, Kerr-McGee Facility - Henderson, Nevada

Analyte	Analyte
1,2-Dibromoethane	Hexachlorobutadiene
1,2-Dichlorobenzene	Iodomethane
1,2-Dichloroethane	Isopropyl Benzene
1,2-Dichloropropane	m,p-Xylene
1,3,5-Trimethylbenzene	Methyl Acetate
1,3-Dichlorobenzene	Methylcyclohexane
1,3-Dichloropropane	Methylene Chloride
1,4-Dichlorobenzene	MTBE
1-Chlorohexane	Naphthalene
2,2-Dichloropropane	n-Butylbenzene
2-Butanone (MEK)	n-Propylbenzene
2-Chloroethyl Vinyl Ether	o-Xylene
2-Chlorotoluene	p-Isopropyltoluene
2-Hexanone	sec-Butylbenzene
4-Chlorotoluene	Styrene
4-Methyl-2-Pentanone (MIBK)	TAME
Acetone	t-Butanol
Acrolein	Tert-Butyl Formate
Acrylonitrile	tert-Butylbenzene
Benzene	Tetrachloroethene
Bromobenzene	Toluene
Bromochloromethane	trans-1,2-Dichloroethene
Bromodichloromethane	trans-1,3-Dichloropropene
Bromoform	trans-1,4-Dichloro-2-butene
Bromomethane	Trichloroethene
Carbon Disulfide	Trichlorofluoromethane
Carbon Tetrachloride	Vinyl Acetate
Chlorobenzene	Vinyl Chloride

APPENDIX A

Kerr-McGee and Regulatory Correspondence

.LEN BIAGGI, *Administrator*

dministration
ate Control
ir
'02) 486-2850

STATE OF NEVADA
KENNY C. GUINN
Governor

R. MICHAEL TURNIPSEED, *Director*

Federal Facilities
Corrective Actions
Waste Management
Facsimile 486-2863

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

(Las Vegas Office)
1771 E. Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837

February 11, 2004

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Supplemental Phase II Report – Environmental Conditions Assessment

Dear Ms. Crowley,

The Nevada Division of Environmental Protection (NDEP) has reviewed the:

Supplemental Phase II Report – Environmental Conditions Assessment; Kerr-McGee Chemical LLC, April 25, 2001.

NDEP's comments to the aforementioned report are contained in Attachment A. In summary, characterization work performed to date does not appear to be technically defensible and additional work will be required. Some specific points include: 1) a need to identify all potential contaminants associated with the site; 2) appropriate background sampling; 3) use of inappropriate action levels; and 4) existence of data gaps. Before additional work is completed, the NDEP recommends that Kerr-McGee Chemical LLC (KM) meet with the NDEP to discuss the comments and development of a plan to move forward.

30th - per Rakvica 3-4-04

By **March ~~8~~, 2004,** KM should provide to the NDEP a schedule for addressing the issues outlined herein. Should you have any questions or concerns, please do not hesitate to contact me at (702) 486-2870.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Remediation and LUST Branch
Bureau of Corrective Actions
NDEP – Las Vegas Office

BAR/bar
Encl: Attachment A

CC: Jim Najima, NDEP, BCA, Carson City
Jon Palm, NDEP, BWPC, Carson City
Todd Croft, NDEP, BCA, Las Vegas
Jennifer Carr, NDEP, BCA, Carson City
Jeff Johnson, NDEP, BCA, Carson City
Valerie King, BWPC, Carson City
Tamara Pelham, BWPC, Carson City
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlman, City of Henderson, 240 Water Street, Suite 210, Henderson, NV 89015
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Carrie Stowers, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BEC, 875 West Warm Springs Road, Henderson, Nevada 89015
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015

Attachment A

NDEP Comments on the *Supplemental Phase II Report – Environmental Conditions Assessment*

1. **Submission of documents**
   a. Two copies of all reports should be provided to Brian Rakvica in the Las Vegas office of the NDEP and two additional copies should be provided to Mr. Jeff Johnson in the Carson City office of the NDEP.
   b. An electronic copy of all reports in PDF format should also be provided to Mr. Brian Rakvica.
   c. All laboratory data should be formatted to comply with the Division's Electronic Data Deliverable's (EDD) format. These data packages will need to be compatible with Earthsoft's EquIS Data Management System (relational database written in Visual Basic and using the Microsoft Access engine). The specific formatting requirements of this data will be provided to KM under separate cover at a later date.
2. **Project Personnel**
   a. NDEP needs to understand what personnel are being applied to this project. Please provide current resumes and/or curricula vitae for each project staff member. This is a multi-disciplinary project and the following expertise may be needed to complete this project: hydrogeologist, engineer, toxicologist, radiochemist, risk assessor, expert in fate and transport, statistician and chemist.
   b. Please provide an organizational chart for the project team.
   c. Please identify the Nevada Certified Environmental Manager (CEM) for this project.
3. **Presentation of Calculations and Data**
   a. Calculations: When a significant calculation is performed and referenced in the text an example calculation should be included in the report. The formulae used and the reference for the formulae should also be shown for the example calculation. These example calculations could be summarized in an appendix to the report, in a footnote, or in the body of the text. The NDEP is also amenable to alternate presentation forms.
   b. Data: Data for soil shall not be separated from data for groundwater. One drawing should be presented for each site-related chemical to illustrate the three dimensional extent of contamination. Information to be included on each drawing is summarized below.
      i. All soil analytical data shall be presented.
      ii. All potential source areas for the chemical being evaluated shall be clearly identified and highlighted. Potential source areas include areas where concentrations in soil exceed background and those portions of the facility where chemicals were used or stored. Source areas may include several Letter of Understanding (LOU) study areas.
      iii. All groundwater analytical data shall be presented.

    iv. Iso-concentration contours for groundwater data illustrating the extent of the groundwater plume shall be presented. Property boundaries are not to be used for termination of the delineation of the chemical plumes.
    v. Any location that is considered a background location for any chemical in soil or groundwater shall be clearly identified on all drawings.
    vi. All site features that may impact contaminant transport (surface and subsurface) shall be identified.
  c. Drawings shall be self-explanatory without the need to refer to the text to interpret what is being presented. The presentation of more than one site-related chemical on a drawing is appropriate when the chemicals are similar (e.g.: VOCs, metals, etc.), are migrating together and have common sources. The above presentation is required to complete a conceptual site model. The conceptual site model should be updated as more data is collected.

4. **Averaging of Analytical Data**
  a. In previous reports, analytical data on several tables are averaged. The NDEP can not evaluate the adequacy of site characterization work based on analytical data that are averaged. Risk assessment is the only phase of the project where analytical data should be averaged. Analytical results should be presented discretely and compared to appropriate risk based criteria; Applicable or Relevant and Appropriate Requirements (ARARs); or approved background levels.
  b. Composite soil samples are appropriate where justification is provided and NDEP approval is obtained. Composite samples may not be appropriate for risk-based closures without a rigorous statistical analysis.

5. **Phase II Consent Agreement Reporting and Public Involvement Obligations**
  a. KM is reminded that quarterly progress reports are due to the NDEP in accordance with Section XIII of the Phase II Consent Agreement.
  b. KM is further reminded that participation in the Public Involvement Plan (PIP) is required in accordance with Section V.2. of the Phase II Consent Agreement. This PIP requires a copy of all key documents to be submitted to the Public Information Repository located at the James I. Gibson Public Library in Henderson, Nevada.

6. **Site Groundwater**
  a. The Nevada Revised Statutes and the Nevada Administrative Code consider all groundwater of the State of Nevada to be potential sources of drinking water; prohibit the discharge of pollutants into the groundwater without a permit; and require the source of any pollutant to be eliminated. It has been well documented that the water beneath the KM plant site has the ability to reach the Las Vegas Wash. The Las Vegas Wash is a tributary to Lake Mead. Lake Mead and the Lower Colorado River are the drinking water supply for over 20,000,000 people. The NDEP would like to stress the importance of: elimination of the migration of pollutants from

the KM site; delineation of the extents of the off-site contamination in the form of a conceptual site model (CSM); and management and remediation of <u>all</u> off-site pollutants. Characterization of off-site pollutants in groundwater may require broad suite analyses. These analyses should include (at a minimum) the following chemical classes: VOCs, SVOCs, PAHs, Pesticides, Radionuclides, Metals, Inorganics, Dioxins/Furans, and PCBs. Please note that the radionuclide analyses should include (at a minimum): the uranium series, the thorium series, radium 226/228 (and all daughter products), as well as potassium 40.

b. It should also be noted that "Beneficial Use Standards" have been developed for the Las Vegas Wash and are presented in NAC 445A.144 and NAC 445A.199-NAC 445A.201.

c. The NDEP requests that KM provide a summary of the on-going monitoring of the site groundwater. This summary should include a list of the monitoring wells; the analytes that each well is monitored for; and the frequency of the analysis.

d. The Division requests that plume maps be developed for each of the site-related chemicals including data that extends off-site. See also comment 3.

7. **Pond GW-11**

a. Pond GW-11 has received effluent from the chromium mitigation system and the perchlorate remediation system. The contaminants in this effluent have been evapo-concentrating in pond GW-11. It is the Division's understanding that the contents of pond GW-11 will eventually be processed through the new fluidized bed reactor (FBR).

    i. Please provide any data on analyses that have been performed on the contents of Pond GW-11.

b. Broad suite analyses may be appropriate for pond GW-11. It is not clear to the NDEP that the contents of pond GW-11 are well characterized.

8. **Chromium Mitigation System**

a. The existing chromium mitigation system treats a limited quantity of groundwater on the plant site. From plume maps provided by KM, it is obvious that there is a large plume of chromium downgradient of the plant site slurry wall. KM has implemented a temporary remedial system to address the elevated hexavalent chromium concentrations at the Athens Road well field.

    i. Please explain KM's long-term plan for the remediation of chromium (total and hexavalent) at the Athens Road well field. It appears to the Division that the concentrations will continue to increase in this location (based on available data).

b. The existing total chromium plume maps terminate near the property boundary and are delineated to 1.0 ppm.

    i. Please provide complete mapping of the existing total chromium plume down to ND(0.05 mg/l). Also, include a 0.1 mg/l contour (current MCL for total chromium).

    ii. It is requested that chromium plume mapping eventually be coordinated with the development of the perchlorate plume maps. Maps should be of identical orientation, scale and sampling date. Please identify a schedule by which this mapping can be coordinated with the perchlorate mapping.
    iii. Please provide any information on sampling conducted to date for total and hexavalent chromium in the Muddy Creek Formation and Muddy Creek Aquifers.

  c. Please provide any available data for the influent concentrations of total and hexavalent chromium to the on-plant site chromium mitigation system.

9. **Site-Related Chemicals**

  a. The NDEP is concerned that site-related chemicals have not been adequately identified for the KM facility. Site-related chemicals include all raw materials, products processed, byproducts, waste products and any other chemical used at the facility. All degradation products associated with any chemical that may have been used at the facility are also site-related chemicals. All site-related chemicals need to be identified in accordance with USEPA guidance (see *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, EPA/540/1-89/002, December 1989*)) If it is unknown whether or not chemicals are present at the site~~, or~~ if all chemicals associated with historical operations have not been adequately documented, then a broad suite analysis is warranted for those chemical classes that may be present. Please note that some chemicals associated with the site may not be covered by broad suite analyses. Site-related chemicals associated with the KM facility need to be identified and justified for each chemical class including but not limited to: metals, radionuclides, volatile organic compounds, semi-volatile organic compounds, dioxins, furans, pesticides, and polycyclic aromatic hydrocarbons (PAHs). A detailed discussion on site-related chemicals is required for any risk assessment. During risk assessment, the list of site-related chemicals is reduced to a list of chemicals of potential concern (COPC). Please note that the term COPC is specific to risk assessment and should only be used after the completion of site characterization and the development of a CSM.

  b. For example, if the suite of metals associated with the site cannot be identified, then a broad suite of metals needs to be analyzed. Twenty-four metals are considered site-related chemicals for the Upper and Lower Ponds east of Boulder Highway (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium (total), chromium (VI), cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, titanium, tungsten, vanadium and zinc). These 24 metals should be included in the list of site-related chemicals for the KM facility or the abbreviated list of metals that were analyzed during the previous investigations needs to be justified.

c. Another example is the unknown chemicals and wastes at the site. In the April 1993 Phase I Environmental Conditions Assessment there are several examples of unknowns at the site.
   i. U.S. Government Activities – "Detailed records describing the quantities of waste produced and the location(s) for disposal…were not found during this study".
   ii. Other previous lessees on KM property – "The actual locations leased and operations conducted by these companies are not well documented".
   iii. Hardesty/Amecco Chemical – "residue from the manufacturing process was pumped directly into a steel tank truck and removed to a remote location and burned". The by-products from this incomplete combustion process are unknown but may include: dioxins, furans, PAHs, as well as components of the residue that were burned. KM should identify this potential source area.

d. The analytical methods for the list of site-related chemicals must be presented for review by the NDEP.

e. The development of a comprehensive list of site-related chemicals should be the <u>first</u> priority for this project.

10. **Data Quality**

a. In this report and previous reports elevated detection limits have been presented. These detection limits are at or above their (potential) corresponding screening levels. Examples include (but are not limited to): benzene, cadmium, ethylbenzene, selenium, and toluene.

b. If a risk assessment is to be performed, the usability of this data will need to be demonstrated in accordance with US EPA Guidance.

c. KM is requested to review this issue with their laboratories to determine the reasoning behind these elevated detection limits.

d. KM is requested to review these issues and the remaining part of the quality assurance program (in accordance with Section VIII of the Phase II Consent Agreement) and submit a formalized response to NDEP.

11. **Action Levels**

a. The NDEP has repeatedly stressed the importance of comparing data to appropriate action levels including letters dated June 10, 1998 and December 17, 1998.

b. Please note that if a chemical is present, but below an established action level, it will not necessarily be removed from consideration or future analysis. This chemical may need to be carried through as a contributor to cumulative risk.

c. Action levels should be protective of human health and the environment. Standards or criteria that can be used to evaluate human health or ecological risks include Maximum Contaminant Levels (MCLs), USEPA soil screening levels (SSLs), USEPA Ambient Water Quality Criteria (AWQC), ATSDR criteria, site-specific background levels, and USEPA Region IX Preliminary Remediation Goals (if used correctly, see below for additional details). KM should present a detailed evaluation of the derivation of the action levels to be used for this project.

d. Please note that although NAC 445A.2272 does allow the use of TCLP maximum concentrations as action levels where the exposure pathway is to surface water or groundwater, TCLP maximum concentrations were established Federally to classify hazardous waste for disposal purposes; they were not established to evaluate human health and ecological risk. Further, there is no basis in regulations to extrapolate these concentrations for use as human health and ecological risk criteria for soil exposure. According to NAC 445A.2272, the most restrictive action level must be used, and at an appropriate level of concentration that is based on the protection of human health and safety and of the environment. Contaminant concentrations associated with human health and ecological risk criteria are generally much lower than TCLP criteria, especially when multiple chemicals are being evaluated. Human health risk criteria, and potentially ecological risk criteria, must be addressed prior to site closure if contaminated media (above applicable target risk levels) are not removed from the site.

e. USEPA Preliminary Remediation Goals (PRGs) can be used to determine action levels if the analysis is completed correctly. If more than one contaminant exists at a site, then the use of PRGs may not be appropriate.

f. It is critical that background concentrations be appropriately evaluated. Background concentrations need to be evaluated by collecting soil samples in an area that is not impacted by site operations. Use of ASTM or USGS background levels for wide geographic areas is not acceptable per the June 10, 1998 NDEP letter to KM. A separate work plan should be submitted that describes where background samples will be collected and how background concentrations will be evaluated. It is highly recommended that an appropriate background study be completed prior to additional site characterization sampling. The development of a Remedial Alternatives Study (RAS) after site characterization is completed will depend heavily on comparisons of background concentrations to contaminant concentrations detected at the facility. The NDEP suggests that KM review the guidance documents listed below.

    i. U.S. Environmental Protection Agency, Guidance for Characterizing Background Chemicals in Soil at Superfund Sites, OSWER 9285.7-41 (EPA 540-R-01-003), June 2001.

    ii. U.S. Environmental Protection Agency, Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites, EPA/540/s-96/500, December 1995.

g. Due to the number of contaminants present at the facility, the lack of acceptable chemical-specific action levels or PRGs for many of the contaminants, and the potential that removal activities may not be cost-effective as a remedial option, KM should consider that a deterministic risk assessment might be required for site closure. A probabilistic risk assessment will not be accepted until after a deterministic risk assessment is completed and it is determined that a probabilistic risk assessment is warranted. Risk assessment, if performed, shall be completed in accordance with USEPA guidance (see references below). Tentative cleanup goals for risk assessment are listed below.

    i. Non-carcinogens: Hazard Index = 1
    ii. Chemical carcinogens: Target Risk = $1x10^{-6}$
    iii. Radionuclides: Target Risk= $1x10^{-6}$

h. Prior to performing a risk assessment, the usability of the data must be demonstrated in accordance with USEPA guidance (see reference below).

i. It is not clear what the objectives of the investigation to date are. Decision rules to guide the characterization process are not clearly laid out. Also, it is not clear how KM will sufficiently evaluate the facility to justify closure. It is highly recommended that data quality objectives (DQOs) be completed in accordance with the reference below. Ideally, DQOs should have been completed prior to any site characterization work to streamline the data collection process. A brief discussion on data quality assessment (DQA) may also be warranted (see reference below). In summary, the NDEP needs to have a better understanding of how KM proposes to close the site and recommends that KM discus the proposed DQOs with NDEP prior to submittal. Additionally, NDEP recommends submittal of DQOs as a separate, stand-alone document. It should be anticipated that these DQOs will be adjusted as the project proceeds.

j. References

    i. U.S. Environmental Protection Agency, Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, December 1989.
    ii. U.S. Environmental Protection Agency, Guidance for Data Usability in Risk Assessment, April 1992.
    iii. U.S. Environmental Protection Agency, Guidance for the Data Quality Objectives Process, August 2000.
    iv. U.S. Environmental Protection Agency, Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, July 2000.

12. Conceptual Site Model

a. The NDEP has repeatedly stressed the importance of the development of a conceptual site model (CSM) including in letters dated June 10, 1998 and December 17, 1998.

b. Kerr-McGee has completed a significant amount of hydro-geologic investigative work for the perchlorate remediation project. This information should prove to be very helpful in the development of a CSM.

c. It is suggested that the CSM be submitted under separate cover as soon as possible. For your information, all of the BMI Companies are preparing CSMs. It is suggested that the CSM include, but not be limited to, the following elements:

    i. A list of site-related chemicals for soil and groundwater should be developed in accordance with USEPA guidance (see also comment

10). This list should identify chemicals that may have been disposed of but were not analyzed for during recent investigations. This list should also present risk-based criteria, such as USEPA Region IX PRGs, soil screening levels (SSLs), MCLs, and other criteria where appropriate. See also comment 11.

ii. A discussion pertaining to the potential for contaminants in soil to leach to groundwater should be provided. Contaminant concentrations in soil should be compared to migration to groundwater SSLs developed by the USEPA at the DAF of 1 or site-specific SSLs could be developed.

iii. Preferential migration pathways, such as paleochannels on top of the Muddy Creek Formation; the fine grained facies of the Muddy Creek Formation (e.g. channel sands); and the coarse grained facies of the Muddy Creek Formation also should be evaluated. Kerr-McGee has already completed significant work on this for the perchlorate remediation project.

iv. Cross sections showing the shallow alluvial aquifer and the next deeper water-bearing zone should also be presented.

v. It does not appear that the nature and extent of the contaminant plumes are well understood. Iso-concentration drawings for contaminant plumes in soil and groundwater (including the vertical extent of contamination) that show the entire extent of the plume (including off site data) should be provided. See also comment 8.

vi. The conceptual site model should discuss surface drainage patterns, surface migration of contaminants, and contaminant migration pathways within the vadose zone and groundwater.

vii. The CSM should discuss exposure pathways for current and future receptors, including ecological receptors.

viii. Data gaps should be identified and additional investigation work to close the data gaps should be proposed.

ix. Unqualified data may be presented, however, KM must ensure that the data are presented in a manner that allows the NDEP to differentiate between qualified and unqualified data.

13. **Soil Sampling**

a. In general, the soil sampling that has been conducted has been in the surface and near-surface. The limited sampling that was conducted is not sufficient to evaluate potential sources that may exist within the vadose zone. Soil samples need to be collected throughout the vadose zone to fully evaluate the extent of contamination in three dimensions and potential impacts to groundwater.

