A Comparison of ASTM standard E1599-94 and a site assessment project located in North Las Vegas

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A COMPARISON OF ASTM STANDARD E1599-94
AND A SITE ASSESSMENT PROJECT LOCATED
IN NORTH LAS VEGAS

A thesis submitted in partial satisfaction
of the degree of
Bachelor of Arts
in
Environmental Studies
UNIVERSITY OF NEVADA
Las Vegas

Submitted By: Kenneth Anthony Katsuda
Spring 1998

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Position
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ABSTRACT

A comparison of ASTM Standard E-1599-94 And A Site Assessment Project Located in North Las Vegas

By Kenneth A. Katsuda

This document provides a comparison of ASTM E-1599-94 Standard for a petroleum release and the procedures performed on a site assessment project in North Las Vegas. The major elements of a site assessment are thoroughly discussed in this document. They elements consist of the Initial Site Assessment, On-Site Delineation, Off-Site Delineation, Sampling/Analysis, and Site Assessment Methodologies.

The data was obtained through extensive research, utilizing reference documents, on-site experience, and the knowledge of Keith Stewart of Stewart Environmental.

After reviewing and comparing the data of my research, the procedures applied to the North Las Vegas Site (NLVS) were quite similar to the ASTM E1599-94 standard, with only a few minor differences.

Conclusions and recommendations are discussed in this document. For example, the groundwater sample results from the NLVS returned non-detect. Therefore, no remedial action was required by the lead agency, Nevada Division of Environmental Protection (NDEP). I recommend that the elevations of the monitoring wells continue to be monitored monthly and samples should be extracted and sent to the laboratory to be analyzed quarterly for an additional year. Given the high concentrations of total petroleum hydrocarbons in the soil before excavation, I would also recommend a risk assessment be performed, to evaluate the future risk of potential contamination of the groundwater.
ACKNOWLEDGMENTS

While working on this document, I had the pleasure of working with three people who assisted and guided me toward my goal. Keith Stewart, Paul Richitt, and Shawn Gerstenberger all contributed to the production of this document.

I would like to give special thanks to Mr. Keith Stewart, of Stewart Environmental Inc. Keith served as my mentor. He gave me the opportunity to experience and explore, first hand, the environmental consulting field. On several occasions, he allowed me to work beside him on two active projects, one of which this document is focused upon. He was always willing to help me, even if it meant taking time out of his weekend to proofread portions of this document! I must admit, the most helpful source of information I utilized in preparing this document was the knowledge that Keith provided on the environmental consulting field. His input and patience was highly appreciated.

I would like to thank Paul Richitt for being my thesis advisor. He gave me several different possibilities for my thesis topic. Once I had determined that I wanted to research a soil related topic, he referred me to Keith. Not only has he been helpful with my thesis, throughout my college career, he has always been somebody that I could turn to for advice. His guidance has played a huge role in my development as a person and a student. Thanks Paul!

I would like to thank Paul Richitt and Shawn Gerstenberger for allowing me to produce this document from out of state. It was difficult at times, and I thank them for being so patient and helpful.
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1.0 INTRODUCTION
1.1 American Society for Testing and Materials (ASTM)

In today’s society, petroleum products are a part of everyday life. Petroleum products have many benefits. The most obvious benefit is that they provide fuel for our cars and other transportation vehicles. But, when do petroleum products become a problem? They become a problem when they are released into the environment. When there is a release of petroleum products, the soil and groundwater are at risk of potential contamination, which could lead to adverse affects on the environment and human health. Therefore, the release site must be taken care of. A corrective action plan should be followed to maximize the efficiency of the corrective action.

There are many different ways to approach a corrective action when dealing with a petroleum release. It is difficult to approach a corrective action without following some type of standard or guide. The American Society for Testing and Materials has produced a standard guide to follow. The standard is labeled E 1599-94 Corrective Action for Petroleum Releases. ASTM E-1599-94 has become a common practice because it is both timely and cost effective.

1.2 North Las Vegas Site (NLVS) Background

The NLVS is a gasoline and diesel vehicle (truck stop) fueling station with an associated garage, convenience store, and restaurant. In January of 1997, the management of the NLVS decided that they wanted to demolish a reconstruct the existing diesel fueling islands. They contracted Geotechnical &Environmental
Services Inc. (GES, Inc.) to assess the site for hydrocarbon impacted soils and groundwater. GES Inc. performed a site assessment and submitted a site assessment report to NDEP in April of 1998.

1.3 Objective

The ASTM standard E-1599-94 includes the entire remediation guide from start to finish. This paper will only concern the site assessment section of the ASTM standard. Site assessment procedures from a North Las Vegas Site (NLVS) and the ASTM E1599-94 standard will be compared, with regards to the initial site evaluation, on-site delineation, off-site delineation, sample/analysis, and site assessment methodologies. Conclusions and recommendations will be drawn from the comparisons.
2.0 ASTM Site Assessment
2.1 Scope

The goals of site assessments are to evaluate the source or sources of the contamination, the extent of the contamination, and the potential impact of the contamination on human health, safety, and environment (ASTM, 1997). The data gathered from the site assessment will help to determine remedial action and remedial action alternatives. The assessment should take into consideration the extent of movement of the contamination as well as the structures and utilities that may be impacted by the contamination.

Once it has been confirmed that there is in fact a contamination, the site assessment should begin. There are many ways that an assessment can be approached. Regardless of the chosen approach, the following should be included: *Initial Site Evaluation, On-Site Delineation, and Off-Site Delineation.*

2.2 ASTM Initial Site Evaluation

2.2.1 Scope

Before any subsurface investigation begins, a record review should take place. This record review should include documents describing the local geologic and hydrogeologic characteristics, and a survey of possible receptors. These can be evaluated by reviewing local well logs, USGS maps, environmental agency reports, or any other source that will give credible information on the region. The data received from these reviews should assist in a number of important determinations, such as estimating the groundwater depth and identifying
subsurface structures. The location of public water supply wells and surface water such as streams and lakes within 0.5 miles of the site must be reported as well.

A visual evaluation of the site is also necessary. While performing the visual evaluation it is important to identify the surrounding land-use and other potential contamination sources.

From the data collected, two maps should be developed. The base map and a surrounding land-use map. The base map should include the property lines of the site, all structures and underground utilities on the site, and all known underground storage tanks, piping, and UST excavations (ASTM, 1997). This map is also used for summarizing future site assessment data. The surrounding land-use map should include the property lines of the site, streets, alleys, utilities, neighboring structures (including structures across the street), and water supply wells within 0.5 miles of the site (ASTM, 1997).

2.3 Initial Site Evaluation for the NLVS

2.3.1 Background

While performing the initial site evaluation, both record review and an on-site visual evaluation took place. When considering geology, hydrology, subsurface utilities, and site history, record review was applied. A visual evaluation of and around the diesel dispensers was used to locate indicators of a possible release. A visual evaluation was also used to determine the surrounding and on-site land use.
2.3.2 Geology

The Las Vegas Valley is an inter-mountain basin within the Basin and Range Province of Western North America. Accumulations of 3,000 to 4,000 feet of alluvial, eolian, and lacustrine sediments overlie bedrock in the central portion of the valley. The valley fill is derived from Paleozoic, Mesozoic, and Cenozoic bedrock units exposed in the surrounding mountain ranges. Mountains to the north, east, and west exhibit predominantly carbonate lithologies: whereas, the McCullough Range to the south is composed primarily of Tertiary volcanic rocks (Nevada Bureau of Mines, 1964).

The lowlands consist of fine-grained alluvial and playa deposits, and that the coarser grained alluvial aprons will be found on the steeper slopes that border the Las Vegas Valley. In general, sediments tend to grade finer when the distance between the source is greater and the elevation decreases.

Performing the geology portion of the initial site assessment provides a general idea of the composition of the subsurface area. The exact composition of the site will be determined later during the on-site delineation when the soil borings are analyzed.

2.3.3 Hydrology

Four aquifer systems occur in the Las Vegas Valley groundwater basin:

- The consolidated rock aquifer which underlies the alluvial deposits;
- The principal alluvial aquifer (200 feet or more below the water table);
• The near surface reservoir (between 30 to 200 feet below water table); and

• The shallow aquifer system (between 0 to 30 feet below the water table).

