Nevada
Environmental
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Project

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Corrective Action Decision Document
for Corrective Action Unit 427:
Area 3 Septic Waste Systems 2 and 6,
Tonopah Test Range, Nevada

Controlled Copy No.: 9
Revision No.: 0

June 1998

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**CORRECTIVE ACTION DECISION DOCUMENT
FOR CORRECTIVE ACTION UNIT 427:
AREA 3 SEPTIC WASTE SYSTEMS 2 AND 6,
TONOPAH TEST RANGE, NEVADA**

DOE Nevada Operations Office
Las Vegas, Nevada

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**CORRECTIVE ACTION DECISION DOCUMENT
FOR CORRECTIVE ACTION UNIT 427:
AREA 3 SEPTIC WASTE SYSTEMS 2 AND 6,
TONOPAH TEST RANGE, NEVADA**

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List of Acronyms and Abbreviations

bgs	Below ground surface
CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	<i>Code of Federal Regulations</i>
CLP	Contract Laboratory Program
cm	Centimeter(s)
cm/sec	Centimeter(s) per second
COA	Certificates of Analysis
COC	Contaminant(s) of concern
COPCs	Contaminants of potential concern
DQO	Data Quality Objective(s)
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EDT	Electronic data transfer
EPA	U.S. Environmental Protection Agency
FFACO	<i>Federal Facility Agreement and Consent Order</i>
ft	Foot (feet)
ft ²	Square foot (feet)
ICP	Inductively coupled plasma
IDW	Investigation-derived waste
in.	Inch(es)
IT	IT Corporation

List of Acronyms and Abbreviations (Continued)

J	Estimated
km	Kilometer(s)
LCS	Laboratory control sample(s)
m	Meter(s)
m ²	Square meter(s)
MDL	Method detection limit(s)
MEK	Methylethyl ketone
mi	Mile(s)
mg/kg	Milligram(s) per kilogram
NAC	<i>Nevada Administrative Code</i>
NDEP	Nevada Division of Environmental Protection
NIST	National Institute for Standard and Technology
O&M	Operation and maintenance
PAL	Preliminary action level(s)
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PCB	Polychlorinated biphenyl(s)
ppm	Part(s) per million
PRG	Preliminary Remediation Goals
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
R	Rejected
RCRA	<i>Resource Conservation and Recovery Act</i>

List of Acronyms and Abbreviations (Continued)

RPD	Relative percent difference
SDG	Same delivery group
SNL	Sandia National Laboratories
SVOC	Semivolatile organic compound(s)
SWS	Septic Waste System(s)
TPH	Total petroleum hydrocarbon(s)
TTR	Tonopah Test Range
U	Undetected
VOC	Volatile organic compound(s)
yd ³	Cubic yard(s)
µg/L	Microgram(s) per liter
µg/kg	Microgram(s) per kilogram
%R	Percent recovery

Executive Summary

This Corrective Action Decision Document has been prepared for the Area 3 Septic Waste Systems 2 and 6 (Corrective Action Unit 427) in accordance with the *Federal Facility Agreement and Consent Order* of 1996 (FFACO, 1996).

Corrective Action Unit 427 is located at the Tonopah Test Range, Nevada, and is comprised of the following Corrective Action Sites, each an individual septic waste system (DOE/NV, 1996a):

- Septic Waste System 2 is Corrective Action Site Number 03-05-002-SW02.
- Septic Waste System 6 is Corrective Action Site Number 03-05-002-SW06.

The purpose of this Corrective Action Decision Document is to identify and provide a rationale for the selection of a recommended corrective action alternative for each Corrective Action Site.

The scope of this Correction Action Decision Document consists of the following tasks:

- Develop corrective action objectives.
- Identify corrective action alternative screening criteria.
- Develop corrective action alternatives.
- Perform detailed and comparative evaluations of the corrective action alternatives in relation to the corrective action objectives and screening criteria.
- Recommend and justify a preferred corrective action alternative for each CAS.

From November 1997 through January 1998, a corrective action investigation was performed as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit No. 427: Area 3 Septic Waste System Numbers 2 and 6, Tonopah Test Range, Nevada* (DOE/NV, 1997b). Details can be found in [Appendix A](#) of this document. The results indicated that contamination is present in some portions of the CAU and not in others as described in [Table ES-1](#) and shown in Figure A.2-2 of Appendix A.

Based on the potential exposure pathways, the following corrective action objectives have been identified for Corrective Action Unit 427:

- Prevent or mitigate human exposure to subsurface soils containing TPH at concentrations greater than 100 milligrams per kilogram (NAC, 1996b).
- Close Septic Tank 33-5 in accordance with *Nevada Administrative Code* 459 (NAC, 1996c).
- Prevent adverse impacts to groundwater quality.

Table ES-1
Locations of Contaminants of Concern

Septic Waste System Component	Investigation Results	
	No Contaminants of Concern Present	Contaminants of Concern Present
Septic Waste System 6: Pre-1965 Leachfield	X	
Septic Waste System 2: Distal End of 1965-1975 Leachfield; Southern Leg of Post 1975 Leachfield; Outfall ends of Tanks 33-6 and 33-12	X	
Septic Waste System 2: Leachbeds and Drainage Ends of the Central and Northern Legs and the Distribution Box Associated with Post-1975 Leachfield		X
Septic Waste System 2: Fork Associated with 1965-1975 Leachfield		X
Septic Waste System 2: Outfall End of Septic Tank 33-4		X

Based on the review of existing data, future land use, and current operations at the Tonopah Test Range, the following alternatives were developed for consideration at the Area 3 Septic Waste Systems 2 and 6:

- Alternative 1 - No Further Action
- Alternative 2 - Closure of Septic Tank 33-5 and Administrative Controls
- Alternative 3 - Closure of Septic Tank 33-5, Excavation, and Disposal

The corrective action alternatives were evaluated based on four general corrective action standards and five remedy selection decision factors. Based on the results of this evaluation, the preferred alternative for Corrective Action Unit 427 is Alternative 2, Closure of Septic Tank 33-5 and Administrative Controls.

The preferred corrective action alternative was evaluated on technical merit, focusing on performance, reliability, feasibility, and safety. The alternative was judged to meet all requirements for the technical components evaluated. The alternative meets all applicable state and federal regulations for closure of the site and will reduce potential future exposure pathways to the contaminated soils.

During corrective action implementation, this alternative will present minimal potential threat to site workers who come in contact with the waste. However, procedures will be developed and implemented to ensure worker health and safety.

1.0 Introduction

This Corrective Action Decision Document (CADD) has been prepared for Corrective Action Unit (CAU) 427, Area 3 Septic Waste Systems 2 and 6, in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) of 1996 that was agreed to by the U.S. Department of Energy, Nevada Operations Office (DOE/NV); the Nevada Division of Environmental Protection (NDEP); and the U.S. Department of Defense (FFACO, 1996). The CADD provides or references the specific information necessary to recommend corrective actions for the Corrective Action Sites (CAS) within CAU 427. Septic Waste Systems 2 and 6 (SWS 2&6) are associated with CAS Numbers 03-05-002-SW02 and 03-05-002-SW06, respectively ([Figure A.2-1](#) in Appendix A).

Corrective Action Unit 427 is located at the Tonopah Test Range (TTR), Nevada. The TTR, included in the Nellis Air Force Range complex, is approximately 255 kilometers (km) (140 miles[mi]) northwest of Las Vegas, Nevada ([Figures 1-1](#) and [1-2](#)).

1.1 Purpose

This CADD identifies and provides a rationale for the selection of a recommended corrective action alternative for the CAU. The need for these alternatives is based on process knowledge and the results of investigative activities conducted in accordance with the *Corrective Action Investigation Plan for Corrective Action Unit No. 427: Area 3 Septic Waste System Numbers 2 and 6, Tonopah Test Range, Nevada* (DOE/NV, 1997b).

1.2 Scope

The scope of this CADD consists of the following tasks:

- Develop corrective action objectives.
- Identify corrective action alternative screening criteria.
- Develop corrective action alternatives.

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Explanation

- Tonopah Test Range Boundary
- Primary Roadway
- Area/Gate
- Spring
- BLM Bureau of Land Management
- NAFR Nellis Air Force Range
- TTR Tonopah Test Range
- Approximate Location of CAU 427

Source: Adapted from DOE/NV, 1996a

Figure 1-2
Location of Area 3 Tonopah Test Range

- Perform detailed and comparative evaluations of corrective action alternatives in relation to corrective action objectives and screening criteria.
- Recommend and justify a preferred corrective action alternative for the CAU.

1.3 CADD Contents

This CADD is divided into the following sections:

Section 1.0 - Introduction: summarizes the purpose, scope, and contents of this CADD

Section 2.0 - Corrective Action Investigation Summary: summarizes the investigation field activities, the results of the investigation, and the need for corrective action

Section 3.0 - Evaluation of Alternatives: documents steps taken to determine a preferred corrective action alternative

Section 4.0 - Recommended Alternative: presents the preferred corrective action alternative and the rationale for its selection based on the corrective action objectives and alternative screening criteria

Section 5.0 - References: provides a list of all referenced documents

Appendix A: *Corrective Action Investigation Report for CAU 427: Area 3 Septic Waste Systems 2 and 6, TTR*

Appendix B: Soil Boring Logs

Appendix C: Cost Estimates

Appendix D: Nevada Environmental Restoration Project Document Review Sheet

All work was performed in accordance with the following documents:

- *Corrective Action Investigation Plan for Corrective Action Unit No. 427: Area 3 Septic Waste System Numbers 2 and 6, Tonopah Test Range, Nevada* (DOE/NV, 1997b)
- *Industrial Sites Quality Assurance Project Plan* (DOE/NV, 1996c)
- *Corrective Action Unit Work Plan, Tonopah Test Range, Nevada* (DOE/NV, 1996a)

- FFACO (FFACO, 1996)
- *Project Management Plan* (DOE/NV, 1994)

2.0 Corrective Action Investigation Summary

The following sections describe and summarize the results of the investigation activities conducted at CAU 427. For detailed investigation results, please refer to [Appendix A](#).

2.1 Investigation Activities

From November 1997 through January 1998, a corrective action investigation was performed that consisted of activities as set forth in the Corrective Action Investigation Plan (CAIP) (DOE/NV, 1997b). The purpose of the investigation was to complete the following tasks:

- Identify the presence and nature of possible contaminant migration from the leachfields and associated wastewater collection systems.
- Determine the vertical and lateral extent of possible contaminant migration.
- Provide sufficient information and sample analytical data from which corrective action alternatives may be developed and evaluated in the CADD for the site.
- Obtain sufficient sample analytical data for management of investigation-derived waste (IDW).