14. **Section 1.0, page 1-1**

a. Second paragraph – Please correct the date for NDEP's conditional approval of the Phase II Supplemental Work Plan from "*December 17, 1999*" to the correct date of December 17, 1998.

15. **Section 2.2.2, page 2-3**

a. First paragraph – In the statement "*The spacing of seven successfully drilled perimeter borings comprises a nearby equidistant...*" replace the word "*nearby*" with the word "nearly".

16. **Section 3.1, page 3-1**

a. Total chromium results for soil were compared to a 100 mg/kg level. This is not an appropriate action level or screening level. For example, the USEPA SSL (DAF 1) is 2.0 mg/kg and the USEPA TCLP is 5.0 mg/kg. Background levels may be more conservative. Using either of the above concentrations, all soil samples are grossly elevated. It appears that the depth and breadth of chromium contamination has not been properly evaluated. Please note that the NDEP is using these SSLs for discussion purposes only. KM should calculate their own SSLs or verify that the model used by the USEPA to calculate the published SSLs fits the model for the KM site. A DAF of 1 is being used for discussion purposes, assuming that there is little or no dilution or attenuation of soil leachate at the site (due to the shallow water table and the large source size).

b. The NDEP's December 17, 1998 letter to KM required comparison of sample results to actual Nevada cleanup standards and background values.

c. Soil samples also appear to indicate that there are elevated pH levels in a number of the locations and depths. Background levels for pH should be delineated in accordance with USEPA guidance (see also comment #11.f).

d. The data presented do not delineate the valences of the chromium present in soil. KM states *"elevated pH values tend to retard the mobility of chromium, especially trivalent chromium Cr(III) (Allen 1993). This implies that the mobility of chromium in soil beneath Old P-2 and P-3 Ponds is retarded, thus limiting or eliminating the ponds as an existing or future source of chromium to groundwater."* The NDEP does not agree with this assessment. There are very high concentrations of chromium in groundwater in the vicinity of the P-2 and P-3 ponds. Data presented by KM indicates that a majority of this chromium may be hexavalent. Please provide further justification for the above statement.

17. **Section 3.2.1, page 3-11**

a. The detection limits presented in Table 3-2 and discussed in this section appear to be elevated. Potential screening levels for benzene, toluene and ethylbenzene in soil are at least an order of magnitude lower than the detection limits presented in table 3-2. For example, the USEPA SSL DAF 1 for benzene is 0.002 mg/kg, for toluene is 0.6 mg/kg, and for ethylbenzene is 0.7 mg/kg. KM needs to derive appropriate action levels and re-evaluate the need for additional sampling in this area.

b. For soil samples SB5-4 and SB5-5, the highest concentrations of "TEPH" are at the greatest depth. The NDEP believes that the depth and volume of soil contamination has not been appropriately evaluated. Additional deeper samples should be proposed in the next workplan.

c. It is suggested that future groundwater samples be analyzed for BTEX. Revised sampling procedures may need to be investigated due to the reported low flow conditions.

18. Section 3.2.2, page 3-11

a. The NDEP does <u>not</u> concur with the assessment that no further investigation is recommended or warranted for the former diesel fuel tank storage area.

LEO DROZDOFF, *Administrator*

(775) 687-4670

Administration
Facsimile 687-5856

Water Quality Planning
Water Pollution Control
Facsimile 687-4684

Mining Regulations and Reclamation
Facsimile 684-5259

STATE OF NEVADA
KENNY C. GUINN
Governor

ALLEN BIAGGI, *Director*

Air Pollution Control
Air Quality Planning
Facsimile 687-6396

Waste Management
Facsimile 687-6396

Corrective Actions
Facsimile 687-8335

ndep.nv.gov

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
Las Vegas Office
1771 East Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837

May 6, 2005

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Background Investigation Work Plan dated March 29, 2005

Dear Ms. Crowley,

The NDEP has received and reviewed KM's correspondence identified above and provides comments in Attachment A. The NDEP requests that KM address the issues outlined herein no later than **June 22, 2005.**

If there is anything further or if there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Remediation and LUST Branch
Bureau of Corrective Actions
NDEP-Las Vegas Office

CC: Jim Najima, NDEP, BCA, Carson City
Jennifer Carr, NDEP, BCA, Carson City
Jeff Johnson, NDEP, BCA, Carson City
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlmann, City of Henderson, 240 Water Street, Suite 210, Henderson, NV 89015
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Carrie Stowers, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BEC, 875 West Warm Springs Road, Henderson, Nevada 89015
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
Mr. George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Mr. Lee Erickson, Stauffer Management Company, 1800 Concord Pike, Hanby 1, Wilmington, DE 19850-5437
Mr. Chris Sylvia, Pioneer Americas LLC, 8000 Lake Mead Parkway, Henderson, Nevada 89015
Mr. Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110

ATTACHMENT A

1. General comment, CEM Jurat, the jurat should clarify who is the responsible CEM for this project. There are three signatures on the page and one of the signatures is by a non-CEM. Please revise.
2. General comment, this report does not discuss the statistical methods that will be used to evaluate the background data once it is collected. It is suggested that KM describe the statistical methods that will be used to evaluate the background data in the revised version of this report.
3. General comment, KM should discuss how the proposed background data set will be evaluated versus background data sets collected by others (i.e., the City of Henderson, TIMET and BRC). It may be necessary for KM to consider these other background data sets in the development of the KM background data set. If the background data collected by KM differs from the data collected by others in the same geologic formation KM may need to discuss and justify the differences.
4. General comment, KM should discuss what types of background are proposed to be evaluated. For example, surface soil, sub-surface soil, sub-surface alluvium, sub-surface Muddy Creek formation (and different intervals?), ground water in the water table aquifer, ground water in deeper aquifers, etc.
5. Section 1.0, page 1-1, KM references a meeting that was held on April 1, 2005. This meeting did not occur. Please revise.
6. Section 1.2, page 1-4, KM states "In February 2004, the NDEP provided ~~a~~ response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that yet additional work would be required including…" The NDEP believes that the tone of this statement is inappropriate and has not been presented with data to not require "additional work". If KM believes that the scope of work that the NDEP is requiring is too onerous, then KM should develop an opinion paper and submit this document to the NDEP prior to the development of any additional reports.
7. Section 2.5, page 2-3, KM describes the water within the Muddy Creek formation as being of "generally good quality" and describes the water from the deeper coarse grained Muddy Creek Formation as containing "55 mg/l calcium, 180 mg/l chloride, 180 mg/l sodium and 250 mg/l sulfate". It would be helpful if this data was compared to site data that is impacted and off-site data that is not impacted. This data has limited meaning when it is not compared to other data sets. KM should substantiate statements in reports with data or references.
8. Section 3.0, page 3-1, it is requested that KM provide additional explanation on how the data that is collected for VOCs and TPH will be used. Ideally, background locations would be selected that are not impacted by anthropogenic activities. Also, please explain how KM will differentiate between site-related impacts from VOCs and TPH given the following:
   a. KM has documented releases of TPH on-site and elevated levels of TPH on-site and in the Western Area Power Administration (WAPA) easement.
   b. KM has a number of VOCs that are site-related chemicals.
   c. KM has collected limited groundwater data to determine the breadth and depth of contamination with regards to TPH and VOCs.
9. Section 3.2, pages 3-1 and 3-2, the NDEP has the following comments:

a. General comment, it may not be necessary to complete DQOs in order to develop a background data set. If KM chooses to develop a set of DQOs it is necessary to complete these DQOs in accordance with USEPA guidance. The NDEP believes that it is necessary to complete as many steps of the DQOs as possible in order to make sound decisions about site issues. KM has chosen to present an abbreviated implementation of the DQOs and the NDEP believes that this has limited value. Specific comments and examples are provided below.

b. Step 1, State the Problem, the NDEP has the following comments:
    i. The NDEP believes that the word "alluvium" in this sentence is extraneous. If KM disagrees, please explain how samples will be collected in the "alluvium" that are different than the soil and groundwater samples that are proposed. This comment applies to other steps in the DQOs as well.
    ii. KM has not identified the planning team and decision makers.
    iii. KM has not identified available resources, constraints and deadlines.
    iv. The NDEP believes that a reference to the CSM should be included in this step.

c. Step 2, Identify the Decision, the NDEP has the following comment:
    i. KM has not identified the principal study question, the alternative actions, or organized multiple decisions (if necessary).

d. Step 3, Identify Inputs to the Decision, the NDEP has the following comment:
    i. The NDEP believes that additional inputs may include: results of field screening of soil and groundwater; results of geological data collected; and the results of physical data of the soil. An additional input that should be discussed are the parameters that KM will compare the background data set to in order to determine if the data set is representative of background conditions.

e. Step 4, Study Area Boundaries, the NDEP has the following comments:
    i. KM should also state the depth-related boundary, and the time-related boundary for this study. In addition, it would be helpful if the areal boundaries were correlated to a figure.
    ii. Populations of interest should be defined. Including but not limited to the following examples: surface soil, subsurface soil (and possibly the different geologic formations), and groundwater (and possibly groundwater derived from different geologic formations).
    iii. The scale of decision making and practical constraints have not been discussed.

f. Step 5, Develop a Decision Rule, the NDEP has the following comments:
    i. KM has not specified the statistical parameter(s) that will characterize the population(s) of interest; or the action level that will be the basis for the decision; or combined the statistical parameter, the scale of decision making and the action level into a decision statement.
    ii. The decision statement should be presented in an if-then format to comply with the USEPA guidance.

   g. Step 6, Specify Limits on Decision Error, and Step 7, Optimize the Design, the NDEP has the following comments:
      i. KM has not specified the limits on decision errors for step 6. KM should also discuss the project goals for power and significance. In addition, the null hypothesis has not been stated.
      ii. Step 7 has not been completed in accordance with the USEPA guidance.
      iii. It may not be necessary to complete Steps 6 and 7 of the DQOs. KM is asked to review the USEPA guidance and contemplate if it is necessary to complete Step 6 and 7 of the DQOs.

10. Section 4.1, pages 4-1 and 4-2, KM discusses the analytical data for perchlorate associated with existing well M-10, however, the analytical data for other analytes and other existing locations is not discussed. It is suggested that KM review and discuss the existing data for wells and soil borings in the vicinity of the proposed background locations. Please see additional comments below regarding the proposed background locations.
11. Section 4.1, pages 4-1 and 4-2, KM has proposed to sample soil and groundwater in a number of different geologic formations, however, KM does not discuss how this data will be applied in the future. KM should clarify the purpose of the work plan and identify if this background data set is intended to be applied to soils in the alluvium and the Muddy Creek Formation. In addition, a reference to the applicable tables would be helpful.
12. Section 4.3.1, page 4-3, please explain the methodology by which KM will obtain PID readings. Sonic drilling tends to produce heat which in turn accelerates volatization. PID readings on the outer surface of a soil boring may not be representative of sub-surface conditions.
13. Section 4.3.5, page 4-5, KM indicated that water generated from well development activities will be containerized and temporarily stored on site. Please explain what the final means of disposition and characterization will be for this material.
14. Section 4.3.6.2, pages 4-6 and 4-7, the NDEP has the following comments:
    a. Please include a discussion on well equilibration.
    b. Per USEPA guidance (*Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996), please limit the variance for electrical conductivity to 3%.
    c. Please clarify the criteria for low-flow purging versus traditional purging methodologies. It is likely that low-flow purging may produce variances in analytical results. KM should consider the implementation of either low-flow purging or traditional methodologies and implement this method uniformly.
    d. KM should consider implementing low-flow purging for wells that are located in low yield formations. Please note that TIMET has successfully implemented a low –flow purging and sampling program with some wells yielding as little as 40 mL/minute.
15. Section 4.3.6.3, pages 4-7 and 4-8, please note that USEPA guidance recommends against the use of a bailer for sample collection (*Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, May 2002).

16. Section 5.2, page 5-1, this section does not indicate that the analytical results will be statistically evaluated; see also general comment above on statistical methods. KM should describe how the background data will be evaluated if statistics are not proposed to be used.
17. Section 6.0, page 6-1, please note that the NDEP project manager for this case is Brian Rakvica not "Brian Ratvecka". Mr. Rakvica has been the project manager for this case for nearly two years and this type of error speaks to the lingering quality problems that KM continues to have.
18. Section 6.0, page 6-2, the Project Management Plan does not identify any personnel that perform QA/QC verification of documents prior to and after production. Based on the quality issues that KM has had in the past and continues to have, it is suggested that KM consider a more rigorous internal QA/QC program.
19. Section 7.0, pages 7-1 and 7-2, it would be helpful if KM listed the specific USEPA guidance that this document was prepared to be in compliance with.
20. Table 1, the NDEP has the following comments:
    a. Wells H-11, TR-8, TR-9, TR-10, and M-103 all appear to be impacted by site operations due to elevated concentrations of perchlorate. These elevated levels of this site-related chemical would disqualify these locations as viable background sample locations. The concentrations of perchlorate in these wells range from 47 – 1,000 ppb. If KM believes that these perchlorate concentrations are representative of background conditions the NDEP will require additional documentation to support this opinion.
    b. The NDEP requests that KM include a summary of the historic data from all of the existing wells that are proposed to be used for background. This data summary should include relevant data from the Montrose, Pioneer and Stauffer Corporations.
    c. KM states that there is an upward hydraulic gradient from the Muddy Creek formation to the alluvial aquifer, however, well TR-9 contains 55 ppb perchlorate at 250' bgs. Please explain the mechanism by which perchlorate impacted this well at this depth.
    d. Well H-11 is located south of the Montrose site and downgradient of an impacted site (the Fiesta Casino and adjacent properties). The properties upgradient of well H-11 that are impacted were historically used to stage ore materials and were also used as a historic dump by the BMI Companies. The NDEP explained this to KM in our meeting on March 16, 2005. It is suggested that KM review and present the historic data associated with well H-11. In addition, KM should present additional information to substantiate any opinion that the upgradient properties do not impact well H-11.
    e. Screened intervals, the NDEP has the following comments:
        i. Existing wells H-11, TR-7, TR-8, TR-9, and TR-10 are all screened well below the water table elevation as depicted on Figures 3, 4, and 5. Some wells are at greater than 200' below the existing water table elevation and are screened in a different geologic formation. KM should use existing wells or install new wells that are installed in the geologic formation that is closest to the alluvial aquifer and represents the "same water" that is found in the alluvial aquifer. It is not obvious

that the water located in the second coarse grained facies of the Muddy Creek Formation (MCF) is analogous to the water located in the alluvial aquifer.

ii. It is not clear why new wells are being proposed to be screened nearly 100' below the water table elevation and in a different geologic formation. It is suggested that the wells be screened in the geologic formation that contains the water table aquifer. For example, proposed well M-118 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table elevation is at approximately 50-60' bgs in the first coarse grained facies of the MCF. The NDEP does not understand the justification for such a proposal. Another example is proposed well M-117 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table is at approximately 70' bgs in the first coarse grained facies of the MCF.

21. Table 2, the NDEP has the following comments:
    a. KM has proposed varying sample depths on a location by location basis. This will provide a limited data set for soils below 50' bgs. KM should discuss if two soil samples from depths of 60-120' bgs will be sufficient to evaluate background. Also, it is not clear that the number of samples proposed for the 0-50' bgs depth increment is sufficient. It is the belief of the NDEP that KM will likely need more soil samples from the various depth intervals to appropriately assess background conditions.
    b. Please discuss how the sampling program was developed. All analytes are not proposed to be analyzed at all depths. Further justification for the analyses in the selected depth intervals is required.
    c. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded. The following metals appear to be omitted: calcium, magnesium, platinum, phosphorous, potassium, sodium, strontium, and tin. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, radon 222, and isotopic uranium. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.
    d. KM should list which VOCs are proposed for analysis.

22. Table 3, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. The method listed for perchlorate is EPA 350.1. This is the method for ammonia analysis. Please revise.
    c. It would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.

   d. The method listed for total uranium is EML ASTM D5174. This appears to be the method for uranium analysis in water. Please clarify and revise if necessary.
   e. KM states that radon-222 is not proposed for analysis because there is "no test – too volatile". The NDEP requests that this statement be clarified. There are analytical methods available to detect radon in soil. It appears that method DOE A-01-R (HASL 300) could be used for this purpose.
   f. KM references "EML HASL 300" as the method for a majority of the radionuclides. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics, organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used. For example, method EML GA-01-R MOD is applicable to Lead-210, Lead-212, Lead-214, Bismuth-212, Bismuth-214, Actinium-228, Potassium-40, and Thallium-208.

23. Table 4, the NDEP has the following comments:
   a. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded. The following metals appear to be omitted: platinum, phosphorous, strontium and tin. In addition, hexavalent chromium is not specifically identified. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, and radon 222. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.

24. Table 5, the NDEP has the following comments:
   a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
   b. Two methods are listed for cyanide. One method measures total cyanide and the other measures cyanide available to chlorination. Please discuss if KM plans to analyze by both methods or one of the methods. If KM is choosing to analyze using one of the indicated methods please delete the extraneous reference and explain why that method was chosen. The NDEP suggests that the analysis for total cyanide be used if KM is going to use one of the methods.
   c. Perchlorate is listed twice. Please remove the duplicate reference.
   d. As stated previously, it would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.
   e. Similar to the comment for cyanide, please specify what is intended for phosphate, sulfate, and radon analysis.
   f. KM references "EML HASL 300" as the method for uranium and thorium. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics,

organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used.

25. Figures 3, 4, and 5, it is suggested that these cross-sections be extended to present the data that shows that the water located in the MCF surfaces into the alluvial aquifer.

KERR-McGEE CHEMICAL LLC

Susan Crowley
Staff Environmental Specialist

(702) 651-2234
Fax (405) 228-6882
scrowley@kmg.com

July 20, 2005

Mr. Brian Rakvica, P.E.
Nevada Division of Environmental Protection
1771 East Flamingo, Suite 121-A
Las Vegas, NV 89119-0837

Subject: NDEP Facility ID H-000539 – Kerr-McGee ECA – *Background Study Work Plan – Groundwater and Soils* - Kerr-McGee Response to NDEP May 6, 2005 Comments

Dear Mr. Rakvica:

Kerr-McGee Chemical LLC (Kerr-McGee) has undertaken an Environmental Conditions Assessment (ECA) as directed by Nevada Division of Environmental Protection (NDEP). Integral to that investigation is understanding background conditions associated with the site. In late March 2005, Kerr-McGee submitted a *Background Study Work Plan – Groundwater and Soils* (Work Plan), which once executed is intended to provide information associated with background site conditions. NDEP provided comments regarding the Work Plan on May 6, 2005 and this correspondence provides responses to those comments. Our Work Plan has been revised to reflect the responses provided here but after discussion with your office we will hold on re-submittal of the revised Work Plan until you have reviewed the Attachment A enclosed.

Feel free to call me at (702) 651-2234 if you have any questions regarding this correspondence. Thank you.

Sincerely,

Susan Crowley

Susan Crowley
Staff Environmental Specialist, CEM 1428

Overnight Mail

Cc: Public Repository
Jeff Johnson, NDEP
Jennifer Carr, NDEP
Todd Croft, NDEP
Mitch Kaplan, EPA Region IX
Val King, NDEP
Jim Najima, NDEP
Jon Palm, NDEP

Brenda Pohlmann, COH
Barry Conaty, COH
Ron Sahu, BMI
Carrie Stowers, CCCP
Paul Sunberg, Montrose
Al Tinney, NDEP
Craig Wilkinson, TIMET
Keith Bailey, Kerr-McGee
Sally Bilodeau, ENSR
Pat Corbett, Kerr-McGee
John Dixon, Kerr-McGee
Dave Gerry, ENSR
Ed Krish, ENSR
Tom Reed, Kerr-McGee
Don Shandy, Kerr-McGee
Rick Stater, Kerr-McGee

Attachment

Attachment A
Kerr-McGee response to NDEP
Comments on the Background Investigation Work Plan
dated March 29, 2005 – Letter Dated May 6, 2005
Henderson, Nevada

NDEP Comment 1:

1. General comment, CEM Jurat, the jurat should clarify who is the responsible CEM for this project. There are three signatures on the page and one of the signatures is by a non-CEM. Please revise.

Response:

The signature page has been revised.