The depth to water from the land surface conceptually subdivides the shallow aquifer system:

• The shallow aquifer is defined as the interval between 0 and 30 feet below the water table where the water table is less than 20 feet below the land surface.

• The shallow intermediate aquifer includes the interval between 0 and 30 feet below the water table where the water table is more than 20 feet below the land surface.

The shallow intermediate aquifer generally corresponds to the near surface reservoir (LVVWD, 1988).

When determining the approximate depth of the groundwater, Stewart Environmental referred to Al Rushanan, a regulator for the Nevada Department of Environmental Protection. Rushanan confirmed that the groundwater depth at the Magic Wand Truck Stop was about 55-60 feet below ground surface. The Magic Wand is located about a quarter of a mile north of the NLVS and the elevation there is about ten feet lower than the NLVS; therefore it was determined that the groundwater level at the NLVS is approximately 65-70 feet bgs.
Another important detail is the direction of the groundwater flow. Groundwater flow is generally eastward toward the Las Vegas Wash, Lake Mead, and the Colorado River (LVVWD, 1988).

2.3.4 Subsurface Utilities

There are several subsurface utilities located on the NLVS. There are underground utilities and poles, UST’s, and petroleum hydrocarbon product lines. The on-site subsurface utilities play a major role in evaluating remedial alternatives. Soil excavation or the improper placement of soil borings could threaten the integrity of these utilities.

2.3.5 Site History

The NLVS was constructed in 1967. Prior to this the site was an open lot. Therefore, the site has only been used as it is today, as a truck stop with a mini-market, repair garage, and fueling islands.

The NLVS has had some remediation work prior to the site assessment project in progress. An Underground Storage Tank (UST) system was previously removed and the site was remediated. On November 25, 1991, a discrepancy was detected in the diesel fuel inventory at the NLVS. After a pressure tightness test was performed, it was concluded that there was a major release into the ground. Approximately 6,000 gallons were released. The appropriate agencies were notified immediately. A new UST system was installed, which included five new
UST’s. They were installed just north of the old system. In September of 1992, the new system was operational and soon after, the old tanks were removed for permanent closure. After the tank system was removed, some excavation around the saturated region took place. A soil bioventilation system was constructed on the eastern end of the site in order to remediate the remaining contamination. (GEOFONS, 1993)

2.3.6 Visual Site Assessment

Vacant lots to the east and west, a McDonalds fast food restaurant to the north, and commercial property to the south border the NLVS. The NLVS is bordered by Losee Road to the east and East Cheyenne Avenue to the south.

Currently, the NLVS has several uses. It is a truck stop facility, therefore it has a restaurant, mini-market, tire and truck repair area, and fueling islands. This NLVS is open 24 hours a day and experiences periods of high volumes of vehicle and foot traffic. The remaining areas around the NLVS are used for parking.

The fuel dispensers were also inspected for possible releases of diesel fuel. When removing the faceplate from the fuel pumps, the wiring and fuel pipes are exposed. Two of the pumps revealed signs of diesel release and odor. Though release were confirmed, the extent of the contamination remains unknown.
2.3.7 Conclusion

The ASTM standard states that two maps should be derived from the information gathered from the initial site evaluation. The information gathered during the initial site evaluation was used to produce a base map that included property lines, structures, underground utilities, and groundwater flow direction. A surrounding land-use map was not produced. Though the surrounding land-use map was not produced, all of the surrounding land-use was noted in the site assessment report and was well aware of. Excluding the surrounding land-use map, the ASTM standard and NLVS procedures were very similar.

The base map located in Figure 1, as well as the results from the initial site evaluation, will assist in the subsurface assessment. For example, we detected signs of diesel release and odor around two of the fuel dispensers. This would be a logical starting point for subsurface investigation because they are the probable release sources.

2.4 ASTM On-Site Delineation

2.4.1 Scope

Now that the initial site assessment is complete the information can be utilized to initiate a subsurface assessment. The assessment should evaluate the geologic and hydrogeologic characteristics as well as the extent of contamination at the release site (within the property boundaries) (ASTM, 1997). There are two objectives of
the on-site delineation. First, to find the contamination sources and second, to evaluate the extent of the contamination.

2.4.2 Subsurface Assessment

The subsurface assessment should begin near the release area or underground storage tank and piping. The assessment should proceed outward from the source until the source area has been identified. After the source areas are identified, the extent of the contamination must be explored both horizontally and vertically.

During the subsurface investigation, soil samples and groundwater samples should be analyzed. The soil samples will determine the soil characteristics, variations in contamination of the soil, and the mobility of the release. The soil samples will also assist in quantifying the release. The water samples will determine the contamination in the water table. It too, will assist in quantifying the release and determining the mobility of the release. Other considerations for subsurface assessments are the depth to groundwater, the hydraulic gradient, and the thickness of liquid hydrocarbons. With this information, additional assessments can be conducted to find the extent of the contamination within the property lines. Investigative activities for the on-site delineation should continue until the full extent of the contamination has been determined or until the assessment reaches the release site property lines (ASTM, 1997).
When the on-site delineation is complete, if there is sufficient data to design and implement remedial action, an on-site delineation report should be written and turned in to the regulatory agency. This report should include all of the following:

- Data collected during the initial site assessment.
- Logs of borings, monitoring wells, and soil samples, including schematics and/or maps of each.
- Depth-to-fluid, depth-to-water, measurements from top of casing to the groundwater, and product thickness summarized in tabular and map form.
- Analytical results in tabular form.
- All laboratory reports including chain of custody forms, and quality assurance/quality control procedures.
- A conceptual design of the remedial action approach (ASTM, 1997).

2.5 On-Site Delineation for the NLVS

2.5.1 Soil Borings

In January of 1997, the NLVS management contacted Geotechnical & Environmental Services Inc., (GES, Inc.) to drill six exploratory soil borings. The borings were used to evaluate the possibility of hydrocarbon impacted soils. These borings were taken prior to a planned demolition and reconstruction of the diesel fueling island. The boring locations are shown in Figure 2.

Another soil boring, B-40, was drilled to evaluate the potential hydrocarbon impact to the groundwater. The location is illustrated in Figure 3. Three additional
soil borings were strategically placed and converted into groundwater monitoring wells. They were labeled M-1, M-2, and M-3 as seen in Figure 4.

2.5.2 Excavation and Soil Samples

The diesel-impacted soil was most severely impacted near the most southwestern fuel dispenser. The impacted area ran from the surface area down to about 40 feet bgs. There was also a large lateral spread of hydrocarbon impacted soil. The soil was stained and had a strong petroleum odor.

The on-site delineation for the NLVS project was performed in two separate stages. In order to keep the diesel island partially open, the west side of the island was demolished and excavated first. The excavation of the western half went down to an average of 12 to 14 feet, removing about 2,090 tons of hydrocarbon impacted soil. The location of the excavated zones and soil sample locations are illustrated in Figure 5. The soil was sent to Las Vegas Paving where it was thermally treated. After the excavation, six soil samples were taken from the bottom of the excavation to determine the extent of the remaining contamination. The excavation and sampling for the western half was completed in early September 1997 (SEI 3, 1997).

The same approach was taken in the eastern half. Due to limited leakage, only 220 tons of hydrocarbon impacted soil was removed. Only four soil samples were
taken from the eastern excavation. The excavation zones and soil sample locations are illustrated in Figure 6 (SEI 2, 1997).

Soil samples were also taken from the soil borings that were converted into Groundwater monitoring wells M-1 and M-3.

2.5.3 Well Installation

Based on our knowledge of soil and ground water conditions from the initial site evaluation, three monitoring wells were strategically placed on the site. They were labeled MW-1 through MW-3. Groundwater samples were taken from these wells to assess the possibility of hydrocarbon contamination and they will be used to monitor the groundwater during remediation, should additional remediation be applied. The well locations can be seen in Figure 4.

2.5.4 Conclusion

All of the requirements of the ASTM standard were met during the on-site delineation of the NLVS. An on-site delineation report was not produced. There was not sufficient data at the time and it was not know if remedial action would even be necessary.
2.6 ASTM Off-Site Delineation

2.6.1 Scope

If, after the on-site delineation is completed and the full extent of the release is remains unknown due to property lines, additional assessment must take place. This assessment is referred to as off-site delineation. It evaluates the extent of the release outside of the release source property lines. The methodologies are the same as those applied in the on-site delineation. The off-site delineation should continue until the extent of the release is evaluated. Off-site access may need to be granted. Neighboring properties are not always willing to grant the access, so after 90 days the regulatory agency should be asked to get involved.