The above tasks were accomplished in a three-phase investigation. The investigation activities conducted under each phase are summarized below:

Phase I

- Excavated ten trenches to define five inactive leachfields. Three were defined and evidence of the other two could not be found.
- Collected soil samples from two horizons within the trenches. The upper sampling horizon was at 0.3 meters (m) (1 foot [ft]) above the leachbed basement. The lower sampling horizon was at 0.8 m (2.5 ft) beneath the leachbed basement. Soil samples were also obtained at the distribution boxes or forks of the three discovered leachfields.
- Located three of four septic tanks and sampled the soil at the outfall ends of the discovered septic tanks. The fourth tank was not found.
- Conducted pipeline video surveys to map the collection system network

Phase II

- Evaluated sample analytical results from Phase I to guide drilling conducted in Phase III and to assist with waste management decisions
- Backfilled the trenches with clean spoils material

Phase III

- Drilled twenty-one soil borings to obtain subsurface soil samples at select locations based upon analytical results evaluated in Phase II

Continuous field-screening of excavated soil was conducted using headspace analysis for volatile organic compounds (VOCs), colorimetric testing for total petroleum hydrocarbons (TPH), and radiological screening for alpha and beta emitters. Soil samples were analyzed for total VOCs, total semivolatile organic compounds (SVOCs), total *Resource Conservation and Recovery Act* (RCRA) metals, TPH as diesel/waste oil, TPH as gasoline, polychlorinated biphenyls (PCB), and gamma-emitting radionuclides. Geotechnical samples were collected from *in situ* soil beneath the distribution box or fork for each leachfield and analyzed for initial moisture content, dry bulk density, calculated porosity, saturated/unsaturated hydraulic conductivity, particle size distribution, and water-release curve.

In addition, historical documents, interviews, and process knowledge assisted the potential contaminant identification process at each of the septic waste systems (see [Appendix A](#)).

2.2 Results

The corrective action investigation results indicated the following:

- All VOCs were below the preliminary action levels (PALs) (see Table A.3-3) outlined in the CAIP (DOE/NV, 1997b).
- All SVOCs were below the PALs (see Section A.3.2) outlined in the CAIP (DOE/NV, 1997b). Pyrene was detected in a sample that also had a detectable level of TPH as waste oil.
- Fifteen of the 120 soil samples contained TPH as waste oil at concentrations above the NDEP-established action level of 100 milligrams/kilogram (mg/kg) (see Table A.3-4). These concentrations are associated with the northern and central distribution lines and the

distribution box of the Post-1975 Leachfield, the proximal end of the 1965-1975 Leachfield, and the outfall end of Septic Tank 33-4.

- Reported levels for all total RCRA metal samples (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) were within the PALs (see Table A.3-5) established in the CAIP (DOE/NV, 1997b) except for arsenic. All but two of the arsenic results were consistent with naturally occurring background levels as established in the TTR Area 3 CAU 424 corrective action investigation (DOE/NV, 1998a). The maximum concentration of 25.2 mg/kg was detected at 4.4 m (14.5 ft) in an area where fill material had been placed and is not believed to be associated with contamination.
- No PCBs were detected.
- Radiological results are within PALs as established in the CAIP (DOE/NV, 1997b) with the exception of three Potassium-40 results. These samples were reanalyzed and found to be within PALs.
- Septic Tanks 33-4 and 33-5 were found to be inactive. Although inactive, Septic Tank 33-5 contained septage. Soil samples, numbers TTR000931 and TTR000933, were obtained from the outfall end of Septic Tank 33-5, and their associated analytical results did not indicate a release had occurred. Samples TTR-335-1 and TTR-335-2 were obtained from within Septic Tank 33-5. The results of these samples indicated the presence of TPH, VOCs, and pesticides at low levels (below PALs) (see Table A3-6). Septic Tank 33-6 was found to be active and in line with the SNL consolidated system.

Details of the methods used and results found during the investigation are presented in [Appendix A](#). Based on these results, the nature and extent of contaminants of concern (COCs) at CAU 427 has been adequately identified.

2.3 Need for Corrective Action

Analytes detected during the corrective action investigation were evaluated against PALs to determine potential COCs for CAU 427. The COCs are those analytes detected at levels above PALs. This evaluation identified TPH as waste oil as the only contaminant above applicable regulatory limits (or PALs) and/or naturally occurring background levels as outlined in the CAIP (DOE/NV, 1997b). Therefore, an evaluation of possible remedial alternatives is required for this site to ensure worker, public, and environmental protection against potential exposure to the TPH contamination in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 1996b).

Total petroleum hydrocarbons were detected above the 100 mg/kg PAL (NAC, 1996b) in soil samples taken from the leachbeds, drainage ends, and distribution box associated with the Post-1975 Leachfield (SWS 2); the fork associated with the 1965-1975 Leachfield (SWS 2); and the outfall end of Septic Tank 33-4 (SWS 2). The maximum detected concentration of 2,900 mg/kg was obtained at Septic Tank 33-4 at a depth of 1.5 m (5.0 ft). The distal end of the northern most leachline of the Post-1975 Leachfield produced the deepest concentration of waste oil above 100 mg/kg at 8.4 m (27.5 ft).

The samples taken from within Septic Tank 33-5 indicated the presence of listed hazardous waste. As a result, Septic Tank 33-5 must be closed in accordance with NAC 459.9921 through 459.999 (NAC, 1996c), inclusive, and the *Code of Federal Regulations* (CFR) Title 40, Parts 280.60 through 280.74 (CFR, 1996), inclusive, and therefore, does not fall under Department of Human Resources, Health Division regulations. These regulations stipulate that all liquids and accumulated sludges must be removed from the tank. The tank must then be removed for disposal or filled with an inert solid material. The results of samples TTR-335-1 and TTR-335-2 can be used to guide waste management determinations.

Specific characteristics which may constrain remedial actions include underground utilities in the vicinity of the CAU ([Figure 2-1](#)) which could interfere with excavation or other corrective action activities.

Investigation activities did not indicate the presence of COCs above PALs at the Pre-1965 Leachfield (SWS 6); the distal end of the 1965-1975 Leachfield, the southern leg of the Post 1975 Leachfield, and the outfall ends of Tanks 33-6 and 33-12 (SWS 2) ([Figure A.2-1](#)). Therefore, no corrective actions are necessary at these portions of CAU 427, and they will not be discussed further in this report.

Explanation

- Active sewer lines
- Leachfield outline (per original drawing)
- Found leachfield distribution lines
- Abandoned sewer lines and miscellaneous utility lines
- IT monument location

Figure 2-1
CAU 427 Tonopah Test Range
Septic Waste Systems 2 and 6
Utilities - Active and Abandoned

3.0 Evaluation of Alternatives

The purpose of this section is to present the corrective action objectives for CAU 427, describe the general standards and decision factors used to screen the corrective action alternatives, and develop and evaluate a set of corrective action alternatives that could be used to meet the corrective action objectives.

3.1 Corrective Action Objectives

The corrective action objectives are media-specific goals for protecting human health and the environment. Based on the potential exposure pathways (see [Section 3.1.2](#)), the following corrective action objectives have been identified for CAU 427:

- Prevent or mitigate human exposure to subsurface soils containing TPH at concentrations greater than 100 mg/kg (NAC, 1996b).
- Close Septic Tank 33-5 in accordance with NAC 459 (NAC, 1996c).
- Prevent adverse impacts to groundwater quality.

3.1.1 Contaminants of Concern

Contaminants of potential concern (COPCs) were determined in the Data Quality Objective (DQO) process as listed in the CAIP (DOE/NV, 1997b). Analytical results obtained from the corrective action investigation were evaluated to determine which of those COPCs were detected above PALs, and should therefore, now be considered COCs for CAU 427. Only TPH as waste oil was detected at concentrations above PALs (Table A-3.4 of Appendix A). No other COCs were identified.

3.1.2 Potential Exposure Pathways

As part of the CAIP (DOE/NV, 1997b), a conceptual model for CAU 427 was developed which identified the potential exposure mechanism as excavation of contaminated material by site workers. This implies a potential exposure pathway through ingestion of soil under industrial scenarios. This pathway includes inhalation of vapors and dermal contact. Site workers could potentially be exposed to contaminated soil during excavation activities associated with underground utility maintenance and/or construction. Groundwater at the site is estimated to be 110 to 120 m (360 to 390 ft) below

ground surface (bgs). In addition, site conditions (i.e., relatively low concentrations of COCs, negative water balance, etc.) do not provide a driver for COCs to migrate to the water table. Therefore, the only potential exposure pathway would be through intrusive activities.

3.2 Screening Criteria

The screening criteria used to evaluate and select the preferred corrective action alternatives are identified in the U.S. Environmental Protection Agency (EPA) *Guidance on Resource Conservation and Recovery Act Corrective Action Decision Documents* (EPA, 1991) and the *Final Resource Conservation and Recovery Act Corrective Action Plan* (EPA, 1994).

Corrective action alternatives will be evaluated based on four general corrective action standards and five remedy selection decision factors. All corrective action alternatives must meet the general standards to be selected for evaluation using the remedy selection decision factors.

The general corrective action standards are:

- Protection of human health and the environment
- Compliance with media cleanup standards
- Control the source(s) of the release
- Comply with applicable federal, state, and local standards for waste management

The remedy selection decision factors are:

- Short-term reliability and effectiveness
- Reduction of toxicity, mobility, and/or volume
- Long-term reliability and effectiveness
- Feasibility
- Cost

3.2.1 Corrective Action Standards

The following text describes the corrective action standards used to evaluate the corrective action alternatives:

Protection of Human Health and the Environment

Protection of human health and the environment is a general mandate of the RCRA statute (EPA, 1994). This mandate requires that the corrective action include any protective measures that

are needed. These measures may or may not be directly related to media cleanup, source control, or management of wastes. The corrective action alternatives are evaluated for the ability to meet corrective action objectives as defined in [Section 3.1](#).

Compliance with Media Cleanup Standards

Each corrective action alternative must have the ability to meet the proposed media cleanup standards as set forth in applicable state and federal regulations (445A [NAC, 1996b] and 459 [NAC, 1996c]). Factors on which an evaluation of cleanup standards must be based ([a] through [k] evaluation) are discussed in [Section 3.3](#). Analytical results are discussed in Appendix A.

Control the Source(s) of the Release

An objective of a corrective action remedy is to stop further environmental degradation by controlling or eliminating additional releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to clean up releases may be ineffective or, at best, will essentially involve a perpetual cleanup. Therefore, each corrective action alternative must use an effective source control program to ensure the long-term effectiveness and protectiveness of the corrective action.

Comply with Applicable Federal, State, and Local Standards for Waste Management

During implementation of any corrective action alternative, all waste management activities must be conducted in accordance with applicable state and federal regulations (e.g., *Nevada Revised Statutes* 459.400 - 459.600 [NRS, 1995]; RCRA 40 CFR 261 - 281 [CFR, 1996]; 40 CFR 268, "Land Disposal Restrictions;" NAC 444, "Solid Waste Disposal" [NAC, 1996a]; and NAC 459.9974, "Disposal and Evaluation of Contaminated Soil" [NAC, 1996c]). The requirements for management of the waste, if any, derived from the corrective action will be determined based on applicable state and federal regulations, field observations, process knowledge, characterization data, and data collected and analyzed during corrective action implementation. Administrative controls (e.g., decontamination procedures and corrective action strategies) will minimize waste generated during site corrective action activities. Decontamination activities will be performed in accordance with approved procedures as specified in the NDEP-approved TTR work plan (DOE/NV, 1996a) and will be designated according to the COCs present at the site.

3.2.2 *Remedy Selection Decision Factors*

The following describe the remedy selection decision factors used to evaluate the corrective action alternatives:

Short-Term Reliability and Effectiveness

Each corrective action alternative must be evaluated with respect to its effects on human health and the environment during the construction and implementation phase of the corrective action. The following factors will be addressed for each alternative:

- Protection of the community from potential risks associated with implementation such as fugitive dusts, transportation of hazardous materials, explosion
- Protection of workers during construction and implementation
- Environmental impacts that may result from construction and implementation
- The amount of time until the corrective action objectives are achieved

Reduction of Toxicity, Mobility, and/or Volume

Each corrective action alternative must be evaluated for its ability to reduce the toxicity, mobility, and/or volume of the contaminated media. Reduction in toxicity, mobility, and/or volume refers to changes in one or more characteristics of the contaminated media by the use of corrective measures that decrease the inherent threats associated with that media.