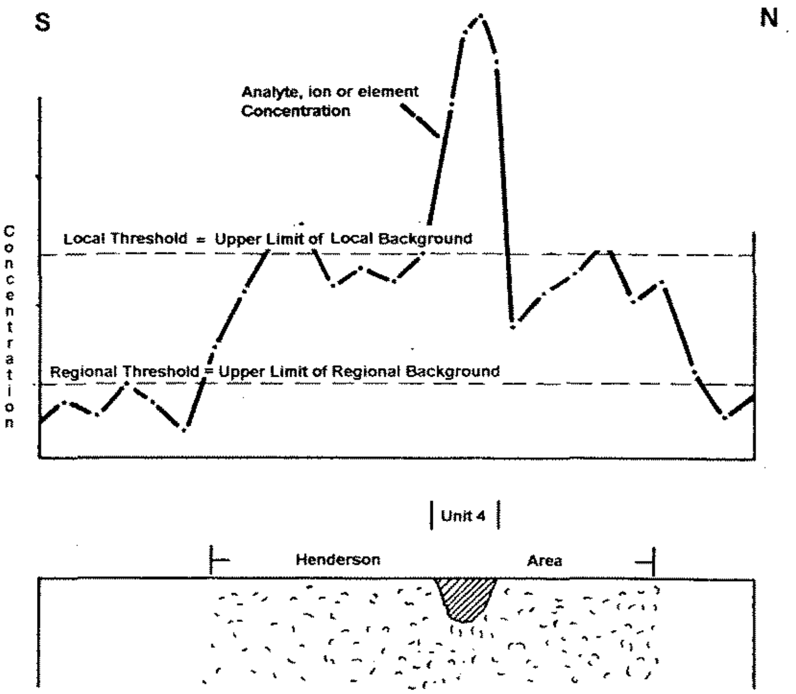
NDEP Comment 2:

2. General comment, this report does not discuss the statistical methods that will be used to evaluate the background data once it is collected. It is suggested that KM describe the statistical methods that will be used to evaluate the background data in the revised version of this report.

Response:

In interpreting the various chemical trends in the area of the Site, it is important to understand the concept of regional versus local background and threshold. As defined in the literature (Levinson, 1980), background is the normal range of concentrations, centered around some most likely value (the median), for an analyte, ion or element in an area. It is essential to understand that background is a range, and that normal backgrounds are established in unimpacted areas. The upper limit of background value, above which samples are considered anomalous, is defined as the threshold. The threshold is the highest background concentration.

Threshold concentrations, like median background concentrations, will vary for each analyte, ion or element, in each formation type and in each area. Concentrations higher than the threshold are considered anomalous and worthy of further evaluation. Statistical analyses of the sampled data allow a threshold to be defined. In most impacted areas there are usually two background values and two threshold values. These are called regional threshold, which is based on the normal (regional) background and the local threshold, based on a local (upgradient) background. The local (upgradient) background gives higher values and is generally in the vicinity of an impacted area. This concept is illustrated in the figure below, modified from Levinson (1980).



Modified from Levinson, 1980

From this figure it can be seen that the regional upper limit of background (the regional threshold) can be considered a "plain" whereas the local upper limit of background (the local threshold) can be considered a "plateau" and the anomalies are represented as peaks. The definition of local backgrounds and thresholds, and the distinction between local and regional backgrounds and thresholds, are of great importance in the interpretation of chemical data.

By way of example, the bottom of the figure shows a theoretical cross section from the Black Mtns. on the south, through the Henderson and the BMI Complex areas, to Frenchman's Mtn on the north. This clearly illustrates the relationship of the higher local Henderson area background to the lower background of the surrounding region and the higher anomalous background in the Unit 4 area to the lower relative background of the Henderson area.

Without the benefit of a detailed geochemical orientation survey, the best way to determine regional and local background and threshold values is by using statistical methods. The conventional method, of taking the threshold as the mean plus two standard deviations, presents problems when dealing with geochemical data. Firstly, this method is designed for single population samples distributed symmetrically (either normal or lognormal). In geochemical surveys, sampling usually includes many individual populations related to bedrock type, environmental phenomena and contamination and therefore precludes the gathering of the requisite single population. Thus this situation really fits a case where the "statistical distribution is irregular" as defined by Hawkes and Webb (1962). Secondly, in areas containing contamination, the *inclusion of erratic high values renders the population asymmetrically distributed and biases the statistics toward the high end. For these kinds of "irregular" distributions the threshold can only be considered an "inspection level" and no true threshold can be determined (Garrett, 1989).*

The preferred method used for determining the median background and upper limit of background (regional and local threshold) is described by Hawkes and Webb (1962). In this method the geochemical data are ordered (ranked) from lowest to highest, as one would do in preparing a cumulative frequency plot, and any erratic high values are set aside and some top percentage of the data are selected for further evaluation. According to these authors, when the statistical distribution is irregular, as it probably is in the Henderson area, "probably the best approximation is to estimate threshold (upper limit of background) as that value which is exceeded by no more than 2.5 percent of the total number of observations, excluding markedly high erratic values". Erratic values are defined as those lacking regularity. They are valid data, collected using approved industry methods and analyzed by reputable geochemical laboratories using approved analytical techniques. The only difference is that the erratic values have a markedly higher analyte content due to the sampling of scattered local anomalous phenomenon.

References:

Garrett, R. G. 1989. A Cry from the Heart. in Explore, Association of Exploration Geochemists Newsletter, Number 66, June 1989, Pg. 18-19.

Hawkes, H.E. and Webb, J.S. 1962. Geochemistry in Mineral Exploration, First edition: Harper and Row, New York, 415p.

Levinson, A.A. 1980. Introduction to Exploration Geochemistry. Second Edition: Applied Publishing, Calgary, 924p.

NDEP Comment 3:

3. General comment, KM should discuss how the proposed background data set will be evaluated versus background data sets collected by others (i.e., the City of Henderson, TIMET and BRC). It may be necessary for KM to consider these other background data sets in the development of the KM background data set. If the background data collected by KM differs from the data collected by others in the same geologic formation KM may need to discuss and justify the differences.

Response:

Kerr-McGee will compare this data set with data sets collected by others as appropriate for data sets collected from different physical locations and different geologic units. Background soil sampling by the City of Henderson, TIMET and BRC will probably suffice to establish the regional background and threshold. Also see the response for NDEP Comment 2.

NDEP Comment 4:

4. General comment, KM should discuss what types of background are proposed to be evaluated. For example, surface soil, sub-surface soil, sub-surface alluvium, sub-surface Muddy Creek formation (and different intervals?), ground water in the water table aquifer, ground water in deeper aquifers, etc.

Response:

Soil samples will be collected from 0.5 feet below ground surface (bgs), subsurface soil/alluvium samples will be collected from depths of 5, 10, 20, 30, 40 feet bgs (i.e. at 10 foot intervals until the Muddy Creek Formation is reached) and Muddy Creek formation samples will be collected at 10 foot intervals to the total depth of each borehole (currently estimated to be 140 feet in M-117 and M-118). Groundwater samples will be collected from the Muddy Creek coarse grained facies 1 and 2 (MCfg 1 and 2) and the Muddy Creek fine grained facies 2. These sample intervals are summarized in Tables 1 and 2 of the Workplan.

NDEP Comment 5:

5. Section 1.0, page 1-1, KM references a meeting that was held on April 1, 2005. This meeting did not occur. Please revise.

Response:

The meeting date has been changed to March 16, 2005.

NDEP Comment 6:

6. Section 1.2, page 1-4, KM states "In February 2004, the NDEP provided a response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that yet additional work would be required including..." The NDEP believes that the tone of this statement is inappropriate and has not been presented with data to not require "additional work". If KM believes that the scope of work that the NDEP is requiring is too onerous, then KM should develop an opinion paper and submit this document to the NDEP prior to the development of any additional reports.

Response:

Kerr-McGee did not intend to offend the NDEP and has removed the "yet" from the sentence.

NDEP Comment 7:

7. Section 2.5, page 2-3, KM describes the water within the Muddy Creek formation as being of "generally good quality" and describes the water from the deeper coarse grained Muddy Creek Formation as containing "55 mg/l calcium, 180 mg/l chloride, 180

mg/l sodium and 250 mg/l sulfate". It would be helpful if this data was compared to site data that is impacted and off-site data that is not impacted. This data has limited meaning when it is not compared to other data sets. KM should substantiate statements in reports with data or references.

Response:

The sentence discussing the data has been removed.

NDEP Comment 8

8. Section 3.0, page 3-1, it is requested that KM provide additional explanation on how the data that is collected for VOCs and TPH will be used. Ideally, background locations would be selected that are not impacted by anthropogenic activities. Also, please explain how KM will differentiate between site-related impacts from VOCs and TPH given the following:
    a. KM has documented releases of TPH on-site and elevated levels of TPH on-site and in the Western Area Power Administration (WAPA) easement.
    b. KM has a number of VOCs that are site-related chemicals.
    c. KM has collected limited groundwater data to determine the breadth and depth of contamination with regards to TPH and VOCs.

Response:

It is acknowledged that if TPH or VOC impacts are detected, additional analysis may be required to determine the extent and/or source of impact. Such analysis could include but not necessarily be limited to fuel fingerprinting.

NDEP Comment 9:

9. Section 3.2, pages 3-1 and 3-2, the NDEP has the following comments:
    a. General comment, it may not be necessary to complete DQOs in order to develop a background data set. If KM chooses to develop a set of DQOs it is necessary to complete these DQOs in accordance with USEPA guidance. The NDEP believes that it is necessary to complete as many steps of the DQOs as possible in order to make sound decisions about site issues. KM has chosen to present an abbreviated implementation of the DQOs and the NDEP believes that this has limited value. Specific comments and examples are provided below.
    b. Step 1, State the Problem, the NDEP has the following comments:
        i. The NDEP believes that the word "alluvium" in this sentence is extraneous. If KM disagrees, please explain how samples will be collected in the "alluvium" that are different than the soil and groundwater samples that are proposed. This comment applies to other steps in the DQOs as well.
        ii. KM has not identified the planning team and decision makers.
        iii. KM has not identified available resources, constraints and deadlines.
        iv. The NDEP believes that a reference to the CSM should be included in this step.

c. Step 2, Identify the Decision, the NDEP has the following comment:
    i. KM has not identified the principal study question, the alternative actions, or organized multiple decisions (if necessary).

d. Step 3, Identify Inputs to the Decision, the NDEP has the following comment:
    i. The NDEP believes that additional inputs may include: results of field screening of soil and groundwater; results of geological data collected; and the results of physical data of the soil. An additional input that should be discussed are the parameters that KM will compare the background data set to in order to determine if the data set is representative of background conditions.

e. Step 4, Study Area Boundaries, the NDEP has the following comments:
    i. KM should also state the depth-related boundary, and the time-related boundary for this study. In addition, it would be helpful if the areal boundaries were correlated to a figure.
    ii. Populations of interest should be defined. Including but not limited to the following examples: surface soil, subsurface soil (and possibly the different geologic formations), and groundwater (and possibly groundwater derived from different geologic formations).
    iii. The scale of decision making and practical constraints have not been discussed.

f. Step 5, Develop a Decision Rule, the NDEP has the following comments:
    i. KM has not specified the statistical parameter(s) that will characterize the population(s) of interest; or the action level that will be the basis for the decision; or combined the statistical parameter, the scale of decision making and the action level into a decision statement.
    ii. The decision statement should be presented in an if-then format to comply with the USEPA guidance.

g. Step 6, Specify Limits on Decision Error, and Step 7, Optimize the Design, the NDEP has the following comments:
    i. KM has not specified the limits on decision errors for step 6. KM should also discuss the project goals for power and significance. In addition, the null hypothesis has not been stated.
    ii. Step 7 has not been completed in accordance with the USEPA guidance.
    iii. It may not be necessary to complete Steps 6 and 7 of the DQOs. KM is asked to review the USEPA guidance and contemplate if it is necessary to complete Step 6 and 7 of the DQOs.

Response:

The DQOs have been removed.

<u>NDEP Comment 10:</u>

10. Section 4.1, pages 4-1 and 4-2, KM discusses the analytical data for perchlorate associated with existing well M-10, however, the analytical data for other analytes and other existing locations is not discussed. It is suggested that KM review and discuss the existing data for wells and soil borings in the vicinity of the proposed background

locations. Please see additional comments below regarding the proposed background locations.

Response:

A table will be added to section 4.1 that will list all of the available recent chemistry for the other existing upgradient wells in the vicinity of the proposed background locations. The contents of the table will be discussed in the text.

NDEP Comment 11:

11. Section 4.1, pages 4-1 and 4-2, KM has proposed to sample soil and groundwater in a number of different geologic formations, however, KM does not discuss how this data will be applied in the future. KM should clarify the purpose of the work plan and identify if this background data set is intended to be applied to soils in the alluvium and the Muddy Creek Formation. In addition, a reference to the applicable tables would be helpful.

Response:

The purpose of this work plan is to characterize the local background geochemistry of the sediments in the different upgradient formations as well as to characterize the local background chemistry of the groundwater that moves through them. It is anticipated that background soil sampling by the City of Henderson, TIMET and BRC will be sufficient to establish the regional background and threshold.

Chemical data generated in the sampling of soil from the different geologic formations will be used to establish a local baseline case showing the present chemical character of these formations at the upgradient edge of the Site. Chemical data generated in the sampling of groundwater from the different geologic formations will also be used to establish a local baseline case showing the present chemical character of these formation waters at the upgradient edge of the Site. These wells will be monitored annually for changes to this baseline. Refer also to the response to comment 2.

NDEP Comment 12:

12. Section 4.3.1, page 4-3, please explain the methodology by which KM will obtain PID readings. Sonic drilling tends to produce heat which in turn accelerates volatization. PID readings on the outer surface of a soil boring may not be representative of sub-surface conditions.

Response:

The following has been added to the workplan. "Approximately 200 grams of soil will be removed from the sampling tube and placed in a zip lock plastic bag. In general soil from the middle sleeve of the sampling tube is used for the PID analysis. Once sealed in the bag the soil will be broken apart and allowed to equilibrate for about 20 minutes. The probe tip of the PID will be inserted into the plastic bag and a reading obtained.

These organic vapor readings will be recorded on boring logs prepared by the field geologist during drilling activities. The PID will be calibrated to 100 ppm isobutylene each day prior to its use."

In response to the heat from sonic drilling, please note that the drill string is removed from the borehole and the split spoon sampler is advanced into "undisturbed" soil, so heat transference from the sonic drill bit to the portion of the soil column that is sampled will be minimal.

NDEP Comment 13:

13. Section 4.3.5, page 4-5, KM indicated that will be containerized and temporarily stored on site. Please explain what the end characterization will be for this material.

Response:

The water generated from well development activities will stored in the GW-11 pond and treated on site.

NDEP Comment 14:

14. Section 4.3.6.2, pages 4-6 and 4-7, the NDEP has the following comments:
    a. Please include a discussion on well equilibration.
    b. Per USEPA guidance (*Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996), please limit the variance for electrical conductivity to 3%.
    c. Please clarify the criteria for low-flow purging versus traditional purging methodologies. It is likely that low-flow purging may produce variances in analytical results. KM should consider the implementation of either low-flow purging or traditional methodologies and implement this method uniformly.
    d. KM should consider implementing low-flow purging for wells that are located in low yield formations. Please note that TIMET has successfully implemented a low –flow purging and sampling program with some wells yielding as little as 40 mL/minute.

Response:

a. *The text has been revised to state, "The well casing will have a vent hole so equilibration of the water level prior to purging and sampling should be achieved. Water levels will be monitored during purging and sampling and, if possible, drawdown will be limited to less than 10 percent of the distance between the initial water level and pump intake."*

b. *Historical data indicate that electrical conductivity varies 5% due to the chemistry of the local aquifer so that site specific value will be applied.*

c. *Kerr-McGee is still in the process of evaluating the purge and sampling methods to apply to the site. It is anticipated that some comparative tests may be proposed to resolve this issue. Kerr-McGee will work closely with NDEP to identify and implement sampling methods that are acceptable to both parties.*

d. *Kerr-McGee is still in the process of evaluating the purge and sampling methods to apply to the site. It is anticipated that some comparative tests may be proposed to resolve this issue. Kerr-McGee will work closely with NDEP to identify and implement sampling methods that are acceptable to both parties.*

NDEP Comment 15:

15. Section 4.3.6.3, pages 4-7 and 4-8, please note that USEPA guidance recommends against the use of a bailer for sample collection (*Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, May 2002).

Response:

Comment noted. See response to 14 c and d above.

NDEP Comment 16:

16. Section 5.2, page 5-1, this section does not indicate that the analytical results will be statistically evaluated; see also general comment above on statistical methods. KM should describe how the background data will be evaluated if statistics are not proposed to be used.

Response:

As described in the response for NDEP Comment 2, Kerr-McGee plans to identify a local threshold (upper limit of background) as that value that is not exceeded by 2.5 percent of the total number of observations, excluding markedly high erratic values.

NDEP Comment 17:

17. Section 6.0, page 6-1, please note that the NDEP project manager for this case is Brian Rakvica not "Brian Ratvecka". Mr. Rakvica has been the project manager for this case for nearly two years and this type of error speaks to the lingering quality problems that KM continues to have.

Response:

Comment noted.

NDEP Comment 18:

18. Section 6.0, page 6-2, the Project Management Plan does not identify any personnel that perform QA/QC verification of documents prior to and after production. Based on the quality issues that KM has had in the past and continues to have, it is suggested that KM consider a more rigorous internal QA/QC program.

Response:

A QA/QC verification of documents team has been designated.

NDEP Comment 19:

19. Section 7.0, pages 7-1 and 7-2, it would be helpful if KM listed the specific USEPA guidance that this document was prepared to be in compliance with.

Response:

The references section has been expanded to include USEPA guidance documents.

NDEP Comment 20:

20. Table 1, the NDEP has the following comments:
    a. Wells H-11, TR-8, TR-9, TR-10, and M-103 all appear to be impacted by site operations due to elevated concentrations of perchlorate. These elevated levels of this site-related chemical would disqualify these locations as viable background sample locations. The concentrations of perchlorate in these wells range from 47 – 1,000 ppb. If KM believes that these perchlorate concentrations are representative of background conditions the NDEP will require additional documentation to support this opinion.
    b. The NDEP requests that KM include a summary of the historic data from all of the existing wells that are proposed to be used for background. This data summary should include relevant data from the Montrose, Pioneer and Stauffer Corporations.
    c. KM states that there is an upward hydraulic gradient from the Muddy Creek formation to the alluvial aquifer; however, well TR-9 contains 55 ppb perchlorate at 250' bgs. Please explain the mechanism by which perchlorate impacted this well at this depth.
    d. Well H-11 is located south of the Montrose site and downgradient of an impacted site (the Fiesta Casino and adjacent properties). The properties upgradient of well H-11 that are impacted were historically used to stage ore materials and were also used as a historic dump by the BMI Companies. The NDEP explained this to KM in our meeting on March 16, 2005. It is suggested that KM review and present the historic data associated with well H-11. In addition, KM should present additional information to substantiate any opinion that the upgradient properties do not impact well H-11.
    e. Screened intervals, the NDEP has the following comments:
        i. Existing wells H-11, TR-7, TR-8, TR-9, and TR-10 are all screened well below the water table elevation as depicted on Figures 3, 4, and 5. Some wells are at greater than 200' below the existing water table elevation and are screened in a different geologic formation. KM should use existing wells or install new wells that are installed in the geologic formation that is closest to the alluvial aquifer and represents the "same water" that is found in the alluvial aquifer. It is not obvious that the water located in the second coarse grained facies of the Muddy Creek Formation (MCF) is analogous to the water located in the alluvial aquifer.
        ii. It is not clear why new wells are being proposed to be screened nearly 100' below the water table elevation and in a different geologic formation.

It is suggested that the wells be screened in the geologic formation that contains the water table aquifer. For example, proposed well M-118 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table elevation is at approximately 50-60' bgs in the first coarse grained facies of the MCF. The NDEP does not understand the justification for such a proposal. Another example is proposed well M-117 is proposed to be screened from 120-140' bgs in the second fine grained facies of the MCF, however, the water table is at approximately 70' bgs in the first coarse grained facies of the MCF.