2.6.2 Off-Site Activities

Off-site activities are a continuation of the on-site delineation. The off-site delineation should continue until the full extent of the release has been determined. This is not always possible since structures, access problems, or insufficient data will not allow for the full extent of the release to be known. The assessment must continue, however, until there is enough data to assess the need for remediation, design the remedial action, and design a method for monitoring its progress.

If an on-site delineation report is prepared, suspected off-site contamination should be included in it. An off-site delineation report should be turned in to the regulatory agency as a supplement to the on-site delineation report.
The extent of the diesel release was determined to be contained within the NLVS property lines, therefore, no off-site delineation was performed for the NLVS.

2.7 ASTM Sample and Analysis

2.7.1 Scope

When sampling both soil and groundwater, it is important to know what to look for. Indicator compounds should be identified during this portion of the site assessment. If the release product is known, the indicator compounds are usually easy to find. The ASTM standard indicates that if the suspected release product is gasoline, BTEX may be the indicator compound. If diesel is known to be the release product, naphthalenes and semi-volatiles may be indicator compounds. Once the indicator compounds have been identified, further analysis can be limited to these compounds. Soil and water samples can be taken and analyzed. The concentrations of the indicator compounds in the samples will help analyze the extent of the contamination. The indicator compounds will be used throughout the entire remediation process. They will assist in defining target levels, monitoring progress, and regulate the potential termination of a remediation project.
2.8 Sampling and Analysis

For the NLVS

2.8.1 Background

Indicator compounds were identified as total petroleum hydrocarbon (TPH) and benzene, toluene, ethylbenzene, and total xylenes (BTEX). These were rather easy to identify because the release was known to be diesel fuel. These indicator compounds were used to analyze both soil and groundwater samples.

2.8.2 Soil Sampling and Analysis

The six initial exploratory borings were labeled B-31 to B-36. The location of these borings can be found in Figure 2. Each soil boring was drilled between 20 and 41.5 feet bgs. The boring logs are located in Appendix A along with the analytical results and a table. After the results were returned from Alpha Analytical Inc., it was concluded that the area around boring B-32 was most severely impacted. The TPH concentrations ranged from 4,800 to 20,000 mg/Kg. The TPH concentrations were 4,800mg/Kg at 40 feet bgs. These statistics are rather high, considering the action level for TPH is 100 mg/kg. BTEX were also detected, although the laboratory characterized the hydrocarbon as diesel.

Soil samples were also taken from the eastern and western excavations. There were six samples taken from the bottom of the western half, they were labeled S-1 to S-6. Four others were taken from the eastern half, and were labeled S-11 to S-14. The locations are illustrated in Figure 6. Samples from the western half were
taken between 5 and 14 feet from the floor of the excavation. These samples contained TPH concentrations that ranged from 45 to 1,900 mg/Kg. Refer to Appendix A for the analytical results. The samples from the eastern half were taken between 3 and 10 feet from the floor of the excavation. These samples contained TPH concentrations that ranging from 6,300 to 14,000 mg/Kg. The analytical results are included in Appendix A.

There were seven additional soil samples taken from the soil borings that were converted into groundwater monitoring wells. Four were collected from M-1, and the remaining three were taken from M-3. Copies of the laboratory analytical reports and boring logs are included in Appendix A. No samples were submitted from M-2 based on the downgradient location.

### 2.8.3 Water Sampling and Analysis

There was a soil boring drilled on October 20, 1997. The purpose of this boring was to obtain a sample in order to evaluate potential hydrocarbon impact to the groundwater. Groundwater was encountered at approximately 57 feet bgs. A water sample was collected from open soil boring B-40 and sent to the laboratory. The TPH concentration was 0.25 mg/L. The samples were also tested for BETEX. The results are as follows:

- Benzene: 65ug/L
- Toluene: 16ug/L
- Ethylbenzene: 3ug/L
- Total Xylenes: 40ug/L
On April 5, 1998, groundwater samples were extracted from the three groundwater monitoring wells, M-1, M-2, and M-3. The samples were analyzed for BTEX and full range TPH. All three samples returned non-detect. Therefore, no remedial action is necessary for the site. The laboratory analytical results are included in Appendix B.

### 2.8.3 Conclusion

The ASTM standard stated that an indicator compound or compounds should be identified. The indicator compounds were identified for the NLVS and samples were analyzed to determine the concentrations of the indicator compound within the samples. Therefore, the NLVS procedures were the same as the ASTM E1599-94 standard.

### 2.9 ASTM Site Assessment Methodologies

There are many different types of assessment methodologies. Depending on the site-specific characteristics, the person conducting the assessment may chose to implement one or several methodologies over others. To obtain more information on what methodology should be implemented, the ASTM standard refers the reader to the American Petroleum Institute (API) Recommended Procedures 1628 and 1629. Included in these standards are the recommended procedures for the following methodologies:
2.10 Site Assessment Methodologies

For the NLVS

2.10.1 Soil Boring, Drilling, and Sampling

Soil borings on the NLVS were drilled with a Mobil B-61 HDX drill rig equipped with a hollow-stem auger. A six-inch diameter bit advanced the borings. Prior to drilling the borings, the drilling equipment was steam cleaned. This was done in order to prevent cross-contamination from prior use of the equipment. For the same reason, the sampling equipment was decontaminated with detergent wash, rinsed with tap water, and finally rinsed with distilled water before each soil sample.

Keith Stewart served as the environmental geologist on site during the soil borings. His responsibilities included classifying the soil according to the Unified Soil Classification System (USCS), logging the location of boreholes, collecting
soil samples, and screening the soil samples for volatile organic vapor compounds (VOCs) with a photo ionization detector (PID).

Soil samples were collected by drilling down to just above the point of the desired sample depth. A modified Porter Split Spoon Sampler was lowered down the center of the hollow-stem auger. The Porter Split Spoon Sampler had three brass sample tubes inside of it. The sampler was driven into undisturbed soil by a 140-pound hammer that fell from 30 inches above the sampler. The sample tubes were then retrieved from the boring. The retrieved soil was USCS classified, PID tested and sent to the laboratory for further analysis.

The top samples were sealed in Teflon sheets and plastic end-caps and packed in a blue-ice chilled cooler, to maintain the sample integrity. If these precautions were not taken, the volatile organic compounds (VOCs) may have escaped from the soil samples. To further maintain the sample integrity, the samples were transferred to the Nevada Environmental Laboratory (NEL) following strict chain-of-custody procedures. The soil samples were also evaluated for the presence or absence of hydrocarbon stains and odor.

The soil from the second sample tube and the remaining soil from the sampler tip were placed in plastic bags. Air was let into the top of the bag to allow for headspace. The samples were then stored for at least 20 minutes to allow the VOCs to accumulate in the headspace of the bag. A PID was then used to screen
the headspace of each sample. The PID measures ionizable organic compounds and is capable of detecting very low concentrations of organic vapors. These were evaluated for hydrocarbon stains and odor as well.

2.10.2 Monitor Well Construction

A permit was obtained from the Nevada Department of Conservation and Natural Resources, Division of Water Resources. The groundwater monitoring wells were constructed of four-inch diameter, flush threaded, Schedule 40 PVC casing and 0.020 inch factory slotted screen, and Schedule 40 PVC screen. A filter pack of Lone Star graded, clean silica sand was carefully placed around the casing in the annular space between the casing and the wall of the soil boring to a depth approximately one foot above the top of the screened interval. A bentonite seal was placed on top of the filter pack to provide a sanitary seal with an approximate thickness of at least two feet. A neat cement grout was then placed in the annulus between the wall of the soil boring and PVC casing from the top of the bentonite seal near the surface grade. A flush-mount groundwater monitoring well box was installed to a point slightly above the original grade to establish positive drain away from the well. The well was capped with a watertight locking cap (SEI 1,1998). An illustration of the construction can be seen in Figure 7.