Long-Term Reliability and Effectiveness

Each corrective action alternative must be evaluated in terms of risk remaining at the CAU after the corrective action alternative has been implemented. The primary focus of this evaluation is on the extent and effectiveness of the controls that may be required to manage risk posed by treatment residuals and/or untreated wastes.

Feasibility

The feasibility criterion addresses the technical and administrative feasibility of implementing a corrective action alternative and the availability of services and materials needed during implementation. Each corrective action alternative must be evaluated for the following criteria:

- **Construction and Operation:** This refers to the feasibility of implementing a corrective action alternative given the existing set of waste and site-specific conditions.
- **Administrative Feasibility:** This refers to the administrative activities needed to implement the corrective action alternative (e.g., permits, public acceptance, rights of way, off-site approval).
- **Availability of Services and Materials:** This refers to the availability of adequate off-site and on-site treatment, storage capacity, disposal services, necessary technical services and materials, and availability of prospective technologies for each corrective action alternative.

Cost

Costs for each alternative are estimated for comparison purposes only. The cost estimate for each corrective action alternative includes both capital and operation and maintenance (O&M) costs, as applicable. The following is a brief description of each component:

- **Capital Costs:** These costs include both direct and indirect costs. Direct costs may consist of materials, labor, mobilization, demobilization, site preparation, construction materials, equipment purchase and rental, sampling and analysis, waste disposal, and health and safety measures. Indirect costs include such items as engineering design, permits and/or fees, start-up costs, and any contingency allowances.
- **Operation and Maintenance:** These costs include labor, training, sampling and analysis, maintenance materials, utilities, and health and safety measures.

Costs associated with potential O&M activities are considered to be minimal for all alternatives and were, therefore, not estimated. Cost estimates were developed by Bechtel Nevada; details of the estimated costs for this CADD are provided in [Appendix C](#).

3.3 Development of Corrective Action Alternatives

This section identifies and briefly describes the viable corrective action technologies and the corrective action alternatives considered for the affected media. Based on the review of existing data, future land use, and current operations at the TTR, the following alternatives have been developed for consideration at CAU 427:

- Alternative 1 - No Further Action
- Alternative 2 - Closure of Septic Tank 33-5 and Administrative Controls
- Alternative 3 - Closure of Septic Tank 33-5, Excavation, and Disposal

In situ bioremediation was also considered; however, site conditions (e.g., small discrete pockets of relatively low-level contamination) do not warrant the added expense and complexity associated with implementation.

The following evaluation of NAC 445A.227 (2) (a-k) (NAC, 1996b) supports the protection of groundwater from site contaminants:

- a. The depth to groundwater is 110 to 120 m (360 to 390 ft) (DOE/NV, 1996a). Because the sources to the leachfields have been rerouted to exclude SWS 2&6, a source no longer exists to contribute to plume size or migration. The precipitation for the area (13 to 15 centimeters [cm] [5 to 6 inches (in.)] annually) (DOE/NV, 1996a) does not influence the movement of the contaminants. Based on data from other subsurface investigations in Area 3, the biological environment should be favorable to natural biological degradation (DOE/NV, 1997a; DOE/NV, 1998b). While the contaminants may continue to migrate vertically, the rate will be slow without a driving force, and the contaminants will continue to degrade over time.
- b. The distance to the nearest drinking water well (Sandia 6) is 610 m (2,000 ft) southeast of the CAS. Groundwater movement in this area is to the northwest (DOE/NV, 1996a). The total areal extent of the individual contamination pockets as determined in the site investigation is limited to approximately 100 square meters (m²) (1,100 square feet [ft²]) (see [Figure A.2-2](#) in Appendix A). Therefore, for the contaminants to affect the drinking water well, they will need to travel the vertical distance to the groundwater, then travel through the groundwater in a direction opposite normal groundwater flow to the radius of influence of the well. Because the contamination has migrated only a short vertical distance and has had no appreciable lateral migration over the last 28 to 33 years and because the hydrocarbons will likely degrade naturally with time, the likelihood of any impacts to the well is minimal.
- c. Geotechnical analysis of three samples taken below zones of contamination defined the soil as well-graded sand with silt and gravel and clayey sand with gravel. The porosity measured in the analysis ranged from 34 to 46 percent. Any silt or clay layers will only serve to impede migration of the contaminants. Low permeabilities were indicated by a range from 2.6×10^{-6} to 9.8×10^{-6} centimeters/second (cm/sec) ([Appendix A](#)). The higher the content of silts and clays, the higher the soil retention capability for the contaminants.
- d. Annual precipitation averages 13 to 15 cm (5 to 6 in.). Annual evaporation is between 147 and 168 cm (58 and 66 in.) (DOE/NV, 1996a). The high evaporation and low precipitation create a negative water balance for the area; therefore, no driving force associated with precipitation is available to mobilize contaminants to groundwater. Ponding is not likely at the CAU because the ground surface slopes such that surface water runs off site.
- e. The type of regulated substance released is petroleum hydrocarbons in the form of waste oil. Light, bulk hydrocarbons such as waste oil can migrate downward in unsaturated zone soil due to gravity and capillary forces. Downward migration is slowed by the following parameters:

- Permeability of the soil
- Natural degradation of the hydrocarbons
- Limited volume of release
- Soil saturation
- Soil particle adsorption/desorption

Analysis of three subsurface soil samples obtained within the CAU defined the permeability to be low (ranging from 2.6×10^{-6} to 9.8×10^{-6} centimeters per second [cm/sec]) (Attachment 1). Based on data from other subsurface investigations in Area 3, the biological environment should be favorable to natural biological degradation (DOE/NV, 1997a; DOE/NV, 1998b). Because of the large distance to groundwater, the slow travel time associated with the gravity drainage mechanism for migration, the small size of the contaminant pockets, and the potential biologically favorable environment, the contaminants will not likely reach or impact the groundwater.

Without specific chemical analysis of the components of the waste oil at the CAU, a quantitative estimate of the risk is not possible. However, direct pathways to the contaminants do not currently exist. The only potential pathway would be inadvertent intrusion to the TPH-contaminated zone.

The highest TPH concentration detected in the investigation was 2,900 mg/kg. The sample associated with this concentration was collected from the outfall end of Septic Tank 33-4 at a depth of 1.4 m to 1.5 m (4.5 ft to 5.0 ft). At this location, samples from boring "Tank 33-4-SB" had detected levels of TPH at 1,300 mg/kg from 2.3 m to 3.0 m (7.5 ft to 10.0 ft) and nondetectable levels below 3 m (10.0 ft). Only 15 of the 123 samples collected had TPH concentrations above 100 mg/kg ([Appendix A](#)).

- f. The extent of contamination is limited to five relatively small areas. The total lateral extent of contamination is estimated to be 100 m^2 (1,100 ft^2). The maximum vertical extent of contamination is no deeper than 10 m (33 ft). Because the source has been removed, it no longer contributes to the movement of the contaminants laterally and vertically. The deepest TPH concentration greater than 100 mg/kg was detected at 8.3 m (27.5 ft). Natural biological degradation of the waste oil should further limit the potential for contaminants to reach groundwater.
- g. Presently, the CAU is located in a government-controlled facility with the potential future land use similar to current use. The TTR is a restricted area that is guarded on a 24-hour, 365-day-per-year basis; unauthorized personnel are not admitted to the facility. The CAU is currently covered by a minimum of a 0.8 m (2.5 ft) clean soil cover, preventing inadvertent access to high concentrations of contaminants which are located at a minimum depth of 1.3 m (4.3 ft) below the surface. Alternatives will be evaluated for control of inadvertent intrusion into the contaminated zone.
- h. Preferred routes of migration are extremely limited or nonexistent since the point sources of the TPH have been removed and the surface area is covered by a minimum of a 0.8 m (2.5 ft) clean

soil cover. Inadvertent intrusion is the only pathway from the contaminants to potential receptors.

- i. The subsurface TPH is located beneath a minimum 0.8 m (2.5 ft) clean soil cover. Building 03-70 is located near, and potentially over, contamination associated with the 1965-1975 Leachfield. Numerous buried utilities cross this area.
- j. The potential for a hazard related to fire, vapor, or explosion is very low because the TPH is located below the surface under a minimum of a 0.8 m (2.5 ft) clean soil cover. The fire and explosion potential for waste oil is moderate when exposed to fire or flame, neither of which are applicable to the buried contaminants at the CAU.
- k. No other site-specific factors are known at this time.

Based on this evaluation, impacts to groundwater are not expected. Therefore, groundwater monitoring is not proposed for this site and is not considered an element of the alternatives.

3.3.1 *Alternative 1 - No Further Action*

Under the No Further Action alternative, no corrective action activities will be implemented. This alternative is used as a starting point to establish a baseline for comparison with the other corrective action alternatives. This alternative does not meet the corrective action objectives because no actions are taken to prevent human contact with the COCs. This alternative will not be compared to the other alternatives using the selection decision factors.

3.3.2 *Alternative 2 - Closure of Septic Tank 33-5 and Administrative Controls*

Administrative controls are used to prevent inadvertent contact with contaminated media. Administrative controls would consist of land-use restrictions to prevent intrusive activities. Based on data from other subsurface investigations in Area 3, the biological environment should be favorable to natural biological degradation (DOE/NV, 1997a; DOE/NV, 1998b). Natural biological activity will likely result in reduced concentrations of hydrocarbons with time. Administrative controls are commonly used and can effectively eliminate potential pathways. Administrative controls are effective because the TTR, which includes CAU 427, is a restricted-access facility. The implementation of administrative controls requires the coordination of all entities at a facility to ensure that the restrictions are enforced. An evaluation of the NAC 445A.227 (2) (a - k) (NAC, 1996b) requirements is presented in [Section 3.3](#). This evaluation provides evidence that

conditions at the CAU will not adversely impact the groundwater beneath the CAU or any nearby drinking water wells.

Septic Tank 33-5 should be closed in accordance with NAC 459 (NAC, 1996c). The estimated 5,150 liters (1,360 gallons) of septage remaining in the tank would be sampled to determine its chemical characteristics and pumped into approved containers for proper disposal. The tank would then be either filled in place with an inert material to prevent subsidence, or removed and disposed of in accordance with applicable regulations depending on the condition of the tank and COCs present (NAC, 1996c).

3.3.3 *Alternative 3 - Closure of Septic Tank 33-5, Excavation, and Disposal*

Alternative 3 consists of removing the soil and associated piping contaminated at levels above 100 mg/kg and disposing of this waste in an approved disposal facility. The excavated areas will be backfilled with uncontaminated soils and returned to original surface conditions. Excavation would be used to remove clean borrow soil from a nearby location for placement in the remaining voids as necessary.

The zone of soil contaminated at levels above 100 mg/kg associated with the 1965-1975 Leachfield may extend beneath Building 03-70. The concentrations of TPH decreased in the downstream direction of leachate flow. The Dbox-RS-SB (the sample location furthest downstream before the building) samples did not have detectable levels of TPH; therefore, the soil beneath Building 03-70 will likely be suitable to leave in place. Confirmatory sampling of the excavation walls should be performed to ensure removal of the higher concentrations of waste oil. If the contamination extends below Building 03-70, the building itself will inhibit inadvertent intrusion to potentially contaminated soil beneath it; however, land-use restrictions should also be implemented to notify workers of the potential hazards in the event of underground utility maintenance or installation.