Response:

a. *In the response to NDEP Comment 2, the concept of regional versus local background and threshold was described and illustrated in a figure. It was stressed that background is a range of values centered around a median concentration and that the threshold is the upper limit of background above which concentrations are anomalous. This concept requires that there will be two backgrounds and two thresholds – a lower regional one and a higher local one. Henderson, by its very nature as a residential/commercial/industrial city, appears to have made its background and threshold the higher local variety. In essence, Henderson, in its 70+ years of existence, has impacted some soil and groundwater. Chemical impacts upgradient of the Kerr-McGee Site contribute to the higher local background and threshold conditions which, in turn, directly impact the Kerr-McGee Site.*

   The NDEP observation of 1000 ug/l perchlorate in well TR-10 has been noted. However the recently discovered 510 and 390 ug/l perchlorate concentrations in groundwater along Lake Mead Parkway, south of TIMET and downgradient of downtown Henderson, appears to indicate other upgradient off-site impacts

   In response to NDEP's concerns, Kerr-McGee has relocated wells M-117 and M-118 to the extreme south end of the property approximately 50 feet north of Lake Mead Parkway. In addition two wells will be constructed in the same area to monitor the first encountered water bearing zone.

b. *A summary table of historic chemical data, of known data quality, will be provided for the existing wells that are proposed to be used for background.*

c. *Potential mechanisms will be discussed.*

d. *The historic data from well H-11, of known data quality, will be presented and the difference between regional background and local (upgradient) background and threshold will be discussed.*

e.i *The TR-series wells were installed in 1999 to specifically look for the deep AMPAC perchlorate plume in the first and second coarse-grained facies of the Muddy Creek formation beneath the Kerr-McGee Site. At that time the eastern most expression of this plume was in the Thatcher well, 3000 feet to the west and possibly in H-11 located 300 feet west of the Kerr-McGee property boundary.*

Kerr-McGee has sought to monitor and understand what upgradient off-Site chemical constituents are flowing toward the Site. The rational for completing proposed wells M-117 and M-118 in the MCfg2 unit is because there are not wells completed in that unit. As mentioned above, the locations for the two new wells have been relocated to the south and two additional wells to monitor the first encountered water bearing zone will also be constructed. Comment noted.

e.ii *In order to be further away and upgradient from historic industrial land uses, Kerr-McGee has relocated wells M-117 and M-118 to the extreme south end of the property just north of the drainage ditch that parallels Lake Mead Parkway. In addition two wells will be constructed in the same area to monitor the first encountered water bearing zone. The map and cross sections will be updated to reflect this change. Comment noted.*

NDEP Comment 21:

21. Table 2, the NDEP has the following comments:
    a. KM has proposed varying sample depths on a location by location basis. This will provide a limited data set for soils below 50' bgs. KM should discuss if two soil samples from depths of 60-120' bgs will be sufficient to evaluate background. Also, it is not clear that the number of samples proposed for the 0-50' bgs depth increment is sufficient. It is the belief of the NDEP that KM will likely need more soil samples from the various depth intervals to appropriately assess background conditions.
    b. Please discuss how the sampling program was developed. All analytes are not proposed to be analyzed at all depths. Further justification for the analyses in the selected depth intervals is required.
    c. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded. The following metals appear to be omitted: calcium, magnesium, platinum, phosphorous, potassium, sodium, strontium, and tin. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, radon 222, and isotopic uranium. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.
    d. KM should list which VOCs are proposed for analysis.

Response:

a. Kerr-McGee will discuss the need for additional background samples following analysis of the samples proposed.
b. Justification for the analysis selected for the depth intervals has been included.
c. Justification for the selected metals and radionuclides has been included.
d. The VOCs proposed for analyses are listed at the end of this document and at the bottom of Table 3.

NDEP Comment 22:

22. Table 3, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. The method listed for perchlorate is EPA 350.1. This is the method for ammonia analysis. Please revise.
    c. It would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.
    d. The method listed for total uranium is EML ASTM D5174. This appears to be the method for uranium analysis in water. Please clarify and revise if necessary.
    e. KM states that radon-222 is not proposed for analysis because there is "no test – too volatile". The NDEP requests that this statement be clarified. There are analytical methods available to detect radon in soil. It appears that method DOE A-01-R (HASL 300) could be used for this purpose.
    f. KM references "EML HASL 300" as the method for a majority of the radionuclides. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics, organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used. For example, method EML GA-01-R MOD is applicable to Lead-210, Lead-212, Lead-214, Bismuth-212, Bismuth-214, Actinium-228, Potassium-40, and Thallium-208.

Response:

a. Comment noted.
b. Comment noted. The method for Perchlorate in soil to be used is EPA 314.0 using preparation method 1:10 DI-leach.
c. The VOCs proposed for analyses are listed at the end of this document and on Table 3.
d. The method to be used for analysis of total Uranium is DOE U-02 using Alpha Spectroscopy.
e. According to the contracted Nevada Certified lab for radionuclide analyses (both soil and water) Radon-222 analyses are not performed on soil, in groundwater the analyses is by Liquid Scintillation SM 7500-RN-B. However, Nevada does not certify a method for Radon-222 in either water or soil.
f. Table 3 has been revised with specific methods.

NDEP Comment 23:

23. Table 4, the NDEP has the following comments:
    a. Please discuss how the metals and radionuclides proposed for analysis relate to the site-related chemicals list and why some chemicals have been excluded.

The following metals appear to be omitted: platinum, phosphorous, strontium and tin. In addition, hexavalent chromium is not specifically identified. The following radionuclides appear to be omitted: actinium 228, bismuth 212, polonium 210, and radon 222. The NDEP does not require that all site-related metals and radionuclides be included, however, justification should be provided for their exclusion.

Response:

Justification for the selected metals and radionuclides has been included.

NDEP Comment 24:

24. Table 5, the NDEP has the following comments:
    a. Please note that the NDEP does not warrant the appropriateness of the methods selected by KM. It is the responsibility of KM to insure that the methods selected will provide data that is usable for the intended purposes and that KM will be in compliance with the NDEP Lab Certification Program. The comments provided below are for informational purposes.
    b. Two methods are listed for cyanide. One method measures total cyanide and the other measures cyanide available to chlorination. Please discuss if KM plans to analyze by both methods or one of the methods. If KM is choosing to analyze using one of the indicated methods please delete the extraneous reference and explain why that method was chosen. The NDEP suggests that the analysis for total cyanide be used if KM is going to use one of the methods.
    c. Perchlorate is listed twice. Please remove the duplicate reference.
    d. As stated previously, it would be helpful if all of the VOCs and fuel alcohols intended for analysis be listed.
    e. Similar to the comment for cyanide, please specify what is intended for phosphate, sulfate, and radon analysis.
    f. KM references "EML HASL 300" as the method for uranium and thorium. EML HASL 300 refers to the procedures of the Environmental Measurements laboratory and can be applied to a number of different analyses (http://www.eml.doe.gov/publications/procman/) including: inorganics, organics, radiochemistry, atmospheric testing and a number of other procedures. Please identify the specific methods that are intended to be used.

Response:

a. Comment noted.

b. The analysis for Total Cyanide will be used (EPA Method 335.2) as it is a better measure of occurrence that will detect free Cyanide and metal associated Cyanides.

c. Comment noted, the duplicate reference has been removed.

d. The list of VOCs to be analyzed is attached in Kerr-McGee's response to comment 25. No fuel alcohols will be analyzed due to the difficulty in analyzing for ethanol and methanol, also methanol is the solvent for the internal standard used in the laboratory making analysis for this analyte virtually impossible.

e. The analysis for phosphate will be the colorimetric method EPA 365.1, which is more sensitive than EPA 300.0. The analysis for sulfate will be EPA 300, which is more precise than EPA 375.4. The analysis for radon will be Standard Methods 7500-RN-B, which is the method proposed by EPA for the Radon Rule and is more precise than EPA 913.0.

f. Total Uranium will be analyzed by DOE U-02 (Alpha Spectroscopy). Isotopic Thorium will be analyzed by ACW-03 (Alpha Spectroscopy), however Nevada does not certified any analysis for Thorium.

NDEP Comment 25:

25. Figures 3, 4, and 5, it is suggested that these cross-sections be extended to present the data that shows that the water located in the MCF surfaces into the alluvial aquifer.

Response:

A north-south cross section (PLATE 4d) that shows the water located in the Muddy Creek formation surfaces into the alluvial aquifer is part of the Conceptual Site Model document dated February 28, 2005. Readers will be referred to that cross section.

24d. List of VOCs to be analyzed in Groundwater and Soil. In groundwater no fuel alcohols will be analyzed due to difficulty in analyzing for ethanol and methanol is the solvent for the internal standard used in the laboratory.

1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane (1,1,2-T
1,1-Dichloroethane
1,1-Dichloroethylene (1,1DCE)
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichloropropane
2,2-Dichloropropane
2-Butanone (MEK)
2-Chloroethylvinyl ether
2-Hexanone
4-Methyl-2-Pentanone (MIBK)
Acetone
Acrylonitrile
Benzene
Bromobenzene
Bromochloromethane
Bromoform
Carbon disulfide
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Dibromomethane
Dichlorobromomethane
Dichlorodifluoromethane
Ethyl benzene
Freon 113
Hexachlorobutadiene
Iodomethane
Isopropylbenzene
m-Dichlorobenzene (1,3-DCB)
Methyl Bromide
Methyl Chloride
*methyl isobutyl ketone**
methyl tert-butyl ether
Methylene Chloride
Naphthalene

n-Butylbenzene
n-Propylbenzene
o-Chlorotoluene
o-Dichlorobenzene (1,2-DCB)
p-Chlorotoluene
p-Dichlorobenzene (1,4-DCB)
p-Isopropyltoluene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene (PCE)
Toluene
Total Trihalomethanes
Total Xylenes
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethylene (TCE)
Trichlorofluoromethane
Vinyl Acetate
Vinyl Chloride (VC)

LEO M. DROZDOFF, *Administrator*
(775) 687-4670

Administration
Facsimile (775) 687-5856

Water Quality Planning
Water Pollution Control
Facsimile (775) 687-4684

Mining Regulations and Reclamation
Facsimile (775) 684-5259

Las Vegas Office
Facsimile (702) 486-2863

STATE OF NEVADA
KENNY C. GUINN
Governor

ALLEN BIAGGI, *Director*

Air Pollution Control
Air Quality Planning
Facsimile (775) 687-6396

Waste Management
Facsimile (775) 687-6396

Corrective Actions
Facsimile (775) 687-8335

Federal Facilities
Facsimile (702) 486-2863

Webpage http://ndep.nv.gov

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
Las Vegas Office
1771 E. Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837
(702) 486-2850

AUG - 1 2005

July 28, 2005

Ms. Susan Crowley
Kerr-McGee Chemical LLC
PO Box 55
Henderson, Nevada 89009

Re: **Kerr-McGee Chemical Corporation LLC (KM)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Background Study Workplan – Groundwater and Soils – Kerr-McGee Response to NDEP May 6, 2005 Comments dated July 20, 2005

Dear Ms. Crowley,

The NDEP has received and reviewed KM's correspondence identified above and provides comments in Attachment A. Please address these comments in the revised workplan, if there are questions it is suggested that these issue be discussed in our next monthly meeting.

If there is anything further or if there are any questions please do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Staff Engineer III
Remediation and LUST Branch
Bureau of Corrective Actions
NDEP-Las Vegas Office

CC:
Jim Najima, NDEP, BCA, Carson City
Jeff Johnson, NDEP, BCA, Carson City
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Rob Mrowka, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BEC, 875 West Warm Springs Road, Henderson, Nevada 89015
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
Mr. George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Mr. Lee Erickson, Stauffer Management Company, 1800 Concord Pike, Hanby 1, Wilmington, DE 19850-5437
Mr. Chris Sylvia, Pioneer Americas LLC, PO Box 86, Henderson, Nevada 89009
Mr. Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110

Attachment A

1. General comment, in a number of instances KM notes that the response is provided in the revised workplan. The NDEP will review the appropriateness of these revisions once the revised workplan in received.
2. Response #2, the NDEP has the following comments:
    a. The NDEP recommends the use of the following statistical tests: Gehan Modification of the Wilcoxon Rank Sum Test; Quantile Test; Slippage Test; and side-by-side plots. The NDEP can provide additional information on these tests and a reference to a website that may assist Kerr-McGee with completing these tests. The derivation of background is an issue that requires rigorous analysis by KM and concurrence by the NDEP.
    b. KM should reference the applicable USEPA guidance on the calculation of the range of background concentrations. Geochemistry textbooks are not an appropriate reference. Please review the applicable USEPA guidance and the KM response.
    c. The NDEP understands and appreciates the importance of establishing upgradient conditions and requests that the terminology of upgradient be used in place of "local background".
    d. KM should note that the range of background concentrations will not necessarily be centered around the median.
3. Response #3, KM should note that the BRC/TIMET evaluation of background includes the evaluation of alluvial soils derived from the River Mountains and McCullough range. This evaluation will also determine if the soils from these two ranges are geologically and chemically similar. KM is located on soils derived from the McCullough Range. Please describe what "different geologic unit" is being referenced by KM in their response. It appears that KM may be referring to soils derived from the Muddy Creek Formation. Please clarify.
4. Response #8, KM should note that the nature and extent of contamination associated with the southern drainage ditch has not been determined and that it is likely that this ditch is a source of perchlorate, TPH, and other contaminants.
5. Response #14a, depending on the methodology used, the drawdown discussed by KM may not be appropriate. If low-flow sampling is performed the drawdown should be limited to less than 0.3 feet at the maximum purge rate. Additionally, it is recommended (for low-flow sampling) that the well equilibration be verified. The well should be opened and a depth to water measurement should be taken. This depth to water measurement should be taken periodically until two consecutive readings within 0.01 feet of each other are recorded. It is recommended that KM discuss the appropriate sampling techniques with a qualified vendor or TIMET personnel.
6. Response #14b, please note that the historical data is not based upon low-flow sampling. Low-flow sampling may allow KM to achieve the less than 3% variance that is requested. The remaining parameters should stabilize prior to sampling of the well. Once KM has selected a sampling method, NDEP will work with KM to determine an appropriate operating procedure. Also, please note that the revised

workplan cannot be approved until a sampling procedure is decided upon and discussed with the NDEP.

7. Response #16, please see NDEP comment above regarding Response #2.
8. Response #20a, KM should note that it is likely that the drainage ditch along the southern property boundary is a likely source of contamination. See also comment #3 above. KM should note that it is possible that the proposed wells may serve as a good indication of upgradient conditions but may not be appropriate for the evaluation of background conditions. As NDEP has discussed with KM previously, it is preferable to locate background locations off-site and upgradient of impacts from the site.
9. Response #24d, it is expected that the revised workplan will provide a discussion on how the VOCs in this list were selected and how they compare to the site-related chemical list.

APPENDIX B

Health and Safety Plan

Health and Safety Plan for Well Installation and Subsurface Investigation of Soils and Groundwater
Kerr-McGee
Henderson, Nevada

Prepared by John Shepard
ENSR Regional Health and Safety Manager

Date: December 3, 2004
Revised: April 7, 2005

Approved by: ______________
ENSR Project Manager

Date: April 7, 2005

Accepted by: ______________
Kerr-McGee

Date: 9-26-05

Project Number 04020-023

Table of Contents

ATTACHMENTS

EXECUTIVE SUMMARY

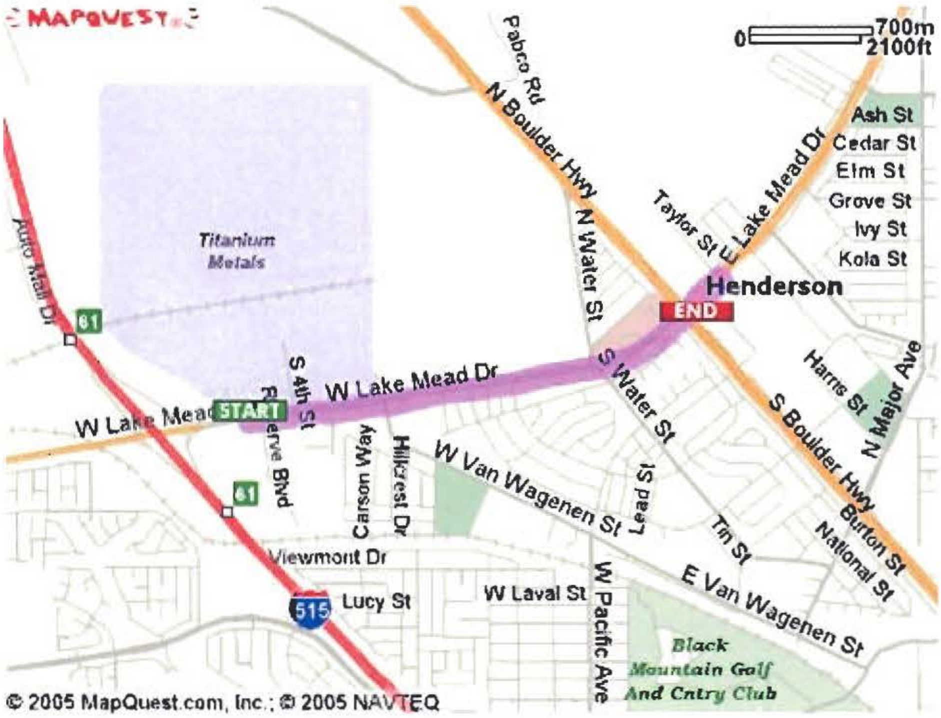
Emergency References

For Well Installation and Subsurface Investigation, Kerr-McGee, Henderson Nevada

Ambulance: 911
Fire: 911
Police: 911

Medical Services:
St Rose Dominican Hospital (702) 616-5000 or (702) 616-4560
102 E Lake Mead Pkwy, Henderson, NV 89015

	Directions	Miles
1.	Start out going EAST on **W LAKE MEAD DR/NV-146** toward RESERVE BLVD. Continue to follow W LAKE MEAD DR.	1.7
2.	Make a U-TURN at **TAYLOR ST** onto E LAKE MEAD DR/NV-564 W.	0.1
3.	End at **St Rose Dominican Hospital**	0.0



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Emergency Muster Point

In case of a site/facility emergency, please meet at

The parking lot in front of the Kerr-McGee office ."

The escape route from the site and an emergency muster point will be determined and provided to all workers during the project mobilization.

Underground Utility Location Service:

DIG SAFE SYSTEM, INC.
Center # 1-888-DIG-SAFE (1-888-344-7233)

CLIENT CONTACTS:

	Office	Cell
Susan Crowley, Site Contact, Project Manager	702 651-2234	702 592-7727
Keith Bailey, Project Engineer	405-270-3651	405-850-3079
Karen Luna, H&S.	702-651-2308	702-592-3486

ENSR Project Representatives:

ENSR /Camarillo, CA	805-338-3775
John Shepard, Regional Health and Safety Manager (RHSM)	972-509-7644
Joe Sanders (alternate RHSM)	970-493-8878
ENSR/PM (Dave Gerry)	805-338-3775 X 244

Hazard Assessment

Chemical Hazards - Perchlorate Compounds

Common salts of perchloric acid are moderately toxic by ingestion and intraperitoneal routes. As a dry compound perchlorates are powerful oxidizers forming explosive mixtures with acetone, 1,3-butylene glycol, 2,3-butylene glycol, CaH_2, charcoal, diaminoethane, dimethyl formamide, ethanolamine, ethylene glycol, formamide, galactose, glycerin, hydrazine, water, NH_4NO_3, Mg, reducing agents, SrH_2, urea. When heated to decomposition it emits toxic fumes of Cl^- and Na_2O.

Dilute solutions in water should be considered mildly toxic and a minor skin irritant.

Other Chemical Hazards

Chemical Name	PEL[1]	TLV[2]	VP[3]	VD[4]	SG[5]	SOL[6]	FP[7]	LEL[8]	UEL[9]
Inorganic Arsenic	0.01	0.002	NA	NA	?	?	NA	NA	NA
Boron as B_2O_3	15	10	NA	NA	2.5	3	NA	NA	NA
Diborane	0.1	0.1	>1000	0.96	NA	reacts	-130	0.8	88
Chromium	1	0.5	NA	NA	7.2	NA	NA	NA	NA
Manganese Compounds	5 (C)	0.2	NA	NA	NA	<1	NA	NA	NA
Vanadium as V_2O_5	0.5 (C)	0.05	NA	NA	3.4	<1	NA	NA	NA
Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radionuclides	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorate Compounds	NA	NA	NA	NA	NA	NA	NA	NA	NA

[1] Permissible Exposure Limit in mg/m^3
[2] Threshold Limit Value in mg/m^3
[3] Vapor Pressure in mm Hg
[4] Vapor Density (air = 1)
[5] Specific Gravity (water = 1)
[6] Solubility in Water in %
[7] Flash Point in °F
[8] Lower Explosive Limit in % by volume
[9] Upper Explosive Limit in % by volume
NA = Not Applicable
? = Not known

Physical Hazards

Dust
Falling objects
Flying objects
Heat
Lifting
Noise
Overhead utilities
Radionuclides
Rotating equipment
Traffic
Tripping
Underground utilities

Personal Protective Equipment

PPE Item	General	Drilling	Sample Collection
Hard Hat	1 & 2	✓	1 & 2
Traffic Vests	2	2	2
Steel Toed Safety Shoes	1	✓	✓
Safety Glasses with Sideshields	1	✓	✓
Hearing Protection		✓	3
PVC or Nitrile Gloves		4	✓
Sun Screen	✓	✓	✓

✓ Required PPE

1 All employees must comply with Kerr-McGee safety requirements.

2 Traffic vests and hardhats are required within twenty feet of any public road or any private road with active traffic.

3 Hearing protection should be worn soil boring equipment if normal conversation cannot be understood.

4 Note that chemical resistant gloves are only required of those that are likely to come in direct contact with potentially contaminated soils and/or groundwater.