2.10.3 Monitoring Well Development

Once the groundwater wells are constructed, groundwater was pumped from the wells. This removed any fine-grained material that was present in the groundwater
well, sand pack, and adjacent formation. The well was pumped a minimum of five well volumes, each time allowing the well to recover to equilibrium. The monitoring well was allowed to sit for an additional three days, allowing it to settle. These precautions were taken so that the samples from the well were representative of the water in the aquifer, clear of any silty matter stirred up during the construction and development of the wells. The water pumped from the groundwater wells during the development stage was placed in 55-gallon, 17-H steel drums, stored on site and labeled for disposal depending on the laboratory analysis results. The development equipment was also decontaminated to prevent cross-contamination. The surge block was steam cleaned and the pump and hoses rinsed with detergent and then clean water.

2.10.4 Groundwater Sampling

Prior to sampling the groundwater from the groundwater monitoring wells, the depth to static water level was measured by utilizing a conductivity based water level indicator. This device is capable of measuring to the nearest 0.10 foot. The groundwater was visually assessed for the presence of floating petroleum hydrocarbons. This was accomplished by lowering a translucent bailer tied to the end of a string into the groundwater well and retrieving a sample.

Before the groundwater samples were taken, approximately three to five well volumes were purged from the wells, allowing the well to recover to equilibrium. This was achieved by using a polyethylene bailer. In order to minimize the loss of
volatile organic compounds, the bailer was lowered slowly into the groundwater surface and raised with the same amount of caution. The samples were then placed into clean sample containers, checked for bubbles, sealed, labeled, and sent to NEL. The samples were transferred to NEL in a blue-ice chilled cooler abiding by the chain-of-custody procedures. To avoid cross-contamination of the samples, new bailers and latex gloves were used for each groundwater sample.

2.10.5 Conclusion

The NLVS followed different guidelines than the ASTM standard recommends, when deciding what methodologies to implement. As stated in the previous section, the ASTM recommends following the API recommended procedures. The NLVS chose a different approach; it followed the NDEP standards. These standards are released by the state. As stated earlier, there are several ways to approach site assessment methodologies. Just because one set of standards was chosen over another, does not necessarily mean that one is more or less effective than the other. This simply illustrates a difference in the procedures implemented at the NLVS and the ASTM E1599-94 standard.

2.11 ASTM Documentation

2.11.1 Scope

After the site assessment is complete, a report must be submitted to the regulatory agency. If an on-site delineation report has already been submitted, then the site
assessment report will serve as a supplement. The site assessment report should include the following:

- Data collected from the initial site evaluation,
- A map indicating borings, well locations, structures, property lines, tanks, piping, pumps, and neighboring properties and their uses,
- Logs of any exploratory borings or other subsurface exploration along with their analytical results,
- Schematics of any groundwater monitoring wells and groundwater levels indicated.
- Depth-to-fluid, depth-to-water, top-of-casing elevation, water table elevations, and product thickness measurements in tabular form,
- Chain-of-custody forms, and
- Recommendations of any further actions.

The list above can be found in the ASTM E1599-94 standard (ASTM, 1997).

2.12 Documentation for the NLVS

2.12.1 Background

Stewart Environmental submitted a site assessment report upon the completion of the site assessment at the NLVS. The report included the following:

- Background of the site,
- Objectives of the site assessment,
- Regional and site geology,
- Hydrology and climate,
• Assessment methodologies,
• Laboratory analytical data for soil and groundwater samples, and
• Conclusions, recommendations, and limitations SEI 3, 1998).

2.12.2 Conclusion

The NLVS site assessment report and the ASTM standard recommendations included the same material. The terminology was different but the objectives of the site assessment reports achieved the same goal.
3.0 Conclusions and Recommendations
3.1 Conclusions

It is concluded that the NLVS procedures and the ASTM E1599-94 standard are very similar with a few minor differences. The differences are as follows:

- During the initial site evaluation, a surrounding land-use map was not produced.
- During the on-site delineation, an onsite delineation report was not produced.
- There was no off-site delineation because the diesel contamination was contained on the NLVS.
- Finally, the site assessment methodologies for the NLVS followed the NDEP recommendations rather than the API recommendations.

3.2 Recommendations

After comparing the NLVS to the ASTM standard E1599-94, I would not recommend making any changes in the procedures that were implemented on the NLVS site assessment. All of the objectives were satisfied and a thorough assessment of the NLVS completed. I do, however, have three recommendations for the NLVS following the site assessment.

First, I would recommend that the elevation of the monitoring wells undergo evaluation every month for one year. It is possible to determine, from this evaluation, if there are hydrocarbons present. If there floating hydrocarbons are present, I would suggest that remedial action be implemented.
Second, I would recommend that groundwater samples are collected and sent to the laboratory to undergo analysis. This should be done on a quarterly basis for an additional year. The results can be used to detect possible hydrocarbon migration into the groundwater. If hydrocarbons were detected, it would be a good indicator that the diesel is still migrating and remedial actions may be necessary.

Finally, if the groundwater monitoring wells remain non-detect after a year, I would recommend that an A-K Risk Evaluation take place. This evaluation will either prove that there is no threat to groundwater and the NDEP will approve a closure of the site or it will prove that there is a threat too the groundwater and remedial action would follow. The A-K Risk evaluation includes the following:

- A- Depth to groundwater,
- B- Distance to irrigation or drinking wells,
- C- Type of soil,
- D- Annual precipitation,
- E- Type of regulated substance released,
- F- Extent of contamination,
- G- Present and potential land-use,
- H- Preferred roots of migration,
- I- Location of structures or impediments,
- J- Potential for hazards related to fire, vapor, for explosion, and
- K- Site specific factors.
By performing this risk evaluation, the regulating agency can be confident that there is no further risk at the NLVS.


Stewart Environmental, Inc. (SEI 1), Site Assessment Report, Morton's Flying J Truck Stop, April 23, 1998.


Stewart Environmental, Inc. (SEI 3), Status Report, Morton's Flying J Truck Stop, October 17, 1997.
FIGURES
UPGRADED UST INSTALLATION

RESTAURANT AND STORE

DIESEL FUEL ISLANDS

Groundwater Flow Direction

CHEYENNE AVENUE

LOSEE ROAD

BASE MAP

NOT TO SCALE

SITE PLAN
NORTH LAS VEGAS SITE

JOB NO. 96421/V4

GES
GEOECONOMICAL & ENVIRONMENTAL SERVICES, INC.

FIG. 1

GES
7005 W. Sahara Ave., Ste. 101 Las Vegas, NV 89117
(702) 363-1001 • Fax (702) 341-7120
LEGEND

 FBI APPROX. BORE LOCATION

NORTH LAS VEGAS SITE

Initial Six Soil Borings

DIESEL FUEL ISLANDS

PROPOSED SOIL EXCAVATION

NOT TO SCALE
NORTH MONITORING WELL TRAVEL PLAZA MCDONALDS MW-2 MW-1 DIESEL FUELING ISLANDS USTs Remedial System Not to Scale

Losee Road

Cheyenne Road

STEWART ENVIRONMENTAL, INC.
MONITORING WELL LOCATIONS NORTH LAS VEGAS SITE

FIGURE NO.: 4 MARCH 30, 1998
Former Fuel Dispenser Location

Project:
Soil Excavation and Soil Sample Locations
Western Half of Fuel Islands
North Las Vegas Site

File No.:
97-503.1

STEWART ENVIRONMENTAL, INC.

Date
10/16/97

Figure:
5
Soil sample S-15 was collected from the stockpile.