Septic Tank 33-5 would be closed in accordance with NAC 459 (NAC, 1996c) as described in [Section 2.3 and 3.3.2](#).

3.4 *Evaluation and Comparison of Alternatives*

The general corrective action standards and remedy selection decision factors described in [Section 3.2](#) were used to conduct detailed and comparative analyses of each corrective action alternative. The advantages and disadvantages of each alternative were assessed to select a preferred alternative for CAU 427. [Table 3-1](#) presents a summary of the detailed analysis of the alternatives. [Table 3-2](#) presents the comparative analysis of alternatives. A cost estimate summary is provided in [Appendix C](#).

Table 3-1
Detailed Evaluation of Alternatives
(Page 1 of 4)

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Closure of Septic Tank 33-5 and Administrative Controls	Alternative 3 Closure of Septic Tank 33-5, Excavation, and Disposal
Closure Standards			
Protection of Human Health and the Environment	<ul style="list-style-type: none"> TPH as waste oil was identified above 100 mg/kg and will remain in soil Does not meet corrective action objective of preventing inadvertent intrusion into the contaminated soil zone No action implemented to close Septic Tank 33-5 No worker exposure associated with implementation NAC 445A.227 (2) (a-k), analysis shows the contaminants are not impacting groundwater. 	<ul style="list-style-type: none"> TPH as waste oil was identified above 100 mg/kg and will remain in soil Meets corrective action objectives Prevents inadvertent intrusion into the contaminated soil zone. Septic Tank 33-5 will be closed in accordance with NAC 459. NAC 445A.227 (2) (a-k), analysis shows the contaminants are not impacting groundwater. Limited worker exposure associated with tank closure Low risk to public because of remote location and controlled access to the TTR 	<ul style="list-style-type: none"> TPH levels will be reduced to 100 mg/kg. Meets corrective action objectives Septic Tank 33-5 will be closed in accordance with NAC 459. Relatively low risk to workers associated with heavy equipment operation and potential exposure to TPH contamination Low risk to public because of remote location and controlled access to the TTR NAC 445A.227 (2) (a-k), analysis shows the contaminants are not impacting groundwater.

Table 3-1
Detailed Evaluation of Alternatives
(Page 2 of 4)

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Closure of Septic Tank 33-5 and Administrative Controls	Alternative 3 Closure of Septic Tank 33-5, Excavation, and Disposal
Compliance with Media Cleanup Standards	<ul style="list-style-type: none"> Does not comply with media cleanup standards because TPH remains at levels above 100 mg/kg, and no corrective action is taken to prevent inadvertent intrusion. No action implemented to close Septic Tank 33-5 NAC 445A.227 (2) (a-k), analysis shows the contaminants are not impacting groundwater. Some natural biological activity will likely result in lower concentrations over time. 	<ul style="list-style-type: none"> Complies with media cleanup standards by eliminating exposure pathways Some natural biological activity will likely result in lower concentrations over time, and protections are provided to prevent human exposure to the contaminated soil through intrusive activities. NAC 445A.227 (2) (a-k), analysis shows the contaminants are not impacting groundwater. The levels identified do not significantly exceed the 100 mg/kg regulatory action level for corrective action. Septic Tank 33-5 will be closed in accordance with NAC 459. 	<ul style="list-style-type: none"> Complies with media cleanup standards because TPH-contaminated subsurface soil above the 100 mg/kg action level will be excavated and disposed of off-site. Cleanup standards will be verified with confirmation sampling. Septic Tank 33-5 will be closed in accordance with NAC 459. NAC 445A.227 (2) (a-k), analysis shows the contaminants are not impacting groundwater.
Control the Source(s) of Release	<ul style="list-style-type: none"> The source(s) to the leachfields and septic tanks have been rerouted. TPH levels greater than the 100 mg/kg action level remain in place No actions implemented to close Septic Tank 33-5 	<ul style="list-style-type: none"> The source(s) to the leachfields and septic tanks have been rerouted. TPH levels greater than the 100 mg/kg action level remain in place Septic Tank 33-5 will be closed in accordance with NAC 459. 	<ul style="list-style-type: none"> The source(s) to the leachfields and septic tanks have been rerouted. TPH-contaminated subsurface soil above the 100 mg/kg action level will be excavated and transported to an appropriate treatment or disposal facility. Septic Tank 33-5 will be closed in accordance with NAC 459.

Table 3-1
Detailed Evaluation of Alternatives
(Page 3 of 4)

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Closure of Septic Tank 33-5 and Administrative Controls	Alternative 3 Closure of Septic Tank 33-5, Excavation, and Disposal
Comply with Applicable Federal, State, and Local Standards for Waste Management	No waste generated	<ul style="list-style-type: none"> Waste would only be generated during the removal of Septic Tank 33-5. The associated septage and tank will be handled and disposed of per applicable standards. 	<ul style="list-style-type: none"> Approximately 230 cubic yards (yd³) of TPH-contaminated soil waste would be generated. Waste would be generated during the removal of Septic Tank 33-5. All waste will be handled and disposed of per applicable standards.
Remedy Selection Decision Factors			
Short-Term Reliability and Effectiveness	Not evaluated	<ul style="list-style-type: none"> Only minimal risk to workers associated with closure of Septic Tank 33-5. Public protected by remote location and TTR site access controls 	<ul style="list-style-type: none"> Risk to workers associated with removal of TPH-contaminated soil and closure of Septic Tank 33-5. Public protected by remote location and TTR site access controls
Reduction of Toxicity, Mobility, and/or Volume	Not evaluated	<ul style="list-style-type: none"> Natural attenuation will likely result in a decrease in toxicity, mobility, and volume of the contaminated soil with time. Permanent closure of Septic Tank 33-5 in accordance with NAC 459 would effectively eliminate associated toxicity, mobility, and volume of wastes. 	<ul style="list-style-type: none"> Removal of TPH-contaminated soil above 100 mg/kg and closure of Septic Tank 33-5 (in accordance with NAC 459) reduces all three characteristics at this CAU. The disposal facility's handling procedures will determine the characteristics after removal from the CAU.
Long-Term Reliability and Effectiveness	Not evaluated	<ul style="list-style-type: none"> Controls inadvertent intrusion Septic Tank 33-5 permanently closed Administrative controls required 	<ul style="list-style-type: none"> All risk will be eliminated upon completion. No maintenance required

Table 3-1
Detailed Evaluation of Alternatives
 (Page 4 of 4)

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Closure of Septic Tank 33-5 and Administrative Controls	Alternative 3 Closure of Septic Tank 33-5, Excavation, and Disposal
Feasibility	Not evaluated	<ul style="list-style-type: none"> Easily implementable Coordination of all entities is necessary to ensure compliance to prevent intrusion into contaminated soil zones. 	<ul style="list-style-type: none"> An existing, active building and numerous underground utilities are present at the CAU. Special consideration will be required during excavation, and access to the underlying contaminated soils may be difficult. Closure of Septic Tank 33-5 is easily implementable.
Cost	\$0	\$70,478*	\$145,882*

*Included estimate for closure in place of Septic Tank 33-5.

Table 3-2
Comparative Evaluation of Alternatives
(Page 1 of 2)

Evaluation Criteria	Comparative Evaluation
Closure Standards	
Protection of Human Health and the Environment	Alternatives 2 and 3 meet corrective action objectives; Alternative 1 does not. No worker exposure to risks associated with Alternative 1. Minor risks are associated with Alternative 2 and slightly higher risks with Alternative 3. NAC 445A.227 (2) (a-k) analysis shows the contaminants are not impacting groundwater.
Compliance with Media Cleanup Standards	Alternatives 1 and 2 do not comply with media cleanup standards; however, natural biological degradation will likely result in decreased concentrations with time. Alternative 3 meets media cleanup standards by removing levels of contamination to cleanup standards and reducing exposure pathways. Alternative 2 controls access to contaminants, effectively eliminating exposure pathways.
Control the Source(s) of the Release	The source to the leachfields and septic tanks has been rerouted. Alternative 1 does not control future release from Septic Tank 33-5; Alternatives 2 and 3 do. Exposure to subsurface contaminated soil is controlled by Alternatives 2 and 3, not by Alternative 1.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Alternative 1 does not generate any waste. Alternative 2 only generates waste associated with closure of Septic Tank 33-5. Alternative 3 generates the same waste as Alternative 2 as well as approximately 230 yd ³ of TPH-contaminated soil. All waste will be managed and disposed of per applicable standards.
Remedy Selection Decision Factors	
Short-Term Reliability and Effectiveness	Minor risks are associated with Alternative 2 and slightly higher risks with Alternative 3.
Reduction of Toxicity, Mobility, and/or Volume	Alternatives 2 and 3 result in a reduction of all three characteristics at this CAU for Septic Tank 33-5. For Alternative 2, only natural attenuation will likely reduce these characteristics with time. Alternative 3 reduces all three parameters by removal from the site.
Long-Term Reliability and Effectiveness	Residual risk is low for 2 and nonexistent for Alternative 3. Alternative 2 requires some administrative measures to control intrusive activities associated with future utility maintenance and installation. Alternative 3 closes the CAU upon completion.
Feasibility	Alternatives 2 and 3 are feasible; however, Alternative 3 requires special consideration of the nearby building and underground utilities during excavation activities. Both require heavy equipment, operating personnel, and disposal of wastes. Alternative 2 is the most feasible.

Table 3-2
Comparative Evaluation of Alternatives
 (Page 2 of 2)

Evaluation Criteria	Comparative Evaluation
Closure Standards	
Cost	The cost for Alternative 1 is \$0. The cost for Alternative 2 is \$70,478* for implementation of administrative controls and closure of Septic Tank 33-5. Alternative 3 is estimated to cost \$145,882* for removal and disposal of TPH-contaminated soil and closure of Septic Tank 33-5.

*Included estimate for closure in place of Septic Tank 33-5.

4.0 Recommended Alternative

Based on the results of the detailed and comparative analysis of the potential corrective action alternatives presented in this document, the preferred corrective action alternative selected for implementation at CAU 427 is Alternative 2, Closure of Septic Tank 33-5 and Administrative Controls. Alternative 2 was chosen for the following reasons:

- It minimizes health risks by preventing public and worker access to the contaminated soil and contents of Septic Tank 33-5.
- It complies with standards for management of wastes because minimal wastes are generated, and all waste will be managed in accordance federal, state, and local requirements.
- Long-term risks are minimized by controlling access to the site.
- It is easily implementable with only a slight potential for disturbance of subsurface utilities during removal Septic Tank 33-5.
- It provides the most cost-effective method for achieving protection and for meeting closure requirements.

The preferred corrective action alternative was evaluated on its technical merits, focusing on performance, reliability, feasibility, and safety. The alternative was judged to meet all requirements for the technical components evaluated. The alternative meets all applicable state and federal regulations for closure of the site and will reduce potential future exposure pathways to the contaminated soil and the contents of Septic Tank 33-5.

During corrective action implementation, this alternative will present minimal potential threat to site workers. However, appropriate health and safety procedures will be developed and implemented.

The future use of any land related to this CAU, as described by this CADD, would be restricted from any activity that may alter or modify the containment control as approved by the State and identified in the CAU Closure Report or other CAU documentation unless appropriate concurrence is obtained in advance.