Respiratory Protection

Respiratory protection (half or full face mask respirator with combination organic vapor/HEPA cartridges) should also be donned if odors become objectionable at any time or if respiratory tract irritation is noticed.

I, John Shepard certify that this hazard assessment and evaluation was performed on April 7, 2005.

1.0 INTRODUCTION

1.1 HASP Applicability

This site-specific Health and Safety Plan (HASP) has been developed by ENSR Corporation (ENSR), to establish the health and safety procedures required to minimize any potential risk to ENSR and contractor personnel involved subsurface investigations for Kerr-McGee in Henderson, Nevada.

The provisions of this plan apply to all ENSR personnel and ENSR subcontractor personnel who may potentially be exposed to safety and/or health hazards related to activities described in Section 2 and 3 of this document.

This HASP has been written to comply with the requirements of the Occupational Safety and Health Administration (OSHA) Personal Protective Equipment Standard (29 CFR 1910.132) for all activities and the OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) for tasks where there are potential exposures to subsurface contaminants. All activities covered by this HASP must be conducted in complete compliance with this HASP and with all applicable federal, state, and local health and safety regulations. Personnel covered by this HASP who cannot or will not comply will be excluded from site activities.

This plan will be distributed to each employee involved with investigation activity at the Site. Each employee must sign a copy of the attached health and safety plan sign-off sheet (see Attachment A).

This HASP only pertains to the tasks, which are listed in Section 3.0. A task specific HASP or addenda to this HASP will be developed at a later date for any other subsequent investigative/remedial activities at the Site.

1.2 Organization/Responsibilities

The implementation of health and safety at the Site will be the shared responsibility of the ENSR Project Manager (PM), the ENSR Regional Health and Safety Manager (RHSM), the ENSR Project Site Safety Officer (SSO) and other ENSR and contractor personnel.

1.2.1 ENSR Project Manager

The ENSR PM (Dave Gerry) is the individual who has the primary responsibility for the overall health and safety of this project. The PM therefore has the primary responsibility for implementing of the requirements of this HASP. Some of the PM's specific responsibilities include:

- Providing the RHSM with updated data regarding the types and extent of contamination at the Site;
- Assuring that all personnel to whom this HASP applies have received a copy and have submitted a completed copy of the HASP sign-off form;
- Assuring that all ENSR and subcontractor personnel submit documentation of the medical surveillance and training requirements specified in Section 10 of this HASP;
- Assuring that all personnel to whom this HASP applies have attended a pre-entry briefing prior to entering an exclusion zone;
- Maintaining a high level of health and safety consciousness among employees at the work site; and
- Maintaining regular communications with the SSO and, if necessary, the RHSM.

1.2.2 ENSR Regional Health and Safety Manager (RHSM)

The ENSR RHSM (John Shepard) is the individual responsible for the preparation, interpretation and where appropriate, modification of this HASP. Modifications to this HASP which may result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the RHSM. Specific duties of the RHSM include:

- Writing, approving and amending the HASP for this project;
- Advising the PM and SSO on matters relating to health and safety on this site;
- Recommending appropriate personal protective equipment (PPE) and air monitoring instrumentation to protect personnel from potential site hazards;
- Conducting accident investigations; and,
- Maintaining regular contact with the PM and SSO to evaluate site conditions and new information which might require modifications to the HASP.

1.2.3 ENSR Site Safety Officer (SSO)

The ENSR SSO, (to be determined by the project manager), will be on-site during all the activities covered by this HASP. The SSO is responsible for enforcing the requirements of this HASP once on-site work begins. By design, the SSO has the authority, and the responsibility, to immediately correct all situations where noncompliance with this HASP is noted and to immediately stop work in cases where an immediate danger is perceived. Some of the SSO's specific responsibilities include:

- Procuring and distributing the PPE needed for this project for ENSR employees;
- Verifying that all PPE and health and safety equipment is in good working order;
- Procuring the necessary air monitoring equipment for this project and ensuring the required monitoring is conducted in accordance with this plan;
- Setting up and maintaining the contamination reduction zone adjacent to the exclusion areas and assuring proper decontamination of all site personnel and equipment;

- Notifying the PM and RHSM of all noncompliance situations and stopping work in the event that an immediate danger situation is perceived;
- Conducting on site Job Hazard Assessments if conditions or tasks change and communicating with the Regional Health and Safety Manager the results of the Job Hazard Assessment. See attachment D for an assessment form.
- Assisting with accident/incident investigations and preparing accident/incident investigation reports;
- Conducting the pre-entry briefing in accordance with Section 10 and
- Initiating emergency response procedures in accordance with Section 11 of this HASP.

1.2.4 ENSR Field Personnel and Covered Contractor Personnel

All ENSR field personnel and contractor personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner. Some of the specific responsibilities of the field personnel are as follows:

- Reading the HASP in its entirety prior to the start of on-site work;
- Submitting a completed HASP Acceptance Form and documentation of medical surveillance and training to the ENSR PM prior to the start of work;
- Attending the required pre-entry briefing prior to beginning on-site work;
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the RHSM prior to the start of work;
- Reporting all accidents, injuries and illnesses, regardless of their severity, to the ENSR SSO; and
- Complying with the requirements of this HASP and the requests of the SSO.

In addition to other requirements referenced in this HASP, all contractors are required to:

- Provide appropriate PPE for their employees;
- Ensure, via daily inspections, that their equipment is maintained in good working condition;
- Operate their equipment in a safe manner; and
- Appoint an on-site safety coordinator to interface with the ENSR SSO.

1.3 Modification of the HASP

The procedures in this HASP have been developed based on information obtained prior to commencing work at the project site. Should additional information become available regarding potential on-site hazards, it may be necessary to modify this HASP. All proposed modifications to this HASP must be reviewed and approved by the ENSR RHSM before such modifications are implemented.

Any significant modifications must be incorporated into the written document and addenda and the HASP must be reissued. The ENSR PM will ensure that all personnel covered by this HASP receive copies of all issued addenda. Sign-off forms will accompany each addendum and must be signed by all personnel covered by the addendum. Sign-off forms will be submitted to the ENSR PM. The HASP addenda should be distributed during the daily safety meeting so that they can be reviewed and discussed. Attendance forms will be collected during the meeting.

2.0 SITE HISTORY

2.1 Site Description

The Site is approximately 452 acres in size and is located 13 miles southeast of Las Vegas in an unincorporated section of Clark County, Nevada. Elevations across the Site range from 1,677 to 1,873 feet above mean sea level. The land surface across the Site slopes toward the north at a gradient of approximately 0.023 foot per foot (ft./ft.). The developed portions of the Site have been modified by grading to accommodate building foundations, surface impoundments and access roads.

The Site is part of the Black Mountain Industrial (BMI) complex, formerly known as Basic Management Inc. (BMI) and Basic Metals Inc. (BMI). Originally operated as a magnesium production plant by the United States (US) Government the BMI complex has been in operation since 1942. In 1945, a portion of the complex was leased by Western Electrochemical Company (WECCO). In November 1950, a large pilot plant was constructed with operations beginning in 1951. By August 1952, WECCO had purchased several portions of the complex. In May 1953, a ten ton-per-day plant was constructed to replace the pilot plant. In June 1953, production started on high purity manganese metal. In 1955, WECCO merged with American Potash and Chemical Company (AP&CC) and this company operated at the Site through 1967. In 1962, AP&CC purchased the ammonium perchlorate plant, sodium perchlorate plant, and half of the sodium chlorate plant from the federal government. Kerr-McGee purchased AP&CC in 1967. Other companies that have operated within the BMI complex include Stauffer Management Company, Inc., U.S. Lime, Montrose Chemical Corporation, State Industries, Jones Chemical Company, Valite Industries, and Hardesty Chemical Company; currently Titanium Metals Corporation and Pioneer Chlor Alkali Company, Inc. are in operation on the BMI complex. .

During the 1970s, the USEPA, the State of Nevada and Clark County investigated potential environmental impacts from the BMI companies' operations including atmospheric emissions, groundwater and surface water discharges and soil impacts. From 1971 to 1976, Kerr-McGee modified their manufacturing process and constructed lined surface impoundments to recycle and evaporate industrial wastewater. In 1976, Kerr-McGee achieved zero discharge status regarding industrial wastewater management. In 1980, the USEPA requested specific information from the

BMI companies regarding their manufacturing processes and their waste management practices by issuing section 308 letters. In 1994, the NDEP issued a Letter of Understanding (LOU) that identified 69 specific areas or items of interest and indicated the level of environmental investigation they wanted Kerr-McGee to conduct. Numerous investigations have been conducted to evaluate the nature, extent, and movement of contaminants on-site and in downgradient and cross-gradient areas.

Soil and groundwater have been impacted with ammonium perchlorate (AP) and hexavalent chromium as a result of current and historic business operations at this facility. Groundwater beneath the Site is impacted with perchlorate compounds in concentrations of 300 - 400 mg/l. More than 100 groundwater-monitoring wells have been installed onsite. KMCC has constructed a groundwater barrier-wall on the facility and installed roughly 22 groundwater interceptor wells to remove impacted groundwater and send the groundwater to an onsite groundwater treatment system where AP and hexavalent chromium are removed.

3.0 SCOPE OF WORK

3.1 Scope of Work

The scope of work consists of an evaluation of background soil and groundwater conditions at the Site. To assess background soil conditions, the completion of four new upgradient soil borings are proposed near the southern boundary of the Site. During drilling, soil samples would be collected at regular intervals for geologic description and laboratory analyses.

To evaluate background groundwater conditions at the Site, monitoring wells will be installed in two of the four soil borings. The two new wells will complement the six existing monitoring wells near the southern boundary of the Site. Together, these eight wells will form a series of upgradient monitoring wells that will enable a more thorough assessment of background groundwater conditions across the Site.

Once the two new wells are developed, groundwater samples will be collected from all eight upgradient wells for laboratory analyses. Selected soil samples and all groundwater samples will be analyzed for perchlorate, major ions, metals, volatile organic compounds (VOCs) including MTBE and other fuel oxygenates, total petroleum hydrocarbon (TPH), and radionuclide constituents.

A report summarizing the results of the fieldwork and analyses will be prepared and submitted to the NDEP.

4.0 CHEMICAL HAZARD ASSESSMENT AND CONTROLS

4.1 Potential Chemical Contaminants

The potential chemical contaminants at this site are:

- Perchlorate compounds
- Arsenic
- Chromium
- Vanadium
- Manganese
- Boron Compounds
- Chlorate compounds
- Volatile Organic Carbons (VOCs)
- Petroleum Hydrocarbons
- Hexavalent Chromium
- Radionuclides

4.1.1 Volatile Organic Compounds (VOCs)

Organic solvents refer to a group of volatile compounds or mixtures that are relatively stable chemically and that exists in the liquid state at temperatures of approximately 32° to 82°F.

Organic solvents are used for extracting, dissolving, or suspending materials such as fats, waxes, and resins that are not soluble in water. The removal of the solvent from a solution permits the recovery of the solute intact with its original properties. Solvents are used in paints, adhesives, glues coatings, and degreasing/ cleaning agents.

Inhalation and percutaneous absorption are the primary routes of solvent uptake into the peripheral blood, which begins within minutes of the onset of exposure. Organic solvents undergo biotransformation or they accumulate in the lipid-rich tissues such as those of the nervous system.

Solvent inhalation by workers may cause effects ranging from an alcohol-like intoxication to narcosis and death from respiratory failure, with a spectrum of intermediate symptoms that include drowsiness, headache, dizziness, dyspepsia, and nausea. The acute effects of solvent inhalation include narcosis, anesthesia, CNS depression, respiratory arrest, unconscious, and death.

4.1.2 Petroleum Hydrocarbons

Petroleum hydrocarbons are generally considered to be of moderate to low toxicity. Federal or recommended airborne exposure limits have not been established for the vapors of petroleum hydrocarbons. However, inhalation of low concentrations of the vapor may cause mucous membrane irritation. Inhalation of high concentrations of the vapor (which would only be likely to occur in confined spaces where the liquid had been significantly heated) may cause extensive pulmonary edema. Chronic direct skin contact with the liquid may produce skin irritation as a result of defatting.

4.1.3 Perchlorate Compounds

Common salts of perchloric acid are moderately toxic by ingestion and intraperitoneal routes. As a dry compound perchlorates are powerful oxidizers forming explosive mixtures with acetone, 1,3-butylene glycol, 2,3-butylene glycol, CaH2, charcoal, diaminoethane, dimethyl formamide, ethanolamine, ethylene glycol, formamide, galactose, glycerin, hydrazine, water, NH4NO3, Mg, reducing agents, SrH2, urea. When heated to decomposition it emits toxic fumes of Cl^- and Na2O.

Dilute solutions in water should be considered mildly toxic and a minor skin irritant.

4.1.4 Chlorates

Inorganic chlorate compounds are used as an herbicide demonstrating a ten fold increase in plant toxicity over sodium chloride. No exposure limits have been established for chlorate compounds and dusts containing chlorates should be considered irritants.

4.1.5 Inorganic Arsenic

Arsenic enters the body principally through the mouth, either in food or in water. Most ingested arsenic is quickly absorbed through the stomach and intestines and enters the bloodstream, although this varies somewhat for different chemical forms of arsenic. Arsenic, which is inhaled, is also well absorbed through the lungs into the blood stream. Small amounts of arsenic may enter the body through the skin, but this is not usually an important consideration.

Most arsenic that is absorbed into the body is converted by the liver to a less-toxic form that is efficiently excreted in the urine. Consequently, arsenic does not have a strong tendency to accumulate in the body except at high exposure levels.

Inorganic arsenic has been recognized as a human poison since ancient times, and large doses can produce death. Lower levels of exposure may produce injury in a number of different body tissues or systems: these are called "systemic" effects. When taken by mouth, a common effect is irritation of the digestive tract, leading to pain, nausea, vomiting, and diarrhea. Other effects typical of exposure by mouth include decreased production of red and white blood cells, abnormal heart function, blood vessel damage, liver and/or kidney injury, and impaired nerve function causing a "pins-and-needles" feeling in the feet and hands. There is evidence from animal studies that high oral doses during pregnancy may be damaging to the fetus, but this has not been well studied in humans.

Inhalation exposure to inorganic arsenic dusts or fumes sometimes produces the same types of systemic health effects produced by oral exposure. However, this is not common, and the effects are usually mild.

Direct dermal contact with arsenic compounds, frequently from inorganic arsenic dusts in air, may result in mild to severe irritation of the skin, eyes, or throat.

4.1.6 Boron & Borates

Boron oxide and boric acid salts of sodium and potassium are commonly found in nature. Dusts of these chemicals can be eye and respiratory tract irritants. Borates are generally considered to be of low human toxicity.

4.1.7 Boranes

Borane compounds include a series of boron-hydrogen compounds or a derivative of such a compound. As a general rule the smaller the borane molecule the higher the toxicity and the more reactive the molecule is in the environment. Most borane compounds oxidize in air or hydrolyze in water to form borates and hydrogen. Borane (BH_3) rapidly converts to the Diborane (B_2H_4) which reacts immediately on contact with air or water. Higher boranes, i.e., penta-, deca, etc., are formed by condensation reactions of the lower boranes. This series progresses through a number of well-characterized crystalline compounds. Hydrides up to $B_{20}H_{26}$ exist. Most are not very stable and readily react with water to yield hydrogen. Many react violently with air. As a rule, they are highly toxic. There are also a number of organoboranes used as reducing agents in electroless nickel-plating of metals and plastics. Some compounds used are di- and tri-ethlylamine borane and pyridine borane. Organic boranes such as triehtylborane also react on contact with air or water. It is very unlikely that borane compounds will be encountered in the environment. The most likely potential exposures would be found in industrial chemical storage and processing areas.

4.1.8 Chromium

Chromium compounds vary greatly in toxicity. Chrome metal, the di-valent (chromous), and the tri-valent (chromic) compounds have low to moderate toxicities. They are poorly absorbed through the skin and mucous membranes, but may cause irritation. Chrome metal, unlike nickel, does not cause allergic contact dermatitis. Nor is it known to cause pulmonary fibrosis or cancer.

Hexavalent chrome compounds (eg. chromic acid and chromates) are corrosive to the skin and mucous membranes. They cause extreme irritation to the nose, throat, and lungs, and may produce chrome sores, ulcers, nasal septum perforations, and pulmonary edema. Hexavalent chrome can cause allergic sensitization, bronchitis, and kidney damage. Cancers of the lung and nasopharynx are associated with heavy exposures.

The PEL for chrome metal, di-valent, and tri-valent chrome compounds is 0.5 mg/m^3. For hexavalent chrome, the PEL is 0.05 mg/m^3.

4.1.9 Manganese Compounds

Manganese is an essential trace element. In excess, it is of medium toxicity to humans. Manganese poisoning is rare and is limited to those exposed occupationally, in the manufacture of manganese compounds and in the pottery manufacturing. It is a respiratory irritant when inhaled and long-term exposure produces symptoms similar to those of Parkinson's disease

Manganese can exist as compounds in up to eight different valence states, which may be cations or anions. It appears that cationic manganese compounds are more toxic than anionic compounds, and that $Mn2^+$ is more toxic than $Mn3^+$. Manganese and its compounds are usually absorbed into the body by oral and respiratory routes, in the form of dust.

In excess amounts, manganese can cause irreversible nervous system damage· Studies have shown that the effects of manganese in the brain are due to the presence of lesions and degeneration in the basal ganglia. The metal is also known to block calcium channels, and with chronic intoxication the levels of dopamine in the CNS are depleted, which causes the Parkinson's-like symptoms.

4.1.10 Vanadium Compounds

Everyone is exposed to low levels of vanadium in air, water, and food. Vanadium is typically encountered as the pentoxide in nature. As a pure powder, vanadium oxide is yellow to orange and is easily dispersed in air. Exposure to the dust of vanadium oxide causes irritation of the eyes and upper respiratory tract. Breathing high levels of vanadium may cause lung irritation, chest pain, coughing, and other effects. Ingestion or high exposures by inhalation cause the tongue to become green and a strong metallic taste.

4.1.11 Radionuclides

A radionuclide is an isotope of an element that exhibits radioactivity. Radionuclides can be man made, naturally occurring, or the product of the decay of another radioactive isotope.

Naturally occurring radionuclides including Radium, Radon, Thorium, and Uranium is present in virtually all soil, rock and water. These radionuclides are distributed throughout the environment by wind, rain and geologic processes. Rocks weather and break down to form soil, and soil can be washed by water and blown by wind, moving uranium into streams and lakes, and ultimately settling out and reforming as rock

The radionuclides of lead are produces by the decay of thorium and uranium.

A person can be exposed to radionuclides by inhaling dust in air, or ingesting water and food. The general population is exposed primarily through food and water. The greatest health risk from large intakes of radionuclides is toxic damage to the kidneys, because, in addition to being weakly radioactive, uranium, thorium and radium are toxic metals.

There is little exposure hazard when working around naturally occurring radionuclides and their decay products. If these materials are enriched or refined, exposure hazards can be created. Radon gas can pose an exposure hazard if it is allowed to accumulate in closed areas such as vaults, cellars, and wells.