Former Fuel Dispenser Location

Project: Soil Excavation and Soil Sample Locations
Eastern Half of Fuel Islands
North Las Vegas Site

File No.: 97-503.1

Date: 12/20/97

Figure: 6
LOCKABLE TRAFFIC RATED VAULT

- *Positive Drainage Directed Away From Well*
  - 8" - 10" Borehole
  - 4" Solid Schedule 40 PVC Pipe (Flush Thread Joints)
  - Cement / Bentonite Grout
  
- Bentonite Seal (at least 2' in thickness)
  
- Sand Backfill (to extend a minimum of 1' above slotted pipe)

4" 0.01 to 0.02 Slotted Schedule 40 PVC - Flush Thread Joints

Threaded End Cap

MONITORING WELL CONSTRUCTION
APPENDIX A

(Soil)
Analytical Reports

For Excavation Soil Samples
ANALYTICAL REPORT

Stewart Environmental
229 Moose Lane
Las Vegas, NV 89128

Job#: 97-503.1
Phone: (702) 254-6731
Attn: Keith Stewart

Sampled: 09/09/97 Received: 09/11/97 Analyzed: 09/13-15/97

Matrix: [ X ] Soil [ ] Water [ ] Waste

Analysis Requested: TPH - Total Petroleum Hydrocarbons-Extractable Quantitated As Diesel

Methodology: TPH - Modified 8015/DHS LUFT Manual/BLS-191

<table>
<thead>
<tr>
<th>Client ID/Lab ID</th>
<th>Parameter</th>
<th>Concentration mg/Kg</th>
<th>Detection Limit mg/Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1 /STW97091103-01</td>
<td>TPH *</td>
<td>1,900</td>
<td>10</td>
</tr>
<tr>
<td>S-2 /STW97091103-02</td>
<td>TPH *</td>
<td>410</td>
<td>10</td>
</tr>
<tr>
<td>S-3 /STW97091103-03</td>
<td>TPH *</td>
<td>130</td>
<td>10</td>
</tr>
<tr>
<td>S-4 /STW97091103-04</td>
<td>TPH **</td>
<td>45</td>
<td>10</td>
</tr>
<tr>
<td>S-5 /STW97091103-05</td>
<td>TPH *</td>
<td>430</td>
<td>10</td>
</tr>
<tr>
<td>S-6 /STW97091103-06</td>
<td>TPH *</td>
<td>51</td>
<td>10</td>
</tr>
</tbody>
</table>

* - Components are primarily in the range of diesel with minor amounts of light oil and motor oil.
** - Components are in the range of light oil and motor oil.

Note: Hydrocarbons outside the range of diesel may have varying recoveries.

Approved By: Roger L. Scholl, Ph.D.
Laboratory Director

Date: 9/17/97
NEL LABORATORIES

CLIENT: Stewart Environmental
PROJECT NAME: North Las Vegas Site
PROJECT NUMBER: 97-503.1

TEST: Total Extractable Petroleum Hydrocarbons by EPA Method 8015M, July 1992
METHOD: EPA 8015M
MATRIX: Soil

<table>
<thead>
<tr>
<th>CLIENT SAMPLE ID</th>
<th>SAMPLE DATE</th>
<th>SAMPLE ID</th>
<th>NEL RESULT</th>
<th>Reporting Limit</th>
<th>Surrogate Recovery*</th>
<th>EXTRACTED</th>
<th>ANALYZED</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-11</td>
<td>11/25/97</td>
<td>L9711223-01</td>
<td>6300</td>
<td>100. mg/kg</td>
<td>88 %</td>
<td>11/26/97</td>
<td>11/29/97</td>
</tr>
<tr>
<td>S-12</td>
<td>11/25/97</td>
<td>L9711223-02</td>
<td>7000</td>
<td>100. mg/kg</td>
<td>121 %</td>
<td>11/26/97</td>
<td>11/29/97</td>
</tr>
<tr>
<td>S-13</td>
<td>11/25/97</td>
<td>L9711223-03</td>
<td>1800</td>
<td>10. mg/kg</td>
<td>70 %</td>
<td>11/26/97</td>
<td>11/29/97</td>
</tr>
<tr>
<td>S-14</td>
<td>11/25/97</td>
<td>L9711223-04</td>
<td>6600</td>
<td>100. mg/kg</td>
<td>97 %</td>
<td>11/26/97</td>
<td>11/29/97</td>
</tr>
<tr>
<td>S-15</td>
<td>11/25/97</td>
<td>L9711223-05</td>
<td>14000</td>
<td>100. mg/kg</td>
<td>113 %</td>
<td>11/26/97</td>
<td>11/29/97</td>
</tr>
</tbody>
</table>

** Diesel Range Organics (C12 to C32).

Note: The reporting limit for Oil Range Organics in soil is 50 mg/kg.

QUALITY CONTROL DATA (Total for Gas and Diesel Range):

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Result</th>
<th>Acceptable Range</th>
<th>Surrogate Recovery*</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank, 971126tphs -BLK</td>
<td>ND</td>
<td>&lt; 10. mg/kg</td>
<td>87 %</td>
<td>NA</td>
</tr>
<tr>
<td>LCS, 971126tphs - LCS</td>
<td>74 %</td>
<td>55 - 102 %</td>
<td>94 %</td>
<td>NA</td>
</tr>
</tbody>
</table>

ND - Not Detected
* Surrogate used was Octacosane, acceptance limits 70-130%.
Boring Logs, Analytical Reports,

And Table from

Initial Six Soil Borings
SOIL SAMPLE ANALYTICAL RESULTS
NORTH LAS VEGAS SITE

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>TPH</th>
<th>BENZENE</th>
<th>TOLUENE</th>
<th>ETHYL-BENZENE</th>
<th>TOTAL XYLENES</th>
</tr>
</thead>
<tbody>
<tr>
<td>B31 @ 10'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B31 @ 20'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B32 @ 10'</td>
<td>20,000</td>
<td>ND</td>
<td>ND</td>
<td>21,000</td>
<td>24,000</td>
</tr>
<tr>
<td>B32 @ 20'</td>
<td>12,000</td>
<td>ND</td>
<td>25,000</td>
<td>17,000</td>
<td>65,000</td>
</tr>
<tr>
<td>B32 @ 25'</td>
<td>11,000</td>
<td>6,400</td>
<td>72,000</td>
<td>13,000</td>
<td>59,000</td>
</tr>
<tr>
<td>B32 @ 40'</td>
<td>4,800</td>
<td>4,000</td>
<td>68,000</td>
<td>15,000</td>
<td>82,000</td>
</tr>
<tr>
<td>B33 @ 10'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B33 @ 20'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B34 @ 5'</td>
<td>17</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B34 @ 15'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B35 @ 10'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B35 @ 20'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B36 @ 10'</td>
<td>ND</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>B36 @ 20'</td>
<td>ND</td>
<td>42</td>
<td>360</td>
<td>26</td>
<td>1.4</td>
</tr>
<tr>
<td>B36 @ 30'</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

* Results are in mg/Kg
* All other results in ug/Kg
### KEY TO SYMBOLS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Strata symbols</strong></td>
<td></td>
<td><strong>Soil Samplers</strong></td>
</tr>
<tr>
<td>![Paving]</td>
<td>Paving</td>
<td>![California sampler]</td>
<td>California sampler</td>
</tr>
<tr>
<td>![Poorly graded sand with clay]</td>
<td>Poorly graded sand with clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Low plasticity clay]</td>
<td>Low plasticity clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Clayey sand]</td>
<td>Clayey sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Caliche]</td>
<td>Caliche</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![High plasticity clay]</td>
<td>High plasticity clay</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Misc. Symbols

- ^ \_ - Boring continues

### Notes:

1. Exploratory borings were drilled on date shown using a Mobile B-53 air rotary drill rig.

2. California sampler driven with 140 pound hammer falling 30 inches.

3. Boring locations shown on site plan estimated by pacing from existing features and elevations, if shown, estimated from available topographic information.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs and attached plates/figures.
# EXPLORATION LOG

## B-31

**PROJECT:** North Las Vegas Site  
**PROJECT NO.:** 96422V4  
**HOLE LOCATION:** SEE FIGURE 1  
**EXPLORATION DATE:** 1-15-97  
**EXPLORATION SIZE (diameter):** 3 7/8" TRICONE  
**G.S. ELEVATION:** EGS  
**EQUIPMENT:** MOBILE B-53  
**LOGGED BY:** S. JOHNSON

**INITIAL DEPTH TO WATER:** NGE  
**FINAL DEPTH TO WATER:** NGE  
**EGS LOGGED BY:** S. JOHNSON  
**NGE DATE MEASURED:** NA  
**NGE DATE MEASURED:** NA