Based on the evaluation in this CADD, Closure of Septic Tank 33-5 and Administrative Controls is the preferred closure method for Septic Waste Systems 2 and 6.

5.0 References

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 1996. Title 40 CFR Parts 260 - 281, "RCRA Regulations."
Washington, DC: U.S. Government Printing Office.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

EPA, see U.S. Environmental Protection Agency.

FFACO, see *Federal Facility Agreement and Consent Order*.

Federal Facility Agreement and Consent Order. 1996. Agreed to by the State of Nevada, the
U.S. Department of Energy, and the U.S. Department of Defense.

NAC, see *Nevada Administrative Code*.

Nevada Administrative Code. 1996a. NAC 444, "Solid Waste Disposal." Carson City, NV.

Nevada Administrative Code. 1996b. NAC 445A, "Water Pollution Control." Carson City, NV.

Nevada Administrative Code. 1996c. NAC 459, "Disposal and Evaluation of Contaminated Soil."
Carson City, NV.

NRS, see *Nevada Revised Statutes*.

Nevada Revised Statutes. 1995. NRS 459.400-459.600, "Disposal of Hazardous Waste."
Carson City, NV.

U.S. Department of Energy, Nevada Operations Office. 1994. *Project Management Plan*, Rev. 0.
Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996a. *Corrective Action Unit Work Plan*,
Tonopah Test Range, Nevada, DOE/NV-426. Las Vegas, NV: IT Corporation.

U.S. Department of Energy, Nevada Operations Office. 1996b. *Final Environmental Impact*
Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, Volume I,
DOE/EIS 0243. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996c. *Industrial Sites Quality Assurance*
Project Plan, DOE/NV-425. Las Vegas, NV.

- U.S. Department of Energy, Nevada Operations Office. 1997a. *Corrective Action Decision Document, Second Gas Station, Tonopah Test Range, Nevada (Corrective Action Unit No. 403)*, DOE/NV--471, UC 700, Rev. 2. Las Vegas, NV: IT Corporation.
- U.S. Department of Energy, Nevada Operations Office. 1997b. *Corrective Action Investigation Plan for Corrective Action Unit No. 427: Area 3 Septic Waste System Numbers 2 and 6, Tonopah Test Range, Nevada*, DOE/NV--488, UC 700, Rev. 0. Las Vegas, NV: IT Corporation.
- U.S. Department of Energy, Nevada Operations Office. 1998a. *Corrective Action Decision Document for the Area 3 Landfill Complex, Tonopah Test Range, CAU 424*, DOE/NV--496, UC 700, Rev. 0. Las Vegas, NV: IT Corporation.
- U.S. Department of Energy, Nevada Operations Office. 1998b. *Corrective Action Decision Document for the Building 03-60 Underground Discharge Point, Tonopah Test Range, CAU 423*, DOE/NV--508, UC 700, Rev. 0. Las Vegas, NV: IT Corporation.
- U.S. Environmental Protection Agency. 1991. *Guidance on Resource Conservation and Recovery Act (RCRA) Corrective Action Decision Documents*, EPA/540/G-91/011. Washington, DC: Office of Research and Development
- U.S. Environmental Protection Agency. 1994. *Final RCRA Corrective Action Plan*, EPA/520-R-94-004. Washington, DC: Office of Solid Waste and Emergency Response.

Appendix A

Corrective Action Investigation Report for CAU 427: Area 3 Septic Waste Systems 2 and 6, Tonopah Test Range, Nevada

A.1.0 Introduction

The report contained in this appendix presents the investigation activities and analytical results from the corrective action investigation conducted at the Area 3 Compound, CAU 427, which is located at the Tonopah Test Range, Nevada. Corrective Action Unit 427 is comprised of Septic Waste Systems 2 and 6 with respective CAS Numbers 03-05-002-SW02 and 03-05-002-SW06 (DOE/NV, 1996a).

The septic waste systems are presented in [Table 3-1](#) of the *Corrective Action Unit Work Plan, Tonopah Test Range* (DOE/NV, 1996a) (hereafter referred to as the TTR Work Plan). The corrective action investigation was conducted in accordance with the requirements set forth in the CAIP for CAU 427: Area 3 Septic Waste System Numbers 2 and 6, Tonopah Test Range, Nevada (DOE/NV, 1997a) as developed under the *Federal Facility Agreement and Consent Order* (FFACO, 1996).

The CAU is located in Area 3 of the TTR, Nye County, Nevada (see [Figure 1-1](#) and [Figure 1-2](#) of the Corrective Action Decision Document). The septic waste systems were installed to receive sanitary and industrial liquid wastes generated from site maintenance and other daily operations conducted at the Area 3 Compound (DOE/NV, 1996a). Septic Waste Systems 2 & 6 were in operation during different time intervals from 1960 through 1990. Process knowledge of early septic operations regarding disposal practices and composition of wastestreams is limited (DOE/NV, 1997a). Additionally, specific details of the installation of subsurface components and the composition and condition of the collection system network were unknown prior to this investigation.

Additional information relating to the site history, planning, and scope of the investigation is presented in the CAIP (DOE/NV, 1997a) and the TTR Work Plan (DOE/NV, 1996a) and is not repeated in this report.

A.1.1 Project Objectives

The primary objectives for this project were to identify the vertical and lateral extent of possible contaminant migration from the leachfields and associated collection system components, to ascertain the potential impact to human health and the environment, and to provide sufficient information and data to develop appropriate corrective action alternatives for the septic waste systems.

The DQO process outlined in the CAIP (DOE/NV, 1997a) proposed an evaluation of: the possible number of leachfields, status of collection system piping and associated septic tanks, and the configuration and exact location of subsurface components. Potential migration pathways for possible contaminant sources from the septic waste systems were also discussed. Subsurface soil was investigated by conducting an exploratory trenching and subsurface drilling program and by collecting environmental samples for both field screening and laboratory analysis. To optimize the sampling program, the exploratory trenches were positioned to transect both proximal and distal locations representative of each found leachfield. Excavations were also conducted at distribution points and septic tank outfalls which have increased potential to impact the surrounding soil in the event of unplanned releases. Environmental soil samples were collected at selected locations and depths. Soil borings were also conducted and core samples collected via split-spoon sampling as needed for step-out locations or to define the vertical extent of contamination. In addition, a video survey of subsurface piping was conducted, and the status and contents of the septic tanks that were found were investigated.

A.1.2 Report Content

This Corrective Action Investigation Report is intended to provide information and data in sufficient detail to support the selection of one of the preferred corrective action alternatives in the CADD. The contents of this report are as follows:

- [Section A.1.0](#) describes the investigation background, objectives, and the report content.
- [Section A.2.0](#) provides information regarding the field activities and sampling method.
- [Section A.3.0](#) summarizes the results of the laboratory analysis from the investigation sampling.
- [Section A.4.0](#) discusses the quality assurance (QA) and quality control (QC) procedures that were followed and the results of the QA and QC activities.
- [Section A.5.0](#) is a summary of the results pertaining to the Area 3 SWS 2 and 6 corrective action investigation program.
- [Section A.6.0](#) cites the references.

- [Attachment 1](#) includes the geotechnical information pertinent to the corrective action decision process.
- [Appendix B](#) includes the soil boring logs.

To make this report a concise summary, the complete field documentation and laboratory data, including Field Activity Daily Logs, Sample Collection Logs, Analysis Request/Chain-of-Custody Forms, soil sample descriptions, laboratory certificates of analyses, analytical results, and surveillance results are not contained in this report. These documents are retained in project files as both hard copy files and electronic media and will be supplied upon request.

A.2.0 Field Investigation and Sampling Activities

Field investigation and sampling activities were divided into three separate phases. The first phase consisted of exploratory trenching with a backhoe to define the leachfields, four septic tank investigations, pipeline video surveys to explore and map the collection system network, and submittal of environmental soil samples on a quick turn-around schedule. A second phase consisted of evaluating analytical results to guide drilling and assist with waste management decisions, and then backfilling the safeguarded trenches with clean spoils piles. These phases were consecutive to minimize impact to ongoing operations at the Area 3 Compound and to prepare the site for drilling. The third phase consisted of hollow-stem auger coring at selected locations based upon analytical results from the environmental soil samples obtained during trenching. The three phases were completed during the time period from October 27 to December 19, 1997, with a brief continuation January 6 and 7, 1998, when one additional septic tank was investigated and the outfall end sampled.

The investigation and sampling program was managed in accordance with the requirements set forth in the CAIP (DOE/NV, 1997a). The field activities were performed in accordance with an approved Site-Specific Health and Safety Plan (IT, 1997). The samples were collected and documented by following approved sampling plans, and documented using field activity logs; sample collection logs; and decontamination, chain of custody, shipping, and radiation screening protocols, procedures, and field sampling instructions as indicated in the CAIP (DOE/NV, 1997a). Quality control samples (e.g., field blanks, rinsate blanks, trip blanks, and sample duplicates) were collected as required by the *Industrial Sites Quality Assurance Project Plan* (QAPP) (DOE/NV, 1996b) and approved procedures. During field activities, waste minimization practices were followed according to approved instructions and procedures, including segregation of the waste from discrete locations, segregation of suspected contaminated items from uncontaminated items, and separation of personal protective equipment into bags.

A.2.1 Site Description and Conditions

Septic Waste Systems 2 and 6 are located within the southwest portion of the Area 3 Compound at the TTR. The initial collection system and leachfield locations were based on interpretations of engineering drawings, interviews with former and current employees, and historical aerial

photographs (DOE/NV, 1997a). Locations for initial excavations were based on the Attribute Composite Map, as presented in the CAIP (DOE/NV, 1997a) ([Figure A.2-1](#)). The actual leachfield boundaries, distribution lines, and septic tanks were located through exploratory trenching.

A.2.2 *Past Geophysical Surveys*

Two geophysical surveys were conducted in Area 3 to identify and delineate the leachfields and to locate septic tanks. The surveys were conducted by IT personnel in July and November 1993, and September 1996 (DOE/NV, 1997b). The results for SWS 2 & 6 were inconclusive as both surveys encountered extensive interference due to the presence of other underground utilities.

A.2.3 *Sampling Logistics*

This section describes the trenching and boring locations and sample collection activities for the SWS 2 & 6 corrective action investigation. Both soil grab-samples and borehole core-samples were collected from specified intervals for laboratory and field-screening analyses as well as for detailed field observations and lithologic description of the subsurface soil conditions.

A.2.3.1 *Trenching and Other Excavations*

Two trenches were excavated at each of the five potential leachfield locations (one leachfield associated with SWS 6 and four leachfields associated with SWS 2). These trenching activities discovered three leachfields in SWS 2 & 6. Once located, each leachfield was exposed along two transect excavations perpendicular to the distribution lines: one near the distribution box and the other near the distal end of the leachfield. Two excavations were conducted in attempts to expose distribution point centers at two of the leachfields. Four additional excavations were completed to reveal the existence of three septic tanks.

Based on historical information, interviews, engineering drawings, and interpretive conclusions, a chronology of septic system installations was derived from the investigation, and names for the individual leachfields are assigned accordingly. The three leachfields are: Pre-1965 Leachfield, 1965-1975 Leachfield, and Post-1975 Leachfield ([Figure A.2-2](#)). The individual leachfields and respective trenches are discussed later in this section. Activities in the early 1990s eliminated the last of the three former systems. The discrete systems were replaced during the Sandia National

Figure A.2-1
CAU 427 Tonopah Test Range
Septic Waste Systems 2 and 6
Attribute Composite Map (DQO)

Laboratories' (SNL) consolidated sewer system installation, and wastewaters were rerouted through the new system. Excavations at key locations and junctions confirmed the “active” status of the SNL system, and by utilizing the video survey camera, the network was further defined ([Figure A.2-2](#)).