4.2 Summary of Hazardous Properties of Potential Contaminants

Chemical Name	PEL[1]	TLV[2]	VP[3]	VD[4]	SG[5]	SOL[6]	FP[7]	LEL[8]	UEL[9]
Inorganic Arsenic	0.01	0.002	NA	NA	?	?	NA	NA	NA
Boron as B_2O_3	15	10	NA	NA	2.5	3	NA	NA	NA
Diborane	0.1	0.1	>1000	0.96	NA	reacts	-130	0.8	88
Chromium	1	0.5	NA	NA	7.2	NA	NA	NA	NA
Manganese Compounds	5 (C)	0.2	NA	NA	NA	<1	NA	NA	NA
Vanadium as V_2O_5	0.5 (C)	0.05	NA	NA	3.4	<1	NA	NA	NA
Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radionuclides	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorate Compounds	NA	NA	NA	NA	NA	NA	NA	NA	NA

[1] Permissible Exposure Limit in mg/m^3

[2] Threshold Limit Value in mg/m^3

[3] Vapor Pressure in mm Hg

[4] Vapor Density (air = 1)

[5] Specific Gravity (water = 1)

[6] Solubility in Water in %

[7] Flash Point in °F

[8] Lower Explosive Limit in % by volume

[9] Upper Explosive Limit in % by volume

NA = Not Applicable

? = Not known

4.3 Chemical Exposure Potential/Control

4.3.1 Potential Routes of Exposure

The potential routes of exposure to the contaminants of concern include:

- Dermal contact with contaminated soils during soil boring and soil sample collection;
- Dermal contact with contaminated groundwater during well installation and groundwater sampling;
- Inhalation of vapors during soil boring and soil sampling; and
- Inhalation of vapors during well installation and groundwater sampling.

4.3.2 Exposure Control

As a precaution, ENSR will be conducting air monitoring in the worker's breathing zone to determine exposures to vapors during the subsurface investigations. If exposures exceed the action levels as defined in Section 4, respiratory protection as discussed in Section 7 will be donned.

To avoid direct dermal contact with contaminated media, protective clothing as described in Section 7 will be required when collecting samples and decontaminating sampling equipment.

Although highly unlikely, exposure to all of the contaminants of concern may occur via ingestion (hand-to-mouth transfer). The decontamination procedures described in Section 9 address personal hygiene issues that will limit the potential for contaminant ingestion.

4.4 Hazardous Substances Brought On-Site by ENSR

A material safety data sheet (MSDS) must be available for each hazardous substance that ENSR bring on the property. This includes solutions/chemicals that will be used to decontaminate sampling equipment. Containers of hazardous materials must be properly labeled in accordance with OSHA's Hazard Communication Standard.

4.5 Physical Hazards and Controls

4.5.1 Drilling Hazards

Use of a drill rig to advance soil borings and install monitoring wells will require personnel in the vicinity of the operating rig to wear steel-toed boots, hard hats, hearing protection and safety eyewear. Personnel shall not remain in the vicinity of operating equipment unless it is required for their work responsibilities.

Additionally, the following safety requirements must be adhered to:

- Drill rigs and other machinery with exposed moving parts must be equipped with an operational emergency stop device. Drillers and geologists must be aware of the location of this device. This device must be tested prior to job initiation and periodically thereafter. The driller and helper shall not simultaneously handle augers unless there is a standby person to activate the emergency stop.
- The driller must not leave the controls while the tools are rotating unless all personnel are kept clear of rotating equipment.
- A long-handled shovel or equivalent must be used to clear drill cuttings away from the hole and from rotating tools. Hands and/or feet are not to be used for this purpose.

- A remote sampling device must be used to sample drill cuttings if the tools are rotating or if the tools are readily capable of rotating. Samplers must not reach into or near the rotating equipment. If personnel must work near any tools, which could rotate, the driller must shut down the rig prior to initiating such work.

- Driller's, helpers and geologists must secure loose clothing when in the vicinity of drilling operations.

- Only equipment, which has been approved by the manufacturer, may be used in conjunction with site equipment and specifically to attach sections of drilling tools together. Pins that protrude excessively from augers shall not be allowed

- No person shall climb the drill mast while tools are rotating.
    - No person shall climb beyond 6 feet above ground on the drill mast without the use of ANSI-approved fall protection (approved belts, lanyards and a fall protection slide rail) or portable ladder which meets the requirements of OSHA standards.

4.5.2 Heat Stress

Types of Heat Stress

Heat related problems include **heat rash, fainting, heat cramps, heat exhaustion and heat stroke**. **Heat rash** can occur when sweat isn't allowed to evaporate; leaving the skin wet most of the time and making it subject to irritation. **Fainting** may occur when blood pools to lower parts of the body and as a result, does not return to the heart to be pumped to the brain. Heat related fainting often occurs during activities that require standing erect and immobile in the heat for long periods of time. **Heat cramps** are painful spasms of the muscles due to excessive salt loss associated with profuse sweating.

Heat exhaustion results from the loss of large amounts of fluid and excessive loss of salt from profuse sweating. The skin will be clammy and moist and the affected individual may exhibit giddiness, nausea and headache.

Heat stroke occurs when the body's temperature regulatory system has failed. The skin is hot, dry, red and spotted. The affected person may be mentally confused and delirious. Convulsions could occur. EARLY RECOGNITION AND TREATMENT OF HEAT STROKE ARE THE ONLY MEANS OF PREVENTING BRAIN DAMAGE OR DEATH. A person exhibiting signs of heat stroke should be removed from the work area to a shaded area. The person should be soaked with water to promote evaporation. Fan the person's body to increase cooling.

Increased body temperature and physical discomfort also promote irritability and a decreased attention to the performance of hazardous tasks.

Early Symptoms of Heat-Related Health Problems:

decline in task performance
incoordination
decline in alertness
unsteady walk
excessive fatigue
reduced vigilance
muscle cramps
dizziness

Susceptibility to Heat Stress Increases due to:

lack of physical fitness
lack of acclimation
increased age
dehydration
obesity
drug or alcohol use
sunburn
infection

People unaccustomed to heat are particularly susceptible to heat fatigue. First timers in PPE need to gradually adjust to the heat.

The Effect of Personal Protective Equipment

Sweating normally cools the body as moisture is removed from the skin by evaporation. However, the wearing of certain personal protective equipment (PPE), particularly chemical protective coveralls (e.g., Tyvek), reduces the body's ability to evaporate sweat and thereby regulate heat buildup. The body's efforts to maintain an acceptable temperature can therefore become significantly impaired by the wearing of PPE.

Measures to Avoid Heat Stress:

The following guidelines should be adhered to when working in hot environments:

Establish work-rest cycles (short and frequent are more beneficial than long and seldom).

- Identify a shaded, cool rest area.
- Rotate personnel, alternative job functions.
- Water intake should be equal to the sweat produced. Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst. **DO NOT DEPEND ON THIRST TO SIGNAL WHEN AND HOW MUCH TO DRINK**. For an 8-hour work day, 50 ounces of fluids should be drunk.
- Eat lightly salted foods or drink salted drinks such as Gatorade to replace lost salt.
- Save most strenuous tasks for non-peak heat hours such as the early morning or at night.
- Avoid alcohol during prolonged periods of heat. Alcohol will cause additional dehydration.
- Avoid double shifts and/or overtime.

The implementation and enforcement of the above mentioned measures will be the joint responsibility of the project manager, on-site field coordinator, and health and safety officer. Potable water and fruit juices should be made available each day for the field team.

Heat Stress Monitoring Techniques

Site personnel should regularly monitor their heart rate as an indicator of heat strain by the following method:

Radial pulse rates should be checked by using fore-and middle fingers and applying light pressure top the pulse in the wrist for one minute at the beginning of each rest cycle. If the pulse rate exceeds 110 beats/minute, the next work cycle will be shortened by one-third and the rest period will be kept the same. If, after the next rest period, the pulse rate still exceeds 110 beats/minute, the work cycle will be shortened again by one-third.

4.5.3 Noise Exposure

The use of the drilling rig will generate noise levels that will require the use of hearing protection in the immediate vicinity. Appropriate earmuff or earplugs (i.e., with an NRR greater than 25 dB) should be worn to prevent overexposure. The general rule of thumb is that if you have to raise your voice to be understood by someone who is standing 3 to 5 feet away from you, the noise levels are likely to be above 85 dB and therefore require the use of hearing protection.

4.5.4 Underground Utility Hazards

Law requires that a utility clearance survey must be performed before any subsurface activities are performed. The utility clearance survey must be requested from:

DIG SAFE SYSTEM, INC.
Center # 1-888-DIG-SAFE (1-888-344-7233)

The survey must be requested at least 72 hours (i.e., 3 full business days) prior to conducting the subsurface activities. The Digsafe ticket should be updated by requesting a remark every 30 days. Remember that digging outside of your originally specified boundaries requires that a new survey be performed.

Be aware that utility companies often can not identify the exact location of their underground services once they cross onto private property. (Note: Utility clearance survey requests are still required on private property). Private property owners may have rerouted these services or installed their own.

4.5.5 Overhead Utility Hazards

Any vehicle or mechanical equipment, particularly the mast of the drilling rig, that is capable of having parts of its structure elevated near energized overhead lines shall be operated so that a minimum clearance of 10 feet is maintained at all times.

4.5.6 Back Safety

Using the proper techniques to lift and move heavy pieces of equipment, such as drums of investigation-derived wastes, is important to reduce the potential for back injury. The following precautions should be implemented when lifting or moving heavy objects.

- Bend at the knees, not the waist. Let your legs do the lifting.
- Do not twist while lifting
- Bring the load as close to you as possible before lifting
- Be sure the path you are taking while carrying a heavy object is free of obstructions and slip, trip and fall hazards
- Use mechanical devices to move objects, such as drums of investigation derived wastes or generators, that are too heavy to be moved manually
- If mechanical devices are not available, ask another person to assist you.

4.5.7 Traffic Safety

The following precautions should be followed to draw attention to you and to warn other people of your presence in high traffic areas.

- Notify the property representative of your work location, dates of work and the anticipated work times and suggest the possibility of a detour around the work area.
- Wear an orange safety vest. If work is being performed at dawn, dusk or evening, the vests must have reflective tape.
- Set up traffic cones 50 feet in front of the work area. "Men at Work" signs should also be placed in a conspicuous area to warn others of your presence.
- Use an employee to direct traffic in high traffic areas where the hazard may increase.

5.0 AIR MONITORING

ENSR will not conduct air monitoring to since the expected contaminants are inorganic and not volatile.

Personal air sampling will not be conducted by ENSR during the activities covered by this HASP.

6.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) will be worn during these activities to prevent on-site personnel from being injured by the safety hazards posed by the site and/or the activities being performed. In addition, chemical protective clothing will be worn to prevent direct dermal contact with the site's chemical contaminants. The following table describes the PPE and chemical protective clothing to be worn for general site activities and for certain specific tasks.

6.1 Protective Clothing

PPE Item	General	Drilling	Sample Collection
Hard Hat	1 & 2	✓	1 & 2
Traffic Vests	2	2	2
Steel Toed Safety Shoes	1	✓	✓
Safety Glasses with Sideshields	1	✓	✓
Hearing Protection		✓	3
PVC or Nitrile Gloves		4	✓
Sun Screen	✓	✓	✓

✓ Required PPE
1 All employees must comply with Kerr-McGee safety requirements.
2 Traffic vests and hardhats are required within twenty feet of any public road or any private road with active traffic.
3 Hearing protection should be worn soil boring equipment if normal conversation cannot be understood.
4 Note that chemical resistant gloves are only required of those that are likely to come in direct contact with potentially contaminated soils and/or groundwater.

6.2 Respiratory Protection

Respiratory protection (half or full face mask respirator with combination organic vapor/HEPA cartridges) should also be donned if odors become objectionable at any time or if respiratory tract irritation is noticed.

6.3 Other Protective Equipment

The following additional safety items should be available at the site:

- Portable, hand-held eyewash bottles
- First aid kit

7.0 SITE CONTROL

To prevent both exposure of unprotected personnel and migration of contamination due to tracking by personnel or equipment, work areas along with personal protective equipment requirements will be clearly identified.

7.1 Designation of Zones

If it is determined that there is contamination in the subsurface soil or groundwater, ENSR will designate work areas or zones as suggested in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," NIOSH/OSHA/USCG/EPA, November 1985. They recommend the areas surrounding each of the work areas to be divided into three zones:

- Exclusion or "hot" Zone
- Contamination Reduction Zone (CRZ)
- Support Zone

7.1.1 Exclusion Zone

The exclusion zone will include the area that immediately surrounds the drilling activities. This zone should be sufficiently large to protect unprotected personnel from contact with vapors or dusts that may arise from these operations as well as the physical hazards associated with the operation of heavy equipment. As a minimum, the exclusion zone should include the area scribed by the shadow of the mast of the drilling rig. All personnel entering the exclusion zone must be trained in accordance with the requirements defined in Sections 10 and 11 of this HASP and must wear the level of personal protective equipment prescribed in section 7.

7.1.2 Contamination Reduction Zone

The Contamination Reduction Zone or decontamination area will be established adjacent to the exclusion zone. Personnel will remove contaminated gloves, Tyvek and other disposable items in this area and place them in a plastic bag until they can be properly disposed of in accordance with the work plan requirements.

7.1.3 Support Zone

At this site the support zone will include the area outside of the exclusion and contamination reduction zones.

7.2 Safety Practices

The following measures are designed to augment the specific health and safety guidelines provided in this plan.

- The "buddy system" will be used at all times by all field personnel. No one is to perform fieldwork alone. Standby team member must be intimately familiar with the procedures for initiating an emergency response.
- Eating, drinking, chewing gum or tobacco, smoking or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in the immediate work area and the decontamination zone.
- Smoking is prohibited in all work areas. Matches and lighters are not allowed in these areas.
- Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking or any other activities.
- Beards or other facial hair that interfere with respirator fit are prohibited.
- The use of alcohol or illicit drugs is prohibited during the conduct of field operations.
- All equipment must be decontaminated or properly discarded before leaving the site in accordance with the project work plan.

8.0 DECONTAMINATION

8.1 Personal Decontamination

Proper decontamination is required of all personnel before leaving the site. Decontamination will occur within the contamination reduction zone.

Regardless of the type of decontamination system required, a container of potable water and liquid soap should be made available so employees can wash their hands and face before leaving the site for lunch or for the day.

After leaving the work area and before eating, smoking or drinking, employees must wash their face and hands with soap and water.

8.2 PPE Decontamination

Disposable PPE, such as Tyvek coveralls, gloves, etc. will be removed and placed in garbage bags. Final disposal of contaminated PPE will be in accordance with the work plan.

If worn, respirators will be cleaned after each use with respirator wipe pads and will be stored in plastic bags after cleaning. Respirators will be thoroughly cleaned using disinfectant material within one week following any respirator use. Refer to the cleaning instructions provided with the respirator or specified by the OSHA regulations at 29 CFR 1910.134.

8.3 Equipment Decontamination

Equipment will be decontaminated prior to being moved to other locations. Decontamination procedures will be specified by the Project Manager.

9.0 MEDICAL MONITORING AND TRAINING REQUIREMENTS

9.1 Medical Monitoring

All personnel performing activities covered by this HASP must be active participants in ENSR's Medical Monitoring Program or in a similar program which complies with 29 CFR 1910.120(f). Each individual must have completed an annual surveillance examination and/or an initial baseline examination within the last year prior to performing any work on the site covered by this HASP.

9.2 Health and Safety Training

If it is determined that there is contamination in the subsurface soil or groundwater, all personnel performing activities covered by this HASP must have completed the appropriate training requirements specified in 29 CFR 1910.120(e). Each individual must have completed an annual 8-hour refresher-training course and/or initial 40-hour training course within the last year prior to performing any work on the sites covered by this HASP. All workers will have completed three days of supervised work on hazardous waste sites before being allowed to work unsupervised. Also, on-site managers and supervisors directly responsible for supervising individuals engaged in hazardous waste operations must have completed the specified 8-hour managers training course. (Note that ENSR corporate policy requires that whenever three or more ENSR employees are performing work on the same site, at least one of these individuals must have completed the manager's training course.)

9.3 Pre-Entry Briefing

Prior to the commencement of on-site activities, a pre-entry briefing will be conducted by the ENSR SSO to review the specific requirements of this HASP. HASP sign-off sheets will be collected at this meeting. Short safety refresher meetings will be conducted, as needed, throughout the duration of the project. Attendance of the pre-entry meeting is mandatory and will be documented by the ENSR SSO. An attendance form is presented in Attachment B.

10.0 EMERGENCY RESPONSE

OSHA defines emergency response as any "response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result in an uncontrolled release of a hazardous substance." According to ENSR policy, ENSR personnel shall not participate in any emergency response where there are potential safety or health hazards (i.e., fire, explosion, or chemical exposure). ENSR response actions will be limited to evacuation and medical/first aid as described within this section below. As such this section is written to comply with the requirements of 29 CFR 1910.38 (a).

The basic elements of an emergency evacuation plan include:

- employee training,
- alarm systems,
- escape routes,
- escape procedures,
- critical operations or equipment,
- rescue and medical duty assignments,
- designation of responsible parties,
- emergency reporting procedures and
- methods to account for all employees after evacuation.

10.1 Employee Training

Employees must be instructed in the specific aspects of emergency evacuation applicable to the site as part of the site safety meeting prior to the commencement of all on-site activities. On-site refresher or update training is required anytime escape routes or procedures are modified or personnel assignments are changed.

10.2 Alarm Systems/Emergency Signals

An emergency communication system must be in effect at all sites. The most simple and effective emergency communication system in many situations will be direct verbal communications. Each site must be assessed at the time of initial site activity and periodically as the work progresses. Verbal communications must be supplemented anytime voices can not be clearly perceived above ambient noise levels (i.e., noise from heavy equipment; drilling rigs, backhoes, etc.) and anytime a clear line-of-sight can not be easily maintained amongst all ENSR personnel because of distance, terrain or other obstructions.

Verbal communications will be adequate to warn employees of hazards associated with the immediate work area. However, it may be difficult to maintain a clear line-of-sight with employees because of the size and remoteness of the site. Walkie-talkies or an emergency air horn must be carried by employees who are working in out of sight locations to enhance their communication with employees working on the site proper. If telephone service is not immediately available upon arrival to the site, a portable phone must be made available to facilitate emergency communications.

10.3 Escape Routes and Procedures

The escape route from the site and an emergency muster point will be determined and provided to all workers during the project mobilization.

10.4 Employee Accounting Method

The SSO is responsible for identifying all ENSR personnel on-site at all times. On small, short duration jobs this can be done informally as long as accurate accounting is possible. On all other sites a formal log-in and log-out procedure must be implemented.

10.5 Rescue and Medical Duty Assignments

The phone numbers of the police and fire departments, ambulance service, local hospital, and ENSR representatives are provided in the emergency reference sheet. This sheet will be posted in the site vehicle and on-site office trailer.

In the event an injury or illness requires more than first aid treatment, the SSO will accompany the injured person to the medical facility and will remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the on-site project manager and the RHSM.

If the injured employee can be moved from the accident area, he or she will be brought to the CRZ where their PPE will be removed. If the person is suffering from a back or neck injury the person will not be moved and the requirements for decontamination do not apply. The SSO must familiarize the responding emergency personnel about the nature of the site and the injury. If the responder feels that the PPE can be cut away from the injured person's body, this will be done on-site. If this not feasible, decontamination will be performed after the injured person has been stabilized.

10.6 Designation of Responsible Parties

The SSO is responsible for initiating emergency response. In the event the SSO cannot fulfill this duty, the alternate SSO will take charge. All personnel on site are responsible for knowing the escape route from the site and where to assemble after evacuation.

10.7 Incident Reporting

All incidents must be reported to the ENSR Project Manager Dave Gerry (805-388-3775) and then to the ENSR Regional Health and Safety Manager, John Shepard (972-509-7644).

10.8 Accident Investigation

Any incident (other than minor first aid treatment) resulting in injury, illness or property damage requires an accident investigation and report. The investigation should be conducted as soon as emergency conditions are under control. The purpose of the investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided. An ENSR accident investigation form is presented in Attachment C of this HASP. The injured ENSR employee's supervisor and the RHSM should be notified immediately of the injury. If a subcontractor employee is injured, they are required to notify the ENSR SSO. Once the incident is under control, the subcontractor will submit a copy of their company's accident investigation report to the ENSR SSO.