<table>
<thead>
<tr>
<th>ELEVATION/DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
<th>MONITORING WELL CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>P</td>
<td></td>
<td>Concrete pad.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td>SP-SC</td>
<td></td>
<td>Reddish brown poorly graded sand with clay and gravel, dry to slightly moist and dense. No hydrocarbon odor observed.</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td>CL</td>
<td></td>
<td>Brown sandy lean clay, slightly moist to moist and stiff. No hydrocarbon odor observed.</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>-9</td>
<td></td>
<td></td>
<td></td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>-12</td>
<td></td>
<td></td>
<td></td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-24</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-30</td>
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<td></td>
</tr>
<tr>
<td>-33</td>
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<td></td>
</tr>
<tr>
<td>-36</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NO GROUNDWATER ENCOUNTERED**  
**END OF EXPLORATION AT 21.5 FEET**
## EXPLORATION LOG

**B-32**

**PROJECT NO.:** 96422V4  
**EXPLORATION DATE:** 1-15-97  
**EQUIPMENT:** MOBILE B-53  
**LOGGED BY:** S. JOHNSON

### INITIAL DEPTH TO WATER:  
**EGS**

### FINAL DEPTH TO WATER:  
**EGS**

<table>
<thead>
<tr>
<th>ELEVATION/DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
<th>MONITORING WELL CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>Concrete pad.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td></td>
<td></td>
<td>Green clayey sand with gravel, slightly moist to moist and medium dense. Strong hydrocarbon odor and soil staining observed.</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td></td>
<td></td>
<td>SC</td>
<td>338</td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td></td>
<td></td>
<td>Dark gray clayey sand, slightly moist to moist and medium dense. Strong hydrocarbon odor and soil staining observed.</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>-5.9</td>
<td></td>
<td></td>
<td>SC</td>
<td>338</td>
<td></td>
</tr>
<tr>
<td>-9</td>
<td></td>
<td></td>
<td>Very pale brown sandy lean clay with isolated gravel, dry to slightly moist and medium dense. Moderate hydrocarbon odor and slight soil staining observed.</td>
<td>223</td>
<td></td>
</tr>
<tr>
<td>-12</td>
<td></td>
<td></td>
<td>CL</td>
<td>441</td>
<td></td>
</tr>
<tr>
<td>-15</td>
<td></td>
<td></td>
<td>...partially cemented and hard, no soil staining to 17.0</td>
<td>223</td>
<td></td>
</tr>
<tr>
<td>-18</td>
<td></td>
<td></td>
<td>CL</td>
<td>441</td>
<td></td>
</tr>
<tr>
<td>-21</td>
<td></td>
<td></td>
<td>Red sandy lean clay, slightly moist to moist and firm. Strong hydrocarbon odor observed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## EXPLORATION LOG

**B-32**

**PROJECT**
North Las Vegas Site

**PROJECT NO.:**
96422V4

**EXPLORATION DATE:**
1-15-97

**EQUIPMENT:**
MOBILE B-53

**LOGGED BY:**
S. JOHNSON

---

### EXPLORATION SIZE (diameter):
3 7/8" TRICON

### G.S. ELEVATION:

### INITIAL DEPTH TO WATER:

### FINAL DEPTH TO WATER:

### ELEVATION / SOIL & SAMPLE SYMBOLS / USCS / DESCRIPTION / PID READING / MONITORING WELL CONSTRUCTION

<table>
<thead>
<tr>
<th>ELEVATION / DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
<th>MONITORING WELL CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>-24</td>
<td></td>
<td></td>
<td>...stiff to 30.0</td>
<td>1278</td>
<td></td>
</tr>
<tr>
<td>-27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-30</td>
<td>SC</td>
<td></td>
<td>Red clayey sand, moist and very dense. Strong hydrocarbon odor observed.</td>
<td>282</td>
<td></td>
</tr>
<tr>
<td>-33</td>
<td>C</td>
<td></td>
<td>White caliche, dry, cemented and hard. Strong hydrocarbon odor observed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-36</td>
<td>SC</td>
<td></td>
<td>Light brown clayey sand, slightly moist, partially cemented and very dense. Strong hydrocarbon odor observed.</td>
<td>1315</td>
<td></td>
</tr>
<tr>
<td>-39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-42</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>-45</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**NO GROUNDWATER ENCOUNTERED**

**END OF EXPLORATION AT 41.5 FEET**
**EXPLORATION LOG**

**B-33**

**PROJECT** North Las Vegas Site  
**PROJECT NO.:** 96422V4  
**EXPLORATION DATE:** 1-16-97  
**EQUIPMENT:** MOBILE 8-53  
**LOGGED BY:** S. JOHNSON

**HOLE LOCATION:** SEE FIGURE 1  
**EXPLORATION SIZE (diameter):** 3 7/8" TRICONE  
**G.S. ELEVATION:** EGS

<table>
<thead>
<tr>
<th>ELEVATION/DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>P</td>
<td>Concrete pad.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SC</td>
<td>Reddish brown clayey sand with gravel, slightly moist and medium dense. No hydrocarbon odor observed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH</td>
<td>Brown sandy fat clay, moist and firm. No hydrocarbon odor observed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL</td>
<td>Very pale brown lean clay, dry, partially cemented and hard. No hydrocarbon odor observed.</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL</td>
<td>Light brown sandy lean clay, slightly moist, partially cemented and stiff. No hydrocarbon odor observed.</td>
<td>17.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>...no longer partially cemented and soft to 20.0</td>
<td>17.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SC</td>
<td>Light brown clayey sand, moist and medium dense. No hydrocarbon odor observed.</td>
<td>9.4</td>
</tr>
</tbody>
</table>

**NO GROUNDWATER ENCOUNTERED**  
**END OF EXPLORATION AT 21.5 FEET**
**EXPLORATION LOG**

**B-34**

**PROJECT:** North Las Vegas Site  
**PROJECT NO.:** 96422V4

**HOLE LOCATION:** SEE FIGURE 1  
**EXPLORATION DATE:** 1-16-97

**EXPLORATION SIZE (diameter):** 3 7/8" TRICONE  
**EQUIPMENT:** MOBILE B-53

**G.S. ELEVATION:** EGS  
**LOGGED BY:** S. JOHNSON

**INITIAL DEPTH TO WATER:** NGE  
**DATE MEASURED:** NA

**FINAL DEPTH TO WATER:** NGE  
**DATE MEASURED:** NA

<table>
<thead>
<tr>
<th>ELEVATION/DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
<th>MONITORING WELL CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td></td>
<td></td>
<td>Concrete pad.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td></td>
<td></td>
<td>SC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light brown clayey sand with gravel, dry to slightly moist and medium dense. No hydrocarbon odor observed.</td>
<td></td>
<td></td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>-9</td>
<td></td>
<td></td>
<td>CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brown sandy lean clay, dry to slightly moist and stiff. No hydrocarbon odor observed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-12</td>
<td></td>
<td></td>
<td>CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very pale brown, lean clay, dry, partially cemented and hard. No hydrocarbon odor observed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>...sandy, slightly moist and stiff to 19.5</td>
<td></td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-18</td>
<td></td>
<td></td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>White caliche, dry, cemented and hard. No hydrocarbon odor observed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NO GROUNDWATER ENCOUNTERED**

**END OF EXPLORATION AT 20.29 FEET**
EXPLORATION LOG
B-35

PROJECT: North Las Vegas Site  PROJECT NO.: 96422V4
HOLE LOCATION: SEE FIGURE 1  EXPLORATION DATE: 1-15-97
EXPLORATION SIZE (diameter): 3 7/8" TRICONE  EQUIPMENT: MOBILE B-53
G.S. ELEVATION: EGS  LOGGED BY: S. JOHNSON

INITIAL DEPTH TO WATER: NGE  DATE MEASURED: NA
FINAL DEPTH TO WATER: NGE  DATE MEASURED: NA

<table>
<thead>
<tr>
<th>ELEVATION/DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
<th>MONITORING WELL CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>P</td>
<td></td>
<td>Concrete pad.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>Dark gray clayey sand with gravel, slightly moist and dense. Soil staining and slight hydrocarbon odor observed. ...black to 4.0</td>
<td></td>
<td></td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>Reddish brown and gray mottled sandy lean clay, moist and firm. Slight hydrocarbon odor and soil staining observed.</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>CL</td>
<td></td>
<td>Reddish brown clay with sand and isolated gypsum crystals, moist and firm. No soil staining or hydrocarbon odor.</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>CL</td>
<td></td>
<td>Light brown sandy lean clay, very moist, partially cemented and stiff. No hydrocarbon odor observed.</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>CL</td>
<td></td>
<td>Brown lean clay, moist and firm. No hydrocarbon odor observed.</td>
<td>3.7</td>
<td></td>
</tr>
</tbody>
</table>