In general, trenching activities consisted of an exploratory excavation to expose just enough pipe or material to visually assess the placement of subsurface components. Selected distribution lines and the network of piping associated with the collection system were mapped using the video survey. Then excavations were performed to access sampling intervals. The interval, from one foot above the basement of the leachbed, defined the uppermost sampling interval. A lower sample was also collected from a second horizon 0.75 m (2.5 ft) beneath the leachfield basement within the same trench walls. Excavations at septic tank outfalls are described in a later section of this report.

Three leachfields were discovered in SWS 2 & 6 during trenching activities. Because of the similarities and common routing of wastewaters, the sites are addressed collectively.

A.2.3.2 Drilling

The hollow-stem auger drilling method was selected to advance the boreholes. Twenty-one borings were conducted to collect continuous core samples at the 1965-1975 and Post-1975 Leachfields and Septic Tank 33-4. Samples were collected using a 4-inch diameter, modified-California stainless-steel split-spoon sampler at 1.5-m (5-ft) intervals and placed into the appropriate containers and submitted for analyses. The borehole locations are shown on ([Figure A.2-2](#)). No borings were conducted to investigate the Pre-1965 Leachfield.

A.2.3.3 Field Screening

Field-screening methods were used to collect qualitative data and provided a mechanism for guiding sampling. Two consecutive “clean” samples, as measured by field-screening (then confirmed through off-site laboratory analyses), defined the lower or lateral limits of the impacted soils. Field screening was performed as specified in the CAIP. The screening methods included:

- Radiological screening for alpha and beta radiation using an Electra instrument

Explanation

- XXX-XX (trench) = trench for exploratory and soil characterization (O) samples
- Soil characterization samples (In general an upper and a lower per planar location)
- XXX-XX-XXX -SB = Borehole designation
- Misc. excavations for septic tanks or other features

- Active sewer lines
- Leachfield outline (per original drawing)
- Found leachfield distribution lines
- Found seepage pits
- IT monument location

Figure A.2-2
CAU 427 Tonopah Test Range
Septic Waste Systems 2 and 6
Collection Point Map

- Headspace screening for volatile organic concentrations using a Photoionization Detector
- TPH screening using the Hanby field testing kit manufactured by Hanby Environmental Laboratory Procedures, Inc.

The preliminary action level for TPH field-screening results was established at 100 parts per million (ppm). The preliminary action level for volatile organic concentration field-screening results was determined to be 20 ppm or 2.5 times background, whichever was higher. The preliminary action level for radiation monitoring results was established at two times background levels (DOE/NV, 1997a). Field-screening preliminary action levels were established to guide the advancement of the borehole and to provide a basis for collecting unplanned environmental samples or drilling additional boreholes.

A.2.3.4 Sample Collection

Sample collection was performed as specified in the CAIP (DOE/NV, 1997a). The field geologist recorded geologic field descriptions on a Visual Classification of Soil Log ([Appendix B](#)) for each of the soil borings.

Soil samples were collected from individual trenches below actual or implied (in the event that the original line was destroyed) distribution lines. An upper trench interval consisted of material from 0.3 m (1 ft) above the basement (original base of excavation when installed) of the leachbed. A lower trench interval consisted of material from 0.75 m (2.5 ft) below the base of the leachbed. The number of distribution lines determined the horizontal distribution of sample collection points. Thus, if there were three distribution lines, a total of twelve samples were collected from the two trenches for a given leachfield. Soil samples were also collected underneath the outfall ends of three septic tanks and at distribution boxes or forks for the three discovered leachfields.

Soil samples were analyzed for total VOCs, total SVOCs, total RCRA Metals, PCBs, TPH, and gamma-emitting radionuclides. In addition, samples were analyzed for geotechnical parameters from *in situ* soils beneath the distribution box or fork for each leachfield.

A.2.3.5 Pre-1965 Leachfield (SWS 6)

This is the earliest of the three leachfields and was installed with the apparent intent to receive liquid wastes from Building 03-60 from 1960 through 1965. This leachfield was transected in several locations and video-surveyed to reveal a five-pipe clay tile system. Investigation of a proximal end trench (LF5-T4), a trench intersecting the central distribution pipe (LF5-T2), an excavation along the central distribution line (LF5-T2-Cutback), and a “potholed” excavation at the historically reported distribution feeder (as projected from an engineering drawing) yielded environmental soil samples (and a geotechnical sample) representative of this portion of the leachfield. Three additional trenches (LF5-T1, LF5-T3, and LF5-T5) were cut at the distal end resulting in the collection of additional samples ([Figure A.2-2](#)).

A majority of the distribution network was clearly defined consisting of a five-pipe vitrified clay tile system residing in individual, narrow leachbeds comprised of 3- to 8-cm (1- to 3-in.) diameter leachrock. The individual leachbeds are approximately 0.9 m (3 ft) wide and were installed from depths of 1.2 to 2.1 m (4 to 7 ft) below ground surface. The clay tile system is in like-new condition and has apparently never been used as evidenced by an absence of any staining or odors, the inner surface of the tiles are perfectly clean and 4-in. wood planks of redwood supporting the tiles do not show evidence of degradation. Records indicate that the leachfield is associated with Septic Tank 33-12 which was specified to be installed as an integral part of the system (DOE/NV, 1997a) (see [Figure A.2-1](#)). The intended purpose of the tank was to receive septage, then route effluent into the leachfield. An extensive exploratory ditch was excavated to intersect either a feeder/input line upgradient from the leachfield and/or the actual tank. There was no evidence of the septic tank or a feeder line ([Figure A.2-2](#)). A video survey of the entire active line from Building 03-60 showed no tie-ins, off-shoots, or other irregularities. This supports the conclusion that this septic system did not receive any discharges from Building 03-60 during this time period.

Twenty-two soil samples were collected at the Pre-1965 Leachfield, exclusive of Quality Assurance/Quality Control (QA/QC) samples. Specifically, these samples are identified by sample numbers TTR00890 through TTR00893, TTR00900, TTR00904, TTR00906 through TTR00908, TTR00910 through TTR00916, TTR00918, TTR00919, TTR00921, and TTR00923 through TTR00925. The associated geotechnical sample is identified as sample number TTR00909. No drilling was conducted at this leachfield.

A.2.3.6 1965-1975 Leachfield (SWS 2)

This system received liquid wastes from all of the contributing SWS 2 & 6 discharge sources during this time period. Buildings 03-74 and 03-80 post date this installation ([Figure A.2-2](#)). Trench LF2-T1 and excavation LF2-T1-Cutback were cut to expose the proximal/distribution end of the leachfield. The location and dimensions were found as illustrated in the 1965 “as-built” engineering drawing (DOE/NV, 1997a). Recent excavations for underground utility installations, including the SNL consolidated system, have mostly disturbed this portion of the leachfield as it was originally installed. The only evidence of the two-pipe distribution lines was a fragment of 10 cm (4-in.) vitrified clay pipe ([Figure A.2-2](#)). A clearly defined horizontal leachbed consisting of 3- to 8-cm (1- to 3-in.) rock with a thickness ranging from 1.2 to 1.4 m (4 to 5 ft) was discovered. The uppermost margin (top) of the leachbeds was found at depths ranging from 0.6 to 0.9 m (2.1 to 3 ft) below ground surface. The leachrock was coated with a black, dry residue in the upper portion which graded to a rust-colored staining at the base. There was some staining into the basement soil, but the basement did not seem to be greatly affected by downward percolation. Building 03-70 has been constructed directly above the leachfield; therefore, the subsurface soil near the leachfield center could not be investigated.

Trench LF2-T2 was cut at the distal end revealing a thin leachrock layer with a maximum thickness of 15 cm (6 in.), defining the approximate end of the leachfield. The leachrock and underlying basement at the distal end were observed to be clean with no staining or evidence of fluid input.

As specified, all soil samples were collected from within the base of the original leachfield and *in situ* soils from the basement underneath. The environmental soil samples collected within the two trenches and cutback excavation are identified by sample numbers: TTR00871, TTR00872, TTR00874, TTR00876, TTR00878, TTR00880, TTR00882, and TTR00883, exclusive of QA/QC samples. Two boreholes were drilled, and core samples were collected from the proximal “distribution mouth” of the leachfield to investigate the vertical extent of possible contamination. These are boreholes DBOX-RS-SB and LF2-T1-17.0RS-SB ([Figure A.2-2](#)). Step-out (outside the margins of the leachfield) boreholes to define the proximal end were also drilled and include: LF2-WEST-SB, LF2-T1-3.0SO-SB, LF2-SWCORNER-SB, and LF2-SECORNER-SB. One borehole, LF2-DBOX-SB, was also drilled to obtain a geotechnical sample (TTR00935). Analytical results are discussed in [Section A.3.0](#) of this appendix.

A.2.3.7 Post-1975 Leachfield (SWS 2)

This leachfield was operational until the SNL consolidated sewer upgrade effectively eliminated the discrete systems that had been in use in the Area 3 Compound (DOE/NV, 1997a). This is a three-pipe, 4-inch plastic system that received effluent originating from SWS 2 & 6 building drains that discharged through in-line septic tanks 33-4, 33-5, and 33-6 (Figure A.2-2). The distribution lines are each approximately 30 m (100 ft) long and the lower 21 m (70 ft) sections (downgradient) of the pipes have 1.3-cm (0.5-in.) perforations. Each horizontal distribution line was installed at a depth of approximately 1.2 m (4 ft) and resides in a 0.6 to 0.9 m (2 to 3 ft) wide leachbed with thicknesses ranging from 0.6 to 1.4 m (2 to 4.5 ft). Initially, a seepage pit was located via tunneling. Further investigation and sampling at this pit and two other potential seepage pits resumed by means of continuous coring. Two of the three distribution lines were found to terminate in gravel-filled vertical seepage pits. No evidence of a third seepage pit was found.

The apparent design function of this system was for wastewaters to percolate through the distribution pipe perforations into the surrounding leachbed, with any residual fraction traveling the length of the pipe and discharging into the respective seepage pits. The majority of the perforations in the pipe were clogged with a thick, black residue indicating an increased likelihood of effluent reaching the seepage pits. This investigation revealed that a seepage pit at the northern-most line was never installed, and evidence of contamination backing up in the line supports the absence of a pit. The proximal ends of the pipes were initially exposed via trenches LF1-T1 and LF3-T1 with respective sample pairs TTR00867, TTR00869; and TTR00885, TTR00903 collected. Trench LF4-T1 transected all three pipes at the distal ends and environmental soil sample numbers TTR00887, TTR00888, TTR00895, TTR00896, TTR00898, and TTR00899 were collected. All analytical results are discussed in Section A.3.0, and borehole information pertaining to this leachfield is discussed in the following paragraph.