Attachment A

Health and Safety Plan Acceptance Form

Health and Safety Plan Receipt and Acceptance Form

Subsurface Investigation of Soils and Groundwater
Kerr-McGee
Henderson, Nevada

I, as an employee of ENSR Corporation or its contractors have received a copy of the Health and Safety Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name (Print) ____

Signature ______________________________________ Date: ___________________

Representing (Print) ___________________________________
Company Name

Attachment B

Health and Safety Pre-Entry Briefing Attendance

Health and Safety Pre-Entry Briefing Attendance
Subsurface Investigation of Soils and Groundwater
Kerr-McGee
Henderson, Nevada

Date Performed: ______________________________

Printed Name	Signature	Representing

Attachment C

Supervisor's Accident Investigation Report

SUPERVISOR'S ACCIDENT INVESTIGATION REPORT

Injured Employee ______________________________ Job Title

Home Office ______________________________ Division/Department

Date/Time of Accident

Location of Accident

Witnesses to the Accident

Injury Incurred? _______ Nature of Injury

Engaged in What Task When Injured? ____

Will Lost Time Occur? _______ How Long? _________ Date Lost Time Began _________________

Were Other Persons Involved/Injured?

How Did the Accident Occur?

What Could Be Done to Prevent Recurrence of the Accident? ______________________________

What Actions Have You Taken Thus Far to Prevent Recurrence? ____________________________

Supervisor's Signature _________________________ Title ___________________ Date

Reviewer's Signature _________________________ Title ___________________ Date

Note: If the space provided on this form is insufficient, provide additional information on a separate page and attach. The completed accident investigation report must be submitted to the Regional Health and Safety Manager within two days of the occurrence of the accident.

Attachment D

Job Hazard Assessment

Job Hazard Assessment Form

Subsurface Investigation of Soils and Groundwater
Kerr-McGee
Henderson, Nevada

To be used for field assessments of new hazards

PRINCIPAL STEPS	**POTENTIAL HAZARDS**	**RECOMMENDED CONTROLS**
SAFETY EQUIPMENT	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**

Attachment E

Material Safety Data Sheets

Alconox® Material Safety Data Sheet

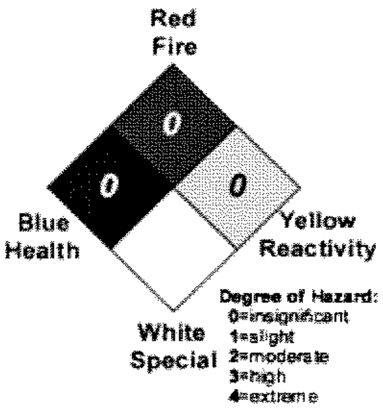
Alconox, Inc.
30 Glenn Street, Suite 309
White Plains, NY 10603

24 Hour Emergency Number - Chem-Tel (800) 255-3924

I. Identification

Product Name (shown on label):	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 1999
Chemical Family:	Anionic Powdered Detergent
Mfr. Catalog #s for Sizes:	1104, 1125, 1150, 1101, 1103, 1112

National Fire Protection Association 704 Labeling:



NJTSRN: 1100

II. Hazardous Ingredients/Identity Information

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. Physical/Chemical Characteristics

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Melting Point:	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.

IV. Fire and Explosion Data

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be

	worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. Reactivity Data

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO2 on burning

VI. Health Hazard Data

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. Precautions for Safe Handling and Use

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and	Material should be stored in a dry area to

Handling:	prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VII. Control Measures

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

APPENDIX C

Examples of Field Forms

ENSR	*Client:*		***BORING ID:***
	Project Number:		
	Site Location:		
	Coordinates:	*Elevation:*	*Sheet: 1 of 1*
	Drilling Method:		*Monitoring Well Installed:*
	Sample Type(s):	*Boring Diameter:*	*Screened Interval:*

Weather:	*Logged By:*	*Date/Time Started:*	*Depth of Boring:*
Drilling Contractor:	*Ground Elevation:*	*Date/Time Finished:*	*Water Level:*

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	**MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)**	Lab Sample ID	Lab Sample Depth (Ft.)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

NOTES:

Checked by ____________________ Date: ____________

Date	Time	Depth to groundwater while drilling

ENSR INTERNATIONAL

ENSR International
1220 Avenida Acaso
Camarillo, CA 93012-8738
Phone (805) 388-3775
Fax (805) 388-3577

ANALYTICAL LAB: ____________________

____

____________________ SITE __________ DATE __________ PAGE _____ OF _____

CLIENT

PROJECT NAME:

PROJECT MANAGER:

JOB #:

COELT LOG CODE: YES / NO ☐ ☐ ☐ ☐

SAMPLER SIGNATURE

____

ANALYTICAL METHODS

TURN-AROUND TIME

LINE ITEM	SAMPLE NO.	DATE	TIME	8260B / 5035 Volatile Organics	8260B BTEX / MTBE / Oxygenates	8015 Diesel / Gasoline / Full Range	8081A Pesticides	CAM 17 Metals														MATRIX TYPE	CONTAINER TYPE	NUMBER OF CONTAINERS	OBSERVATIONS/ COMMENTS
1.																									
2.																									
3.																									
4.																									
5.																									
6.																									
7.																									
8.																									
9.																									
10.																									

MATRIX TYPE:
S - Soil
W - Water
O - Other

CONTAINER TYPE:
G - Glass Bottle
P - Plastic
O - Other

PRESERVATIVES:
All samples are preserved on ice.
Water samples are preserved as indicated on the sample labels.

TEMPERATURE BLANK EACH COOLER ☐ YES ☐ NO

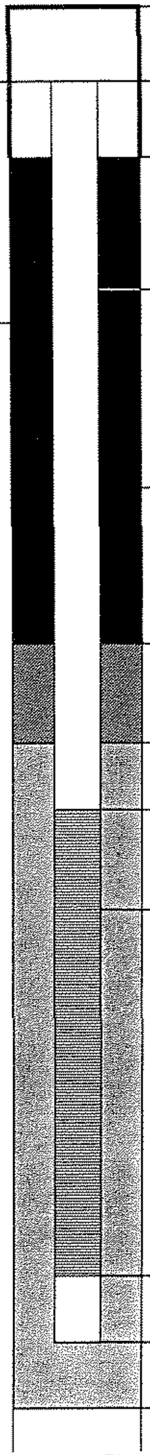
RELINQUISHED BY:	SIGNATURE	**ENSR International**	DATE	TIME	TOTAL NUMBER OF CONTAINERS:
RECEIVED BY:	SIGNATURE	COMPANY	DATE	TIME	METHOD OF SHIPMENT
RELINQUISHED BY:	SIGNATURE	COMPANY	DATE	TIME	SPECIAL SHIMENT/HANDLING/STORAGE REQUIREMENTS:
RECEIVED BY	SIGNATURE	COMPANY	DATE	TIME	

DISTRIBUTION: White and Canary = Laboratory **Pink = ENSR International**

Serial No. 2626

ENSR	*Client:*	***WELL ID:***
	Project Number:	
	Site Location:	*Date Installed:*
	Well Location: *Coords:*	*Inspector:*
	Method:	*Contractor:*

MONITORING WELL CONSTRUCTION DETAIL



	Depth from G.S. (feet)	Elevation(feet) Datum
Top of Steel Guard Pipe		
Top of Riser Pipe		
Ground Surface (G.S.)	0.0	
Bottom of Steel Guard Pipe		
Top of Bentonite		
Top of Sand		
Top of Screen		
▲ Stabilized Water Level		
Bottom of Screen		
Bottom of Tail Pipe:		
Bottom of Borehole		

Measuring Point for Surveying & Water Levels

Cement, Bentonite, Bentonite Slurry Grout, or Native Materials

% Cement

% Bentonite

% Native Materials

Riser Pipe:
- Length
- Inside Diameter (ID)
- Type of Material

Bentonite Seal Thickness

Screen:
- Length
- Inside Diameter (ID)
- Slot Size
- Type of Material

Type/Size of Sand

Sand Pack Thickness

Borehole Diameter:

Approved:

Describe Measuring Point:

ENSR

Well/Piez. ID:

Well/Piezometer Development Record

Client: ____________ Site Location: ____________

Project No: ____________ Date: ____________ Developer: ____________

WELL/PIEZOMETER DATA

Well ☐ Piezometer ☐ Diameter ________ Material ________

Measuring Point Description ____________

Depth to Top of Screen (ft.) ____________

Depth to Bottom of Screen (ft.) ____________

Total Well Depth (ft.) ____________

Depth to Static Water Level (ft.) ____________

Geology at Screen Interval (if known) ____________

Time of Water Level Measurement ________

Calculate Purge Volume (gal.) ________

Disposal Method ____________

Wellhead PID/FID ____________

Original Well Development ☐ Redevelopment ☐ Date of Original Development ________

DEVELOPMENT METHOD ____________ **PURGE METHOD** ____________

Field Testing Equipment Used:

Make	Model	Serial Number

Field Testing Calibration Documentation Found in Field Notebook # __________ Page # __________

Time	Volume Removed (gal)	T° (C/F)	pH	Spec. Cond (umhos)	Turbidity (NTUs)	DO	Color	Odor	Other

ACCEPTANCE CRITERIA (from workplan)

Min. Purge Volume (____ well volumes) _____gallons

Maximum Turbidity Allowed _____ NTUs

Stabilization of parameters _____%

	Yes	No	N/A
Has required volume been removed	☐	☐	☐
Has required turbidity been reached	☐	☐	☐
Have parameters stabilized	☐	☐	☐

If no or N/A explain below:

____

____

____

Signature ____________ Date: ____________

ENSR

Well ID:

Low Flow Ground Water Sample Collection Record

Client: ______ Date: ______ Time: Start ______ am/pm
Project No: ______ Finish ______ am/pm
Site Location: ______
Weather Conds: ______ Collector(s): ______

1. WATER LEVEL DATA: (measured from Top of Casing)

a. Total Well Length ______ c. Length of Water Column ______ (a-b)
Casing Diameter/Material ______

b. Water Table Depth ______ d. Calculated System Volume (see back) ______

2. WELL PURGE DATA

a. Purge Method: ______

b. Acceptance Criteria defined (see workplan)

- Temperature	3%	-D.O.	10%
- pH	± 1.0 unit	- ORP	± 10mV
- Sp. Cond.	3%	- Drawdown	< 0.3'

c. Field Testing Equipment used:

Make	Model	Serial Number

Time (24hr)	Volume Removed (Liters)	Temp. (°C)	pH	Spec. Cond. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Flow Rate (ml/min)	Drawdown (feet)	Color/Odor

d. Acceptance criteria pass/fail

	Yes	No	N/A
Has required volume been removed	☐	☐	☐
Has required turbidity been reached	☐	☐	☐
Have parameters stabilized	☐	☐	☐

(continued on back)

If no or N/A - Explain below.

______

3. SAMPLE COLLECTION:

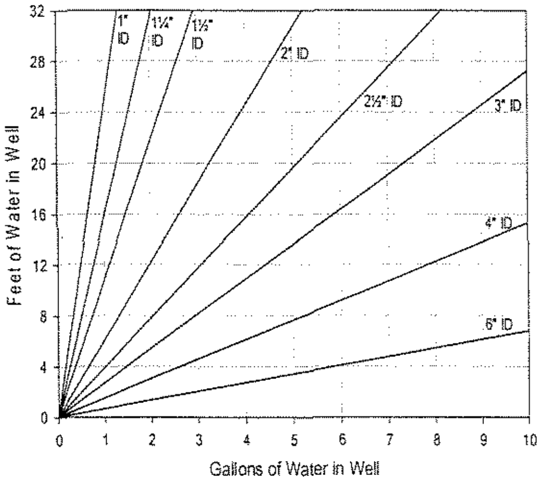
Method: ______

Sample ID	Container Type	No. of Containers	Preservation	Analysis Req.	Time

Comments ______

Signature ______ Date ______

Purge Volume Calculation



Volume / Linear Ft. of Pipe		
ID (in)	Gallon	Liter
0.25	0.0025	0.0097
0.375	0.0057	0.0217
0.5	0.0102	0.0386
0.75	0.0229	0.0869
1	0.0408	0.1544
1.25	0.0637	0.2413
1.5	0.0918	0.3475
2	0.1632	0.6178
2.5	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

(continued from front)

Time (24 hr)	Volume Removed (Liters)	Temp (°C)	pH	Spec. Cond. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Flow Rate (ml/min)	Drawdown (ft)	Color/Odor

ENSR

Well/Piezo ID:

Ground Water Sample Collection Record

Client: ____________________ Date: ________
Project No: ____________________ Time: Start ________ am/pm
Site Location: ____________________ Finish ________ am/pm
Weather Conds: ____________ Collector(s) ____________

WATER LEVEL DATA: (measured from Top of Casing) Well ☐ Piezometer ☐

a. Total Well Length ________
c. Casing Material ________
e. Length of Water Column ________
b. Water Table Depth ________
d. Casing Diameter ________
f. Calculated Well Volume (see back) ____

WELL PURGING DATA

a. Purge Method ____________________

b. Acceptance Criteria defined (from workplan)
- Minimum Required Purge Volume (@ ________ well volumes) ____________
- Maximum Allowable Turbidity ________ NTUs
- Stabilization of parameters ________ %

c. Field Testing Equipment Used: Make Model Serial Number

____

____

d. Field Testing Equipment Calibration Documentation Found in Field Notebook # ________ Page # ________

Time	Volume Removed (gal)	T° (C/F)	pH	Spec. Cond (umhos)	Turbidity (NTUs)	DO	Color	Odor	Other

e. Acceptance criteria pass/fail	Yes	No	N/A
Has required volume been removed	☐	☐	☐
Has required turbidity been reached	☐	☐	☐
Have parameters stabilized	☐	☐	☐

If no or N/A - Explain below.

____

____

SAMPLE COLLECTION: Method: ____________________

Sample ID	Container Type	No. of Containers	Preservation	Analysis	Time

Comments ____________________

____

Signature ____________________ Date ____________________

APPENDIX D

Method Detection Limits, Reporting Limits and Quality Control Limits

SUMMARY OF MDL RL & QC LIMITS

8260B

		WATER						SOIL					
	TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
1	1,1,1,2-Tetrachloroethane	1	5	ug/L				2	5	ug/Kg			
2	1,1,1-Trichloroethane	1	5	ug/L				2	5	ug/Kg			
3	1,1,2,2-Tetrachloroethane	1	5	ug/L				2	5	ug/Kg			
4	1,1,2-Trichloro-1,2,2-	1	5	ug/L				2	5	ug/Kg			
5	1,1,2-Trichloroethane	1	5	ug/L				2	5	ug/Kg			
6	1,1-Dichloroethane	1	5	ug/L				2	5	ug/Kg			
7	1,1-Dichloroethene	1	5	ug/L	60 - 130	54 - 143	30	2	5	ug/Kg	60 - 140	54 - 154	50
8	1,1-Dichloropropene	1	5	ug/L				2	5	ug/Kg			
9	1,2,3-Trichlorobenzene	1	5	ug/L				2	5	ug/Kg			
10	1,2,3-Trichloropropane	1	5	ug/L				2	5	ug/Kg			
11	1,2,4-Trichlorobenzene	1	5	ug/L				2	5	ug/Kg			
12	1,2,4-Trimethylbenzene	1	5	ug/L				2	5	ug/Kg			
13	1,2-Dibromo-3-chloropropane	2	10	ug/L				2	10	ug/Kg			
14	1,2-Dibromoethane	1	5	ug/L				2	5	ug/Kg			
15	1,2-Dichlorobenzene	1	5	ug/L				2	5	ug/Kg			
16	1,2-Dichloroethane	1	5	ug/L				2	5	ug/Kg			
17	1,2-Dichloropropane	1	5	ug/L				2	5	ug/Kg			
18	1,3,5-Trimethylbenzene	1	5	ug/L				2	5	ug/Kg			
19	1,3-Dichlorobenzene	1	5	ug/L				2	5	ug/Kg			
20	1,3-Dichloropropane	1	5	ug/L				2	5	ug/Kg			
21	1,4-Dichlorobenzene	1	5	ug/L				2	5	ug/Kg			
22	1-Chlorohexane	1	5	ug/L				2	5	ug/Kg			
23	2,2-Dichloropropane	1	5	ug/L				2	5	ug/Kg			
24	2-Butanone (MEK)	5	10	ug/L				5	10	ug/Kg			
25	2-Chloroethyl Vinyl Ether	1	5	ug/L				2	10	ug/Kg			
26	2-Chlorotoluene	1	5	ug/L				2	5	ug/Kg			
27	2-Ethyl-1-butanol	5	20	ug/L				5	20	ug/Kg			
28	2-Hexanone	5	10	ug/L				5	10	ug/Kg			
29	4-Chlorotoluene	1	5	ug/L				2	5	ug/Kg			
30	4-Methyl-2-Pentanone (MIBK)	5	10	ug/L				5	10	ug/Kg			

8260B

	TARGET ANALYTE	WATER						SOIL					
		MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD
31	Acetone	5	10	ug/L				5	10	ug/Kg			
32	Acrolein	5	50	ug/L				5	50	ug/Kg			
33	Acrylonitrile	5	20	ug/L				5	20	ug/Kg			
34	Benzene	1	5	ug/L	70 - 130	63 - 143	30	2	5	ug/Kg	70 - 130	63 - 143	50
35	Bromobenzene	1	5	ug/L				2	5	ug/Kg			
36	Bromochloromethane	1	5	ug/L				2	5	ug/Kg			
37	Bromodichloromethane	1	5	ug/L				2	5	ug/Kg			
38	Bromoform	1	5	ug/L				2	5	ug/Kg			
39	Bromomethane	1	10	ug/L				2	10	ug/Kg			
40	Carbon Disulfide	1	5	ug/L				2	5	ug/Kg			
41	Carbon Tetrachloride	1	5	ug/L				2	5	ug/Kg			
42	Chlorobenzene	1	5	ug/L	70 - 120	63 - 132	30	2	5	ug/Kg	70 - 130	63 - 143	50
43	Chloroethane	1	5	ug/L				2	5	ug/Kg			
44	Chloroform	1	5	ug/L				2	5	ug/Kg			
45	Chloromethane	1	5	ug/L				2	10	ug/Kg			
46	cis-1,2-Dichloroethene	1	5	ug/L				2	5	ug/Kg			
47	cis-1,3-Dichloropropene	1	5	ug/L				2	5	ug/Kg			
48	Cyclohexane	1	5	ug/L				2	5	ug/Kg			
49	Dibromochloromethane	1	5	ug/L				2	5	ug/Kg			
50	Dibromomethane	1	5	ug/L				2	5	ug/Kg			
51	Dichlorodifluoromethane	1	5	ug/L				2	10	ug/Kg			
52	DIPE	1	5	ug/L				2	5	ug/Kg			
53	ETBE	2	5	ug/L				2	5	ug/Kg			
54	Ethyl Methacrylate	1	10	ug/L				2	10	ug/Kg			
55	Ethylbenzene	1	5	ug/L				2	5	ug/Kg			
56	Hexachlorobutadiene	1	10	ug/L				2	10	ug/Kg			
57	Iodomethane	5	10	ug/L				5	10	ug/Kg			
58	Isopropyl Benzene	1	5	ug/L				2	5	ug/Kg			
59	m,p-Xylene	2	10	ug/L				2	10	ug/Kg			
60	Methyl Acetate	1	5	ug/L				2	5	ug/Kg			

8260B		**WATER**						**SOIL**					
		MDL	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
TARGET ANALYTE													
61	Methylcyclohexane	1	5	ug/L				2	5	ug/Kg			
62	Methylene Chloride	1	10	ug/L				2	10	ug/Kg			
63	MTBE	1	5	ug/L				2	5	ug/Kg			
64	Naphthalene	1	5	ug/L				2	5	ug/Kg			
65	n-Butylbenzene	1	5	ug/L				2	5	ug/Kg			
66	n-Propylbenzene	1	5	ug/L				2	5	ug/Kg			
67	o-Xylene	1	5	ug/L				2	5	ug/Kg			
68	p-Isopropyltoluene	1	5	ug/L				2	5	ug/Kg			
69	sec-Butylbenzene	1	5	ug/L				2	5	ug/Kg			
70	Styrene	1	5	ug/L				2	5	ug/Kg			
71	TAME	1	5	ug/L				2	5	ug/Kg			
72	t-Butanol	5	20	ug/L				10	20	ug/Kg			
73	tert-Butylbenzene	1	5	ug/L				2	5	ug/Kg			
74	Tetrachloroethene	1	5	ug/L				2	5	ug/Kg			
75	Toluene	1	5	ug/L	70 - 130	63 - 143	30	2	5	ug/Kg	70 - 130	63 - 143	50
76	trans-1,2-Dichloroethene	1	5	ug/L				2	5	ug/Kg			
77	trans-1,3-Dichloropropene	1	5	ug/L				2	5	ug/Kg			
78	trans-1,4-Dichloro-2-butene	1	10	ug/L				2	10	ug/Kg			
79	Trichloroethene	1	5	ug/L	70 - 130	63 - 143	30	2	5	ug/Kg	70 - 130	63 - 143	50
80	Trichlorofluoromethane	1	5	ug/L				2	5	ug/Kg			
81	Vinyl Acetate	1	10	ug/L				2	10	ug/Kg			
82	Vinyl Chloride	1	5	ug/L				2	5	ug/Kg			
SURROGATE													
1	1,2-Dichloroethane-d4				70 - 130	63 - 143					60 - 140	54 - 154	
2	4-Bromofluorobenzene				70 - 130	63 - 143					70 - 130	63 - 143	
3	Toluene-d8				70 - 130	63 - 143					70 - 130	63 - 143	