NO GROUNDWATER ENCOUNTERED
END OF EXPLORATION AT 21.5 FEET
**EXPLORATION LOG**  
**B-36**

**PROJECT:** North Las Vegas Site  
**PROJECT NO.:** 96422V4  
**HOLE LOCATION:** SEE FIGURE 1  
**EXPLORATION DATE:** 1-16-97  
**EXPLORATION SIZE (diameter):** 3 7/8" TRICONE  
**EQUIPMENT:** MOBILE B-53  
**LOGGED BY:** S. JOHNSON  

**INITIAL DEPTH TO WATER:**  
**FINAL DEPTH TO WATER:**  

<table>
<thead>
<tr>
<th>ELEVATION/DEPTH</th>
<th>SOIL &amp; SAMPLE SYMBOLS</th>
<th>USCS</th>
<th>DESCRIPTION</th>
<th>PID READING</th>
<th>MONITORING WELL CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>P</td>
<td></td>
<td>Concrete pad.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td>SC</td>
<td></td>
<td>Brown clayey sand with gravel, dry to slightly moist and dense. No hydrocarbon odor observed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>...light gray brown to 13.0 (possible slight soil staining)</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-9</td>
<td>CL</td>
<td></td>
<td>Reddish brown sandy lean clay, moist and dense. No hydrocarbon odor observed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>...pale brown, dry and partially cemented to 17.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>...brown and moist to 20.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**A-13**
EXPLORATION LOG
B-36

PROJECT: North Las Vegas Site
PROJECT NO.: 96422V4
HOLE LOCATION: SEE FIGURE 1
EXPLORATION DATE: 1-16-97
EXPLORATION SIZE (diameter): 3 7/8" TRICONE
EQUIPMENT: MOBILE B-53
LOGGED BY: S. JOHNSON

<table>
<thead>
<tr>
<th align="center">ELEVATION/D</th>
<th align="center">SOIL &amp; SAMPLE</th>
<th align="center">USCS</th>
<th align="center">DESCRIPTION</th>
<th align="center">PID</th>
<th align="center">MONITORING WELL</th>
</tr>
</thead>
<tbody>
<tr>
<td align="center">Depth</td>
<td align="center">SYMBOLS</td>
<td align="center"></td>
<td align="center"></td>
<td align="center">PID</td>
<td align="center">MONITORING WELL</td>
</tr>
<tr>
<td align="center">-24</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">0.0</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-27</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-30</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-33</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-36</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-39</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-42</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
<tr>
<td align="center">-45</td>
<td align="center"></td>
<td align="center"></td>
<td align="center"></td>
<td align="center">NA</td>
<td align="center"></td>
</tr>
</tbody>
</table>

...reddish brown, slightly moist and partially cemented to 31.0

NO GROUNDWATER ENCOUNTERED
END OF EXPLORATION AT 31 FEET
### RESULTS:

<table>
<thead>
<tr>
<th>Client ID/ Lab ID</th>
<th>Parameter</th>
<th>Concentration (mg/Kg)</th>
<th>Detection Limit (mg/Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-31 10' /GES012197-11LV</td>
<td>TPH</td>
<td>ND</td>
<td>10</td>
</tr>
<tr>
<td>B-31 20' /GES012197-12LV</td>
<td>TPH</td>
<td>ND</td>
<td>10</td>
</tr>
<tr>
<td>B-32 10' /GES012197-13LV</td>
<td>TPH</td>
<td>20,000</td>
<td>100</td>
</tr>
<tr>
<td>B-32 20' /GES012197-14LV</td>
<td>TPH</td>
<td>12,000</td>
<td>100</td>
</tr>
<tr>
<td>B-32 25' /GES012197-15LV</td>
<td>TPH</td>
<td>11,000</td>
<td>100</td>
</tr>
<tr>
<td>B-32 40' /GES012197-16LV</td>
<td>TPH</td>
<td>4,800</td>
<td>10</td>
</tr>
<tr>
<td>B-33 10' /GES012197-17LV</td>
<td>TPH</td>
<td>ND</td>
<td>10</td>
</tr>
<tr>
<td>B-33 20' /GES012197-18LV</td>
<td>TPH</td>
<td>ND</td>
<td>10</td>
</tr>
<tr>
<td>B-34 5' /GES012197-19LV</td>
<td>TPH **</td>
<td>17</td>
<td>10</td>
</tr>
</tbody>
</table>
### Alpha Analytical, Inc.

265 Glendale Avenue, Suite 21  
Sparks, Nevada 89431  
(702) 355-1044  
FAX: (702) 355-0406  
1-800-283-1183  
e-mail: alpha@powernet.net  
http://www.powernet.net/alpha

### Continued:

<table>
<thead>
<tr>
<th>Client ID/ Lab ID</th>
<th>Parameter</th>
<th>Concentration Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-34 @ 15' /GES012197-20LV</td>
<td>TPH</td>
<td>ND</td>
</tr>
<tr>
<td>B-35 @ 10' /GES012197-21LV</td>
<td>TPH</td>
<td>ND</td>
</tr>
<tr>
<td>B-35 @ 20' /GES012197-22LV</td>
<td>TPH</td>
<td>ND</td>
</tr>
<tr>
<td>B-36 @ 10' /GES012197-23LV</td>
<td>TPH</td>
<td>ND</td>
</tr>
<tr>
<td>B-36 @ 20' /GES012197-24LV</td>
<td>TPH</td>
<td>ND</td>
</tr>
<tr>
<td>B-36 @ 30' /GES012197-25LV</td>
<td>TPH</td>
<td>ND</td>
</tr>
</tbody>
</table>

* - Components are in the range of diesel.

** - Components are in the range of light oil and motor oil.

Note: Hydrocarbons outside the range of diesel may have varying recoveries.

ND - Not Detected

Approved By: [Signature]  
Roger L. Scholl, Ph.D.  
Laboratory Director  
Date: 1/27/97
Boring Logs and Analytical Reports

From Monitoring Wells
<table>
<thead>
<tr>
<th>Time</th>
<th>PID Reading (ppmv)</th>
<th>Blow Count (per 6 inches)</th>
<th>Sample Number</th>
<th>Sample Interval</th>
<th>Depth (ft)</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>Brown, clayey, silt, no odor, no staining, moist.</td>
</tr>
<tr>
<td>10:20</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>10'</td>
<td>Lt. tan, silty clay, no staining, no odor, dry.</td>
</tr>
<tr>
<td>10:55</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>25'</td>
<td>Brown, moist, clay, no staining, no odor,</td>
</tr>
<tr>
<td>11:10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4-Inch PVC Casing</td>
</tr>
</tbody>
</table>

Date Started/Completed: 3/9/98
Logged by: Keith Stewart

Drilling Agency/Driller: Weber Drilling
Checked by: Keith Stewart
Equipment Used: B-61HDX

Drilling Method/Fluid: Hollow Stem
Comments:

Hammer Weight/Drop Distance: 140

Groundwater Elevation (MSL): —

Borehole Location: —

Total Depth: 70 Feet

Depth to Bedrock: —

Depth to Water: 62 Feet

Brown, clayey, moist. cit, no odor, no staining.

Lt. tan, silty clay, no staining, no odor, dry.

Brown, moist, clay, no staining, no odor,

4-Inch PVC Casing

Cement Grout

STEWART ENVIRONMENTAL, INC.