Nine boreholes were drilled and continuously cored to investigate potential contamination of soils in the immediate vicinity of the seepage pits (Figure A.2-2). The first seepage pit investigated was associated with the southern-most pipe. Borehole LF4-T1-1.0SEEP-SB was drilled vertically through the gravel contents of the 0.9 to 1.1 m (3 to 4 ft) wide pit, and core samples were collected from the base at 8.9 m (29.5 ft) and appropriate depth intervals underneath. A “paired” downgradient borehole, LF4-T1-1.0SEEP(D/G)-SB, was cored through native material into the sidewall

approximately 0.5 m (1.5 ft) outside of the pit to investigate potential migration. At the seepage pit associated with the center distribution line, a set of three boreholes, including an upgradient location, were continuously cored and sampled in the same manner. Specifically, these are LF4-T1-20.0SEEPCENTER-SB, LF4-T1-20.0SEEP-SB, and LF4-T1-20.0SEEP(D/G)-SB. The bottom of this pit was found at a depth of 6 m (20 ft). The northern-most pipe of the system was investigated by drilling four boreholes: LF4-T1-40.0SEEP(D/G)-SB, LF4-T1-40.0SEEPCENTER(1st)-SB, LF4-T1-40.0SEEPCENTER(2nd)-SB, and LF4-T1-40.0SEEP(U/G)-SB). The cluster of boreholes at the pipe end encountered native materials only, therefore ruling out the existence of a seepage pit associated with this pipe. Borehole LF4-DBOX-SB was used to investigate the subsurface within 1.5 m (5 ft) of and downgradient from the distribution box. Geotechnical sample number TTR00967 was also collected at this location.

A.2.3.8 Septic Tanks

As stated in the CAIP, a septic tank abandonment program which included Septic Tanks 33-4, 33-5 and 33-6 was conducted in 1993 by SNL consisting of pumping out any residual liquid wastes, air drying the tanks, and filling the tanks with sand and cement (DOE/NV, 1996a). These three septic tanks were located during this investigation. Septic Tank 33-4 was found in an abandoned state, free of all liquids and completely filled with “Morrell Mix,” a hard, cement-like mixture. Environmental soil sample number TTR00929 was collected at the outfall end of the tank which was breached as evidenced by hydrocarbon staining and analytical sample results. See [Table A.3-1](#) and [Section A.3.3](#) for additional discussion of these results. During this investigation, Septic Tank 33-5 was located and was found to be inactive, but it still contained septage. A breather/riser pipe was removed from the lid of the exposed tank, and a probe was inserted to reveal that the tank was approximately half full of septage. Environmental soil sample number TTR00933 was collected from the outfall end of the tank. Septic Tank 33-6 was uncovered along with the associated outfall pipe. The tank was found to have been filled with a coarse-grained sand which is now saturated with what appears to be water. The tank is connected to the SNL consolidated system and functions in some capacity to route liquid released from a floor drain in Building 03-74. The existing outfall pipe is modern which suggests that the original pipe was replaced during the 1991 or 1993 SNL effort. A thick layer of “Morrell Mix” has been poured on the top surface of the tank, sealing the individual central and outfall lids. There was no evidence to indicate soil contamination or breaches of the system. Environmental soil sample

number TTR01048 was collected at a depth of 2.4 to 2.6 m (8 to 8.5 ft) bgs, which is below the interval of material that was placed to backfill the excavation during the 1991 activities. The collected sample is representative of soil conditions prior to 1991 activities. As previously stated, Septic Tank 33-12 has never been located or had its existence field-verified.

A.2.3.9 Septic Tank 33-5 Samples

To supplement the initial corrective action investigation activities, additional sampling activities were conducted on March 30, 1998. The purpose of these activities was to obtain environmental samples of the contents of Septic Tank 33-5.

The soil above Septic Tank 33-5 was excavated to expose the vent pipes and the manhole cover to the tank. The manhole cover was removed and two samples were obtained from the waste within the tank. A liquid sample, sample number TTR-335-1, was collected and analyzed for VOCs and TPH. Due to the limited amount of liquid medium, no other analytical methods were performed on this sample. A solid sample, sample number TTR-335-2, was collected and analyzed for VOCs, SVOCs, Pesticides, TCLP Metals and TPH. These samples were analyzed by NEL Laboratories in Las Vegas, Nevada.

A.2.4 Geology

The surface at the SWS 2 & 6 site consists of reworked and compacted gravels and sands with native soils underneath. Regional native surface deposits consist of well-sorted, moderately consolidated alluvial silty sands with gravel and cobble-sized volcanic detritus (DOE/NV, 1996a). The IT field geologist recorded field descriptions for each boring and recorded on Visual Classification of Soil Logs ([Appendix B](#)).

A.2.5 Hydrology

The Area 3 topography slopes gently to the northwest with surface drainage flowing in the same direction. Depth to groundwater beneath SWS 2 & 6 is estimated at 110 to 120 m (361 to 394 ft) bgs (DOE/NV, 1996a). No perched water, any indication of recent liquid input, or saturated materials were found in the subsurface at the SWS 2 & 6 site.

A.3.0 Investigation Results

The analytical results of samples collected from the Area 3 SWS 2 & 6 CAU have been compiled and evaluated to determine the presence and/or extent of contamination. The analytical results are summarized in the following subsections. The complete laboratory results data packages are available in the project files.

During the investigation activities, 120 soil sample sets and 14 liquid samples were collected for laboratory analysis. Three soil samples were collected for geotechnical analysis. A list of the sample numbers (including field duplicate and other quality control samples) and their relationship to the boreholes is presented in [Table A.3-1](#). The analytical parameters and laboratory analytical methods

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 1 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
Post-1975 Leachfield			
Pre-startup	TTR00864	n/a	Trip Blank
	TTR00865	n/a	Equipment Rinsate Blank
	TTR00866	n/a	Field Blank
LF1-T1	TTR00867	4.3 - 4.6	Soil
	TTR00868	n/a	Trip Blank
	TTR00869	9.5 - 9.8	Soil
LF4-T1	TTR00887	5.0 - 6.0	Soil
	TTR00888	8.5 - 9.0	Soil
	TTR00889	n/a	Trip Blank
	TTR00895	8.5 - 9.0	Soil
	TTR00896	11.0 - 12.0	Soil
	TTR00897	11.0 - 12.0	Duplicate of TTR00896
	TTR00898	6.5 - 7.0	MS/MSD
	TTR00899	9.0 - 9.5	Soil

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 2 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
LF3-T1	TTR00885	4.5 - 5.5	MS/MSD
	TTR00886	n/a	Trip Blank
	TTR00901	n/a	Equipment Rinsate Blank
	TTR00902	n/a	Field Blank
	TTR00903	9.0 - 10.0	Soil
LF4-DBOX-SB	TTR00966	6.5 - 7.5	Soil
	TTR00967	8.0 - 9.0	Geotechnical
	TTR00968	10.0 - 12.5	Soil
	TTR00969	15.0 - 17.5	Soil
LF4-T1-1.0SEEP-SB	TTR00970	30.0 - 32.5	Soil
	TTR00971	35.0 - 37.5	Soil
	TTR00972	40.0 - 42.5	Soil
	TTR00973	n/a	Trip Blank
	TTR00974	40.0 - 42.5	Duplicate of TTR00972
LF4-T1-20.0SEEP-SB	TTR00975	7.5 - 10.0	Soil
	TTR00976	n/a	Trip Blank
	TTR00977	n/a	Equipment Rinsate
	TTR00978	n/a	Field Blank
	TTR00979	20.0 - 22.5	MS/MSD
	TTR00980	25.0 - 27.5	Soil
LF4-T1-20.0SEEP(D/G)-SB	TTR00981	n/a	Trip Blank
	TTR00982	5.0 - 7.5	Soil
	TTR00983	10.0 - 12.5	Soil
	TTR00984	15.0 - 17.5	Soil
	TTR00985	20.0 - 22.5	Soil
	TTR00986	25.0 - 27.5	Soil
	TTR00987	30.0 - 32.5	Soil
	TTR00988	35.0 - 37.5	Soil
	TTR00989	n/a	Trip Blank

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 3 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
LF4-T1-40.0SEEP(U/G)-SB	TTR00990	10.0 - 12.5	Soil
	TTR00991	15.0 - 17.5	Soil
	TTR00992	20.0 - 22.5	Soil
	TTR00993	25.0 - 27.5	Soil
	TTR00994	33.5 - 35.0	Soil
	TTR00995	40.0 - 42.5	Soil
	TTR00996	n/a	Trip Blank
40.0SEEP-29.0(U/G)-SB	TTR00997	7.5 - 10.0	Soil
	TTR00998	12.5 - 15.0	Soil
20.0SEEP-29.0(U/G)-SB	TTR00999	7.5 - 10.0	Soil
	TTR01000	12.5 - 15.0	Soil
	TTR01001	n/a	Trip Blank
LF4-T1-20.0SEEP CENTER-SB	TTR01012	20.0 - 22.5	Soil
	TTR01013	25.0 - 26.0	Soil
	TTR01014	30.0 - 32.5	MS/MSD
	TTR01015	35.0 - 37.5	Soil
LF4-T1-40.0SEEP(D/G)-SB	TTR01016	7.5 - 10.0	Soil
	TTR01017	12.5 - 15.0	Soil
	TTR01018	17.5 - 20.0	Soil
	TTR01019	17.5 - 20.0	Duplicate of TTR01018
	TTR01020	22.5 - 25.0	Soil
	TTR01021	27.5 - 30.0	Soil
	TTR01022	32.5 - 35.0	Soil
	TTR01023	n/a	Trip Blank
	TTR01024	37.5 - 40.0	Soil
	TTR01025	n/a	Trip Blank
	TTR01026	n/a	Trip Blank
	TTR01027	n/a	Field Blank
	TTR01028	n/a	Equipment Rinsate

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 4 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
LF4-T1-40.0SEEP CENTER(2nd)-SB	TTR01029	15.0 - 17.5	Soil
	TTR01030	20.0 - 22.5	Soil
	TTR01031	25.0 - 27.5	Soil
	TTR01032	31.5 - 34.0	Soil
	TTR01033	36.5 - 39.0	Soil
	TTR01034	n/a	Trip Blank
	TTR01035	41.5 - 44.0	Soil
	TTR01036	41.5 - 44.0	Duplicate of TTR01035
LF4-T1-1.0SEEP(D/G)-SB	TTR01037	n/a	Trip Blank
	TTR01038	5.0 - 7.5	Soil
	TTR01039	10.0 - 12.5	MS/MSD
	TTR01040	15.0 - 17.5	Soil
	TTR01041	20.0 - 22.5	Soil
	TTR01042	25.0 - 27.5	Soil
	TTR01043	30.0 - 32.5	Soil
	TTR01044	35.0 - 37.5	Soil
	TTR01045	40.0 - 42.5	Soil
	TTR01046	n/a	Trip Blank
1965-1975 Leachfield			
LF2-T1 & LF2-T1-CUTBACK	TTR00870	n/a	Trip Blank
	TTR00871	5.0 - 5.5	Soil
	TTR00872	7.2 - 7.7	Soil
	TTR00873	n/a	Trip Blank
	TTR00874	5.0 - 6.0	Soil
	TTR00876	7.5 - 8.0	Soil
	TTR00877	n/a	Trip Blank
	TTR00878	9.5 - 10.0	Soil