8260B	**WATER**						**SOIL**					
	MDL	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: MASTER

SUMMARY OF MDL RL & QC LIMITS

6010B	WATER						SOIL					
TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
Aluminum	0.06	0.2	mg/L	80 - 120	75 - 125	20	5	20	mg/Kg	80 - 120	75 - 125	20
Antimony	0.04	0.1	mg/L	80 - 120	75 - 125	20	2	10	mg/Kg	80 - 120	75 - 125	20
Barium	0.002	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
Beryllium	0.001	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
Boron	0.01	0.1	mg/L	80 - 120	75 - 125	20	2	10	mg/Kg	80 - 120	75 - 125	20
Cadmium	0.002	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
Calcium	0.1	1	mg/L	80 - 120	75 - 125	20	10	100	mg/Kg	80 - 120	75 - 125	20
Chromium	0.005	0.01	mg/L	80 - 120	75 - 125	20	1	2	mg/Kg	80 - 120	75 - 125	20
Cobalt	0.005	0.01	mg/L	80 - 120	75 - 125	20	1	2	mg/Kg	80 - 120	75 - 125	20
Copper	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	2	mg/Kg	80 - 120	75 - 125	20
Iron	0.04	0.2	mg/L	80 - 120	75 - 125	20	5	20	mg/Kg	80 - 120	75 - 125	20
Magnesium	0.1	1	mg/L	80 - 120	75 - 125	20	10	100	mg/Kg	80 - 120	75 - 125	20
Manganese	0.003	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
Molybdenum	0.01	0.05	mg/L	80 - 120	75 - 125	20	0.5	5	mg/Kg	80 - 120	75 - 125	20
Nickel	0.01	0.02	mg/L	80 - 120	75 - 125	20	1	2	mg/Kg	80 - 120	75 - 125	20
Potassium	1	2	mg/L	80 - 120	75 - 125	20	75	500	mg/Kg	80 - 120	75 - 125	20
Silver	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	2	mg/Kg	80 - 120	75 - 125	20
Sodium	0.25	1	mg/L	80 - 120	75 - 125	20	25	100	mg/Kg	80 - 120	75 - 125	20
Strontium	0.01	0.02	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
Tin	0.05	0.1	mg/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
Titanium	0.005	0.01	mg/L	80 - 120	75 - 125	20	1	10	mg/Kg	80 - 120	75 - 125	20
Vanadium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	2	mg/Kg	80 - 120	75 - 125	20
Zinc	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20

6010B	WATER						SOIL					
	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: MASTER

SUMMARY OF MDL RL & QC LIMITS

6010B

	WATER						SOIL					
TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
Antimony	0.04	0.1	mg/L	80 - 120	75 - 125	20	2	10	mg/Kg	80 - 120	75 - 125	20
Barium	0.002	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
Beryllium	0.001	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
Cadmium	0.002	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
Chromium	0.005	0.01	mg/L	80 - 120	75 - 125	20	1	2	mg/Kg	80 - 120	75 - 125	20
Cobalt	0.005	0.01	mg/L	80 - 120	75 - 125	20	1	2	mg/Kg	80 - 120	75 - 125	20
Copper	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	2	mg/Kg	80 - 120	75 - 125	20
Molybdenum	0.01	0.05	mg/L	80 - 120	75 - 125	20	0.5	5	mg/Kg	80 - 120	75 - 125	20
Nickel	0.01	0.02	mg/L	80 - 120	75 - 125	20	1	2	mg/Kg	80 - 120	75 - 125	20
Silver	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	2	mg/Kg	80 - 120	75 - 125	20
Vanadium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	2	mg/Kg	80 - 120	75 - 125	20
Zinc	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20

6010B-Trace

	WATER						SOIL					
TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
Arsenic	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.4	1	mg/Kg	80 - 120	75 - 125	20
Lead	0.003	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
Selenium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
Thallium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: CAM

SUMMARY OF MDL RL QC LIMITS

8260B		WATER						SOIL					
	TARGET ANALYTE	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD
1	1,1,1-Trichloroethane	1	5	ug/L				2	5	ug/Kg			
2	1,1,2,2-Tetrachloroethane	1	5	ug/L				2	5	ug/Kg			
3	1,1,2-Trichloroethane	1	5	ug/L				2	5	ug/Kg			
4	1,1-Dichloroethane	1	5	ug/L				2	5	ug/Kg			
5	1,1-Dichloroethene	1	5	ug/L	60 - 130	54 - 143	30	2	5	ug/Kg	60 - 140	54 - 154	50
6	1,2-Dichloroethane	1	5	ug/L				2	5	ug/Kg			
7	1,2-Dichloropropane	1	5	ug/L				2	5	ug/Kg			
8	2-Butanone (MEK)	5	10	ug/L				5	10	ug/Kg			
9	2-Hexanone	5	10	ug/L				5	10	ug/Kg			
10	4-Methyl-2-Pentanone (MIBK)	5	10	ug/L				5	10	ug/Kg			
11	Acetone	5	10	ug/L				5	10	ug/Kg			
12	Benzene	1	5	ug/L	70 - 130	63 - 143	30	2	5	ug/Kg	70 - 130	63 - 143	50
13	Bromodichloromethane	1	5	ug/L				2	5	ug/Kg			
14	Bromoform	1	5	ug/L				2	5	ug/Kg			
15	Bromomethane	1	10	ug/L				2	10	ug/Kg			
16	Carbon Disulfide	1	5	ug/L				2	5	ug/Kg			
17	Carbon Tetrachloride	1	5	ug/L				2	5	ug/Kg			
18	Chlorobenzene	1	5	ug/L	70 - 120	63 - 132	30	2	5	ug/Kg	70 - 130	63 - 143	50
19	Chloroethane	1	5	ug/L				2	5	ug/Kg			
20	Chloroform	1	5	ug/L				2	5	ug/Kg			
21	Chloromethane	1	5	ug/L				2	10	ug/Kg			
22	cis-1,2-Dichloroethene	1	5	ug/L				2	5	ug/Kg			
23	cis-1,3-Dichloropropene	1	5	ug/L				2	5	ug/Kg			
24	Dibromochloromethane	1	5	ug/L				2	5	ug/Kg			
25	DIPE	1	5	ug/L				2	5	ug/Kg			
26	ETBE	2	5	ug/L				2	5	ug/Kg			
27	Ethylbenzene	1	5	ug/L				2	5	ug/Kg			
28	m,p-Xylene	2	10	ug/L				2	10	ug/Kg			
29	Methylene Chloride	1	10	ug/L				2	10	ug/Kg			
30	MTBE	1	5	ug/L				2	5	ug/Kg			

8260B		WATER						SOIL					
		MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD
TARGET ANALYTE													
31	o-Xylene	1	5	ug/L				2	5	ug/Kg			
32	Styrene	1	5	ug/L				2	5	ug/Kg			
33	TAME	1	5	ug/L				2	5	ug/Kg			
34	t-Butanol	5	20	ug/L				10	20	ug/Kg			
35	Tetrachloroethene	1	5	ug/L				2	5	ug/Kg			
36	Toluene	1	5	ug/L	70 - 130	63 - 143	30	2	5	ug/Kg	70 - 130	63 - 143	50
37	trans-1,2-Dichloroethene	1	5	ug/L				2	5	ug/Kg			
38	trans-1,3-Dichloropropene	1	5	ug/L				2	5	ug/Kg			
39	Trichloroethene	1	5	ug/L	70 - 130	63 - 143	30	2	5	ug/Kg	70 - 130	63 - 143	50
40	Vinyl Chloride	1	5	ug/L				2	5	ug/Kg			
SURROGATE													
1	1,2-Dichloroethane-d4				70 - 130	63 - 143					60 - 140	54 - 154	
2	4-Bromofluorobenzene				70 - 130	63 - 143					70 - 130	63 - 143	
3	Toluene-d8				70 - 130	63 - 143					70 - 130	63 - 143	

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: STANDARD + OXY

SUMMARY OF MDL RL & QC LIMITS

7196A

	WATER						SOIL					
TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
Hexavalent Chromium	0.005	0.01	mg/L	80-120	75-125	20	0.05	0.1	mg/Kg	80-120	75-125	20

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: MASTER

SUMMARY OF MDL RL & QC LIMITS

314.0	**WATER**						**SOIL**					
	MDL	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
TARGET ANALYTE												
1 Perchlorate	0.5	2	ug/L	85 - 115	75 - 125	20	10	20	ug/Kg	80 - 120	75 - 125	20

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: STANDARD

SUMMARY OF MDL RL & QC LIMITS

8015B EXTRACTABLE	WATER						SOIL					
	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD
TARGET ANALYTE												
Diesel	0.1	0.5	mg/L	60 - 140	54 - 154	30	5	10	mg/Kg	60 - 150	54 - 165	50
SURROGATE												
Bromobenzene				50 - 140	45 - 154					60 - 150	54 - 165	
Hexacosane				70 - 150	63 - 165					60 - 160	54 - 176	

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: STANDARD

SUMMARY OF MDL RL & QC LIMITS

7470A	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
TARGET ANALYTE						
1 Mercury	0.1	0.5	ug/L	80 - 120	75 - 125	20

7471A	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
TARGET ANALYTE						
1 Mercury	0.033	0.1	mg/Kg	80 - 120	75 - 125	20

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: STANDARD

SUMMARY OF MDL RL & QC LIMITS

6020A

	WATER						SOIL					
TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
1 Aluminum	50	100	ug/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
2 Antimony	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
3 Arsenic	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
4 Barium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
5 Beryllium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
6 Boron	5	10	ug/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
7 Cadmium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
8 Calcium	50	100	ug/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
9 Chromium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
10 Cobalt	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
11 Copper	0.5	1	ug/L	80 - 120	75 - 125	20	0.2	0.5	mg/Kg	80 - 120	75 - 125	20
12 Iron	50	100	ug/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
13 Lead	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
14 Lithium	0.5	2	ug/L	80 - 120	75 - 125	20	0.2	0.5	mg/Kg	80 - 120	75 - 125	20
15 Magnesium	50	100	ug/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
16 Manganese	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
17 Molybdenum	1	2	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
18 Nickel	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
19 Potassium	50	100	ug/L	80 - 120	75 - 125	20	10	20	mg/Kg	80 - 120	75 - 125	20
20 Selenium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
21 Silver	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
22 Sodium	50	100	ug/L	80 - 120	75 - 125	20	10	20	mg/Kg	80 - 120	75 - 125	20
23 Strontium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
24 Thallium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
25 Tin	0.5	1	ug/L	80 - 120	75 - 125	20	5	10	mg/Kg	80 - 120	75 - 125	20
26 Titanium	1	2	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
27 Uranium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
28 Vanadium	0.5	1	ug/L	80 - 120	75 - 125	20	0.1	0.5	mg/Kg	80 - 120	75 - 125	20
29 Zinc	5	10	ug/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20

6020A	WATER						SOIL					
	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD	MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: MASTER

SUMMARY OF MDL RL & QC LIMITS

6010B-SuperTrace

	WATER						SOIL					
TARGET ANALYTE	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
1 Aluminum	0.06	0.2	mg/L	80 - 120	75 - 125	20	5	20	mg/Kg	80 - 120	75 - 125	20
2 Antimony	0.014	0.1	mg/L	80 - 120	75 - 125	20	2	10	mg/Kg	80 - 120	75 - 125	20
3 Arsenic	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.4	1	mg/Kg	80 - 120	75 - 125	20
4 Barium	0.002	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
5 Beryllium	0.001	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
6 Boron	0.01	0.1	mg/L	80 - 120	75 - 125	20	2	10	mg/Kg	80 - 120	75 - 125	20
7 Cadmium	0.001	0.01	mg/L	80 - 120	75 - 125	20	0.1	1	mg/Kg	80 - 120	75 - 125	20
8 Calcium	0.1	1	mg/L	80 - 120	75 - 125	20	10	100	mg/Kg	80 - 120	75 - 125	20
9 Chromium	0.0025	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
10 Cobalt	0.0025	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
11 Copper	0.002	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
12 Iron	0.04	0.2	mg/L	80 - 120	75 - 125	20	3	20	mg/Kg	80 - 120	75 - 125	20
13 Lead	0.003	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
14 Magnesium	0.1	1	mg/L	80 - 120	75 - 125	20	10	100	mg/Kg	80 - 120	75 - 125	20
15 Manganese	0.003	0.01	mg/L	80 - 120	75 - 125	20	0.1	1	mg/Kg	80 - 120	75 - 125	20
16 Molybdenum	0.005	0.05	mg/L	80 - 120	75 - 125	20	0.5	5	mg/Kg	80 - 120	75 - 125	20
17 Nickel	0.0025	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
18 Potassium	0.1	1	mg/L	80 - 120	75 - 125	20	25	100	mg/Kg	80 - 120	75 - 125	20
19 Selenium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
20 Silver	0.003	0.01	mg/L	80 - 120	75 - 125	20	0.25	1	mg/Kg	80 - 120	75 - 125	20
21 Sodium	0.1	1	mg/L	80 - 120	75 - 125	20	10	100	mg/Kg	80 - 120	75 - 125	20
22 Strontium	0.001	0.01	mg/L	80 - 120	75 - 125	20	0.2	1	mg/Kg	80 - 120	75 - 125	20
23 Thallium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
24 Tin	0.01	0.1	mg/L	80 - 120	75 - 125	20	2	10	mg/Kg	80 - 120	75 - 125	20
25 Titanium	0.005	0.1	mg/L	80 - 120	75 - 125	20	1	10	mg/Kg	80 - 120	75 - 125	20
26 Vanadium	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20
27 Zinc	0.005	0.01	mg/L	80 - 120	75 - 125	20	0.5	1	mg/Kg	80 - 120	75 - 125	20

6010B-SuperTrace			**WATER**						**SOIL**			
	MDL	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: MASTER

SUMMARY OF MDL RL & QC LIMITS

8260B LOW	**MDL**	**RL**	**UNIT**	**LCS QCL (%R)**	**MS QCL (%R)**	**RPD**
TARGET ANALYTE						
1 1,1,1,2-Tetrachloroethane	0.2	1	ug/L			
2 1,1,1-Trichloroethane	0.2	1	ug/L			
3 1,1,2,2-Tetrachloroethane	0.2	1	ug/L			
4 1,1,2-Trichloro-1,2,2-trifluoroethane	0.2	1	ug/L			
5 1,1,2-Trichloroethane	0.2	1	ug/L			
6 1,1-Dichloroethane	0.2	1	ug/L			
7 1,1-Dichloroethene	0.2	1	ug/L	60 - 130	54 - 143	30
8 1,1-Dichloropropene	0.2	1	ug/L			
9 1,2,3-Trichlorobenzene	0.2	1	ug/L			
10 1,2,3-Trichloropropane	0.5	1	ug/L			
11 1,2,4-Trichlorobenzene	0.2	1	ug/L			
12 1,2,4-Trimethylbenzene	0.2	1	ug/L			
13 1,2-Dibromo-3-chloropropane	0.5	2	ug/L			
14 1,2-Dibromoethane	0.2	1	ug/L			
15 1,2-Dichlorobenzene	0.2	1	ug/L			
16 1,2-Dichloroethane	0.2	1	ug/L			
17 1,2-Dichloropropane	0.2	1	ug/L			
18 1,3,5-Trimethylbenzene	0.2	1	ug/L			
19 1,3-Dichlorobenzene	0.2	1	ug/L			
20 1,3-Dichloropropane	0.2	1	ug/L			
21 1,4-Dichlorobenzene	0.2	1	ug/L			
22 1-Chlorohexane	0.2	1	ug/L			
23 2,2-Dichloropropane	0.2	1	ug/L			
24 2-Butanone (MEK)	5	10	ug/L			
25 2-Chloroethyl Vinyl Ether	2	5	ug/L			
26 2-Chlorotoluene	0.2	1	ug/L			
27 2-Hexanone	5	10	ug/L			
28 4-Chlorotoluene	0.2	1	ug/L			
29 4-Methyl-2-Pentanone (MIBK)	5	10	ug/L			
30 Acetone	5	10	ug/L			
31 Acrolein	5	10	ug/L			
32 Acrylonitrile	5	10	ug/L			

8260B LOW TARGET ANALYTE		MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD
33	Benzene	0.2	1	ug/L	70 - 130	63 - 143	30
34	Bromobenzene	0.2	1	ug/L			
35	Bromochloromethane	0.2	1	ug/L			
36	Bromodichloromethane	0.2	1	ug/L			
37	Bromoform	0.3	1	ug/L			
38	Bromomethane	0.2	1	ug/L			
39	Carbon Disulfide	0.2	1	ug/L			
40	Carbon Tetrachloride	0.2	1	ug/L			
41	Chlorobenzene	0.2	1	ug/L	70 - 120	63 - 132	30
42	Chloroethane	0.2	1	ug/L			
43	Chloroform	0.2	1	ug/L			
44	Chloromethane	0.2	1	ug/L			
45	cis-1,2-Dichloroethene	0.2	1	ug/L			
46	cis-1,3-Dichloropropene	0.2	1	ug/L			
47	Cyclohexane	0.2	1	ug/L			
48	Dibromochloromethane	0.2	1	ug/L			
49	Dibromomethane	0.2	1	ug/L			
50	Dichlorodifluoromethane	0.3	1	ug/L			
51	DIPE	0.2	1	ug/L			
52	ETBE	0.2	1	ug/L			
53	Ethyl Methacrylate	0.5	1	ug/L			
54	Ethylbenzene	0.2	1	ug/L			
55	Hexachlorobutadiene	0.2	1	ug/L			
56	Iodomethane	0.5	1	ug/L			
57	Isopropyl Benzene	0.2	1	ug/L			
58	m,p-Xylene	0.5	2	ug/L			
59	Methyl Acetate	0.5	1	ug/L			
60	Methylcyclohexane	0.2	1	ug/L			
61	Methylene Chloride	0.5	1	ug/L			
62	MTBE	0.2	1	ug/L			
63	Naphthalene	0.5	2	ug/L			
64	n-Butylbenzene	0.2	1	ug/L			

8260B LOW		MDL	RL	UNIT	LCS QCL (%R)	MS QCL (%R)	RPD
TARGET ANALYTE							
65	n-Propylbenzene	0.2	1	ug/L			
66	o-Xylene	0.2	1	ug/L			
67	p-Isopropyltoluene	0.2	1	ug/L			
68	sec-Butylbenzene	0.2	1	ug/L			
69	Styrene	0.2	1	ug/L			
70	TAME	0.2	1	ug/L			
71	t-Butanol	5	10	ug/L			
72	Tert-Butyl Formate	0.5	1	ug/L			
73	tert-Butylbenzene	0.2	1	ug/L			
74	Tetrachloroethene	0.2	1	ug/L			
75	Toluene	0.2	1	ug/L	70 - 130	63 - 143	30
76	trans-1,2-Dichloroethene	0.2	1	ug/L			
77	trans-1,3-Dichloropropene	0.2	1	ug/L			
78	trans-1,4-Dichloro-2-butene	0.5	2	ug/L			
79	Trichloroethene	0.2	1	ug/L	70 - 130	63 - 143	30
80	Trichlorofluoromethane	0.2	1	ug/L			
81	Vinyl Acetate	0.5	2	ug/L			
82	Vinyl Chloride	0.2	1	ug/L			
SURROGATE							
1	1,2-Dichloroethane-d4				70 - 130	63 - 143	
2	4-Bromofluorobenzene				70 - 130	63 - 143	
3	Toluene-d8				70 - 130	63 - 143	

Comment: The RL and QCL specified in this document is the in-house default value. The contract takes precedence in the event that the project specifies the required RL and QC Limits.

MDL: Method Detection Limit
RL: Reporting Limit
LCS: Lab Control Sample
MS/MSD: Matrix Spike/Matrix Spike Duplicate
QCL: Quality Control Limits
%R: Percent Recovery
Notes:
MS Surrogate QCL also applies to field samples.

Target List: MASTER