File No.: 97-503.7

LOG OF BORING NO.: MW-1

03/98 Page 1 of 2 Plate No.
<table>
<thead>
<tr>
<th>Time</th>
<th>PID Reading (ppmv)</th>
<th>Blow Count (per 6 inches)</th>
<th>Sample Number</th>
<th>Sample Interval</th>
<th>Depth (ft)</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Borehole Location:</td>
</tr>
<tr>
<td>11:25</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total Depth: 70 Feet</td>
</tr>
<tr>
<td>12:32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Depth to Bedrock: —</td>
</tr>
<tr>
<td>1:15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Depth to Water: 62 Feet</td>
</tr>
</tbody>
</table>

*Groundwater Elevation (MSL): —*

<table>
<thead>
<tr>
<th></th>
<th>Well Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-Inch PVC Casing</td>
</tr>
<tr>
<td></td>
<td>Cement Grout</td>
</tr>
<tr>
<td></td>
<td>Bentonite</td>
</tr>
<tr>
<td></td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>0.020 Slotted Screen</td>
</tr>
<tr>
<td></td>
<td>End of Boring.</td>
</tr>
</tbody>
</table>

**Date Started/Completed:** 3/9/98

**Logged by:** Keith Stewart

**Checked by:** Keith Stewart

**Comments:**

**STEWART ENVIRONMENTAL, INC.**

**File No.:** 97-503.7

**LOG OF BORING NO.:** MW-1

**03/98** Page 2 of 2 Plate No.
**DESCRIPTION OF SUBSURFACE MATERIALS**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Lithology</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5</td>
<td>SC</td>
<td>Light tan, silty, clayey sand, no staining, no odor.</td>
</tr>
<tr>
<td>5 - 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - 20</td>
<td>C</td>
<td>Light tan, silty sand, moist Caliche, 3.5 feet thick.</td>
</tr>
<tr>
<td>20 - 25</td>
<td>CL</td>
<td>Light brown, silty clay, no staining, no odor.</td>
</tr>
<tr>
<td>25 - 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 - 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 - 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 - 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 - 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 - 55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 - 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 - 65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 - 70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well Construction**

- 4-Inch PVC Casing
- Cement Grout

---

**Date Started/Completed:** 3/9/98  
**Drilling Agency/Driller:** Weber Drilling  
**Equipment Used:** B-61HDX  
**Drilling Method/Fluid:** Hollow Stem  
**Hammer Weight/Drop Distance:** 140  
**Borehole Diameter:** Six Inches  
**Completion:**

---

**Logged by:** Keith Stewart  
**Checked by:** Keith Stewart  
**Comments:**

---

**STEWART ENVIRONMENTAL, INC.**

**File No.:** 97-503.7  
**LOG OF BORING NO.:** MW-2

---

03/98 Page 1 of 2 Plate No.
<table>
<thead>
<tr>
<th>Time</th>
<th>PID Reading (ppmv)</th>
<th>Blow Count (per 6 inches)</th>
<th>Sample Number</th>
<th>Sample Interval</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DESCRIPTION OF SUBSURFACE MATERIALS**

- **Lithology**
  - CL
  - Light brown, silty clay, no staining, no odor.

- **Well Construction**
  - 4-Inch PVC Casing
  - Grout
  - Bentonite
  - Sand
  - 0.020 Slotted Screen
  - End of Boring.

- **Date Started/Completed:** 3/9/98
- **Logged by:** Keith Stewart
- **Checked by:** Keith Stewart

**Comments:**

**STEWART ENVIRONMENTAL, INC.**

**File No.:** 97-503.7

**LOG OF BORING NO.:** MW-2

**03/98**

**Page 2 of 2**

**Plate No.**
<table>
<thead>
<tr>
<th>Time</th>
<th>PID Reading (ppmv)</th>
<th>Blow Count (per 6 inches)</th>
<th>Sample Number</th>
<th>Sample Interval</th>
<th>Depth (ft)</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:42</td>
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</tr>
<tr>
<td>10:47</td>
<td>0</td>
<td></td>
<td>25</td>
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<td></td>
<td></td>
</tr>
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<td>11:00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Logged by:** Keith Stewart  
**Checked by:** Keith Stewart

**Comments:**

**STEWART ENVIRONMENTAL, INC.**  
File No.: 97-503.7

**LOG OF BORING NO.:** MW-3

**Date Started/Completed:** 3/10/98  
**Drilling Agency/Driller:** Weber Drilling  
**Equipment Used:** B-61HDX  
**Drilling Method/Fluid:** Hollow Stem  
**Hammer Weight/Drop Distance:** 140  
**Borehole Diameter:** Six Inches  
**Completion:**
APPENDIX B

(Groundwater)
Analytical Reports For

Monitoring Wells
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Result</th>
<th>Reporting Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
<tr>
<td>Toluene</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
<tr>
<td>Total Xylenes</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
</tbody>
</table>

ND = Not Detected

**QUALITY CONTROL DATA:**

<table>
<thead>
<tr>
<th>Surrogate</th>
<th>% Recovery</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1-Trifluorotoluene</td>
<td>95</td>
<td>75 - 125</td>
</tr>
</tbody>
</table>
NEL LABORATORIES

CLIENT: Stewart Environmental
PROJECT NAME: North Las Vegas Site
PROJECT NUMBER: 97-503.7

CLIENT ID: MW-2
DATE SAMPLED: 4/3/98
NEL SAMPLE ID: L9804043-02

TEST: BTEX by EPA 8020
MATRX: Aqueous
DILUTION: 1
EXTRACTED: 4/5/98
ANALYZED: 4/5/98
ANALYST: Suzanne

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Result</th>
<th>Reporting Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
<tr>
<td>Toluene</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
<tr>
<td>Total Xylenes</td>
<td>ND</td>
<td>2. µg/L</td>
</tr>
</tbody>
</table>

ND - Not Detected

QUALITY CONTROL DATA:

Surrogate

<table>
<thead>
<tr>
<th>% Recovery</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>75 - 125</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>Result</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Benzene</td>
<td>ND</td>
</tr>
<tr>
<td>Toluene</td>
<td>ND</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>ND</td>
</tr>
<tr>
<td>Total Xylenes</td>
<td>ND</td>
</tr>
</tbody>
</table>

ND - Not Detected

**QUALITY CONTROL DATA:**

<table>
<thead>
<tr>
<th>Surrogate</th>
<th>% Recovery</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>a,a,a-Trifluorotoluene</td>
<td>88</td>
<td>75 - 125</td>
</tr>
</tbody>
</table>
**NEL LABORATORIES**

**CLIENT:** Stewart Environmental  
**PROJECT NAME:** North Las Vegas Site  
**PROJECT NUMBER:** 97-503.7

**TEST:** Total Extractable Petroleum Hydrocarbons by EPA Method 8015M, July 1992  
**METHOD:** EPA 8015M  
**MATRIX:** Aqueous  
**ANALYST:** Suzanne

<table>
<thead>
<tr>
<th>CLIENT SAMPLE NEL RESULT Reporting Surrogate</th>
<th>SAMPLE ID</th>
<th>DATE</th>
<th>SAMPLE ID</th>
<th>mg/L</th>
<th>C.R.</th>
<th>LIMIT</th>
<th>RECOVERY</th>
<th>EXTRACTED</th>
<th>ANALYZED</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW-1</td>
<td>L9804043-01</td>
<td>4/3/98</td>
<td>ND</td>
<td>0.5 mg/L</td>
<td>79 %</td>
<td>4/3/98</td>
<td>4/9/98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MW-2</td>
<td>L9804043-02</td>
<td>4/3/98</td>
<td>ND</td>
<td>0.5 mg/L</td>
<td>83 %</td>
<td>4/3/98</td>
<td>4/9/98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MW-3</td>
<td>L9804043-03</td>
<td>4/3/98</td>
<td>ND</td>
<td>0.5 mg/L</td>
<td>77 %</td>
<td>4/3/98</td>
<td>4/9/98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The reporting limit for Oil Range Organics in soil is 50 mg/kg.

**QUALITY CONTROL DATA (Total for Gas and Diesel Range):**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Result</th>
<th>Acceptable Range</th>
<th>Surrogate Recovery</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank, 980403TPH-RLK</td>
<td>ND</td>
<td>&lt; 0.5 mg/L</td>
<td>90 %</td>
<td>NA</td>
</tr>
<tr>
<td>LCS, 980403TP</td>
<td>LCS</td>
<td>76 % 61 - 104 %</td>
<td>84 %</td>
<td>NA</td>
</tr>
<tr>
<td>LCSD 980403TP</td>
<td>LCSD</td>
<td>80 % 61 - 104 %</td>
<td>91 %</td>
<td>NA</td>
</tr>
</tbody>
</table>

ND - Not Detected

*Surrogate used was Octacosane, acceptance limits 55-116% for solids, 60-121% for aqueous samples*