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 5 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
LF2-T2	TTR00879	3.5 - 4.0	Soil
	TTR00880	6.5 - 7.5	Soil
	TTR00881	6.5 - 7.5	Duplicate of TTR00880
	TTR00882	3.5 - 4.0	Soil
	TTR00883	6.5 - 7.5	Soil
	TTR00884	n/a	Trip Blank
LF2-DBOX-SB	TTR00935	6.0 - 7.5	Geotechnical
Tank-33-4-SB	TTR00945	7.5 - 10.0	Soil
	TTR00946	12.5 - 14.5	Soil
	TTR00947	n/a	Trip Blank
LF2-SECORNER-SB	TTR00948	7.5 - 10.0	MS/MSD
	TTR00949	12.5 - 15.0	Soil
	TTR00950	12.5 - 15.0	Duplicate of TTR00949
	TTR00951	17.5 - 20.0	Soil
LF2-T1-3.0-SO-SB	TTR00952	n/a	Trip Blank
	TTR00953	n/a	Field Blank
	TTR00954	n/a	Equipment Rinsate
	TTR00955	7.5 - 10.0	Soil
	TTR00956	12.5 - 15.0	Soil
	TTR00957	17.5 - 20.0	Soil
LF2-WEST-SB	TTR00958	n/a	Trip Blank
	TTR00959	5.0 - 7.5	Soil
	TTR00960	10.0 - 12.5	Soil
	TTR00961	15.0 - 17.5	Soil
LF2- SWCORNER-SB	TTR00962	5.0 - 7.5	Soil
	TTR00963	10.0 - 12.5	Soil
	TTR00964	15.0 - 17.5	Soil
	TTR00965	n/a	Trip Blank

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 6 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
DBOX-RS-SB	TTR01002	7.5 - 10.0	Soil
	TTR01003	n/a	Field Blank
	TTR01004	17.5 - 19.0	Soil
	TTR01005	n/a	Trip Blank
	TTR01006	n/a	Equipment Rinsate
	TTR01007	22.5 - 25.0	Soil
LF2-T1-17.0-RS-SB	TTR01008	7.5 - 10.0	Soil
	TTR01009	15.0 - 17.5	Soil
	TTR01010	20.0 - 22.5	Soil
	TTR01011	n/a	Trip Blank
Pre-1965 Leachfield			
LF5-T1	TTR00890	5.0 - 6.0	Soil
	TTR00891	8.5 - 9.0	Soil
	TTR00892	5.0 - 6.0	Soil
	TTR00893	8.5 - 9.0	Soil
	TTR00894	n/a	Trip Blank
LF5-T2	TTR00900	5.0 - 6.0	Soil
	TTR00904	9.5 - 10.0	Soil
	TTR00905	n/a	Trip Blank
LF5-T2-CUTBACK	TTR00906	6.5 - 7.0	Soil
	TTR00907	9.5 - 10.0	Soil
LF5-DBOX	TTR00908	7.5 - 8.0	Soil
	TTR00909	7.0 - 8.0	Geotechnical
	TTR00910	9.5 - 10.0	Soil
LF5-T3	TTR00911	6.0 - 7.0	Soil
	TTR00912	9.0 - 10.0	Soil
	TTR00913	6.5 - 7.0	Soil
	TTR00914	9.0 - 10.0	Soil

Table A.3-1
Samples Collected During the Area 3 SWS 2 & 6
Corrective Action Investigation Activities
(Page 7 of 7)

Borehole/Trench Name	Sample Number	Depth (feet bgs)	Sample Type
LF5-T4	TTR00915	7.5 - 8.0	Soil
	TTR00916	9.5 - 10.0	Soil
	TTR00917	n/a	Trip Blank
	TTR00918	6.5 - 7.0	Soil
	TTR00919	9.5 - 10.0	Soil
	TTR00920	n/a	Trip Blank
LF5-T5	TTR00921	6.5 - 7.0	MS/MSD
	TTR00922	9.5 - 10.0	Soil
	TTR00923	9.5 - 10.0	Duplicate of TTR00922
	TTR00924	6.5 - 7.0	Soil
	TTR00925	9.0 - 9.5	Soil
	TTR00926	n/a	Field Blank
	TTR00927	n/a	Equipment Rinsate
	TTR00928	n/a	Trip Blank
Septic Tanks			
33-4	TTR00928	n/a	Trip Blank
	TTR00929	4.5 - 5.0	Soil
33-5	TTR00932	n/a	Trip Blank
	TTR00931 & TTR00933	7.1 - 7.4	Soil/Soil
33-6	TTR01047	n/a	Trip Blank
	TTR01048	8.0 - 8.5	Soil

requested for this investigation are presented in [Table A.3-2](#). The analytical parameters were selected through the application of site process knowledge according to the EPA's *Guidance for the Data Quality Objectives Process* (EPA, 1994a). Preliminary action levels for off-site laboratory analytical methods were determined during the DQO process and are based on the EPA Region 9 Preliminary Remediation Goals (PRGs) (EPA, 1996a) for chemical parameters and either background levels or levels listed in the *Offsite Radiation Exposure Review Project Phase II Soil Programs* report (McArthur and Miller, 1989) for radiological constituents. The results of the DQO process are

Table A.3-2
Laboratory Analytical Methods Used for
Area 3 SWS 2 & 6 Investigation Samples

Analytical Parameter	Analytical Method
Total volatile organic compounds	EPA 8260 ^a
Total petroleum hydrocarbons - gasoline and diesel/oil	EPA 8015 (modified) ^a
Total semivolatile organic compounds	EPA 8270 ^a
Total RCRA metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury)	EPA 6010/7470 ^a
Total polychlorinated biphenyls	EPA 8080 ^a
Gamma Spectroscopy	HASL 300, 4.5.2.3 ^b
Geotechnical Requirements	Method
Initial moisture content	ASTM ^c D 2216
Dry bulk content	EM ^d 1110-2-1906
Calculated porosity	EM ^d -1110-2-1906
Saturated/unsaturated hydraulic conductivity	ASTM ^c D 5084
Particle-size distribution	ASTM ^c D 422
Atterberg limits	ASTM ^c D 4318-93
Moisture retention characteristics	ASTM ^c D 3152

^a EPA *Test Methods for Evaluating Solid Waste*, 3rd Edition, Parts 1-4, SW-846 (EPA, 1996b)

^b *Environmental Measurements Laboratory Procedures Manual*, HASL-300, U.S. Department of Energy (DOE, 1992)

^c *Annual Book of American Society for Testing and Materials (ASTM) Standards*, Section 4, "Construction", Volume 04.08, "Soil and Rock (1)", and Volume 04.09, "Soil and Rock (11)", 1996

^d United States Army Corps of Engineers (USACE), *Engineer Manual* 1110-2-1906, "Laboratory Soils Testing," Appendix II, 1970

documented in the CAIP (DOE/NV, 1997a) with the remainder of the documentation retained in the IT Corporation (IT) project files. Sampling activities were conducted to either confirm or disprove the assumptions made in the DQO process. Samples collected from the SWS 2 & 6 CAU were analyzed by Quanterra Environmental Services in St. Louis, Missouri. The geotechnical samples were analyzed by Converse Consultants Southwest, Inc., in Las Vegas, Nevada.

A.3.1 Total Volatile Organic Compound Analytical Results

The total VOC analytical results above minimum reporting limits established in the CAIP (DOE/NV, 1997a), along with the associated preliminary action levels, are presented in [Table A.3-3](#).

Table A.3-3
Soil Sample Results for Total Volatile Organic Compounds Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 1 of 2)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Constituents of Concern in micrograms per kilogram (µg/kg)					
			Acetone	2-Butanone	Carbon Tetrachloride	1, 1, 2, 2-Tetra- chloroethane	Methylene Chloride	Xylene (total)
	Preliminary Action Levels (µg/kg) (Industrial Soil PRG) ^a		8,800,000	27,000,000	500	1,100	18,000	320,000
LF2-T1 & LF2-T1-CUTBACK	TTR00874	6.0	36 (J)	5 (J)	--	--	--	--
LF5-T1	TTR00890	6.0	--	--	--	--	13	--
	TTR00891	9.0	--	--	--	--	12	--
	TTR00892	6.0	21	--	--	6	8	--
	TTR00893	9.0	18 (J)	--	--	--	7	--
LF4-T1	TTR00895	9.0	15 (J)	--	--	--	--	--
	TTR00896	12.0	21	--	--	--	--	--
	TTR00897	12.0	30	--	--	--	--	--
	TTR00898	7.0	32	--	--	--	--	--
	TTR00899	9.5	17 (J)	9 (J)	--	--	--	--
LF5-T2	TTR00900	7.0	14 (J)	--	--	--	--	--
LF3-T1	TTR00903	10.0	18 (J)	--	--	--	--	--
LF5-T2	TTR00904	10.0	10 (J)	--	--	--	--	--
LF5-DBOX	TTR00908	8.0	13 (J)	17 (J)	--	--	--	--
LF5-DBOX	TTR00910	10.0	34	--	--	--	--	--
LF5-T3	TTR00911	7.0	18 (J)	--	--	--	--	--
	TTR00912	10.0	8 (J)	16	--	--	--	--
	TTR00913	7.0	18 (J)	--	--	--	--	--
	TTR00914	10.0	12 (J)	--	--	--	--	--
LF5-T4	TTR00915	8.0	48 (J)	--	--	--	8 (J)	--
	TTR00916	10.0	15 (J)	--	--	--	--	--
	TTR00918	7.0	22	--	--	6	--	--
	TTR00919	10.0	13 (J)	--	--	--	--	--
LF5-T5	TTR00922	10.0	50	--	--	--	--	--
	TTR00923	10.0	60	--	--	--	--	--
	TTR00924	7.0	--	--	--	--	--	8

^aU.S. Environmental Protection Agency, Region 9 Preliminary Remediation Goals (PRGs) (EPA, 1996a)

-- Not detected above the minimum reporting levels specified in the CAIP (DOE/NV, 1997a).

µg/kg = Microgram(s) per kilogram

(J) = Estimated value

Table A.3-3
Soil Sample Results for Total Volatile Organic Compounds Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 2 of 2)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Constituents of Concern in micrograms per kilogram (µg/kg)					
			Acetone	2-Butanone	Carbon Tetrachloride	1, 1, 2, 2-Tetra- chloroethane	Methylene Chloride	Xylene (total)
	Preliminary Action Levels (µg/kg) (Industrial Soil PRG) ^a		8,800,000	27,000,000	500	1,100	18,000	320,000
Tank 33-5	TTR00933	8.0	--	6 (J)	--	--	--	--
Tank 33-4-SB	TTR00945	10.0	48 (J)	--	--	--	--	--
LF4-DBOX-SB	TTR00966	7.5	27 (J)	--	--	--	--	--
	TTR00969	17.5	--	--	--	--	46	--
LF4-T1-1.0SEEP-SB	TTR00970	32.5	--	--	--	--	38	--
LF4-T1-20.0SEEP-SB	TTR00975	10.0	23	--	--	--	--	--
	TTR00979	22.5	--	--	--	--	42	--
	TTR00980	27.5	--	7 (J)	5 (J)	--	--	--
LF4-T1-20.0SEEP (D/G)SB	TTR00982	7.5	23	--	--	--	--	--
	TTR00983	12.5	22	--	--	--	--	--
	TTR00984	17.5	49	10 (J)	--	--	--	--
	TTR00985	22.5	32	--	--	--	--	--
	TTR0986	27.5	40	--	--	--	--	--
	TTR00987	32.5	14 (J)	--	--	--	--	--
	TTR00988	37.5	--	7 (J)	--	--	--	--
40.0SEEP-29.0 (U/G)-SB	TTR00997	10.0	13 (J)	--	--	--	--	--
20.0SEEP-29.0 (U/G)-SB	TTR01000	15.0	13 (J)	6 (J)	--	--	--	--
LF4-T1-20.0SEEP CENTER-SB	TTR01012	22.5	9 (J)	--	--	--	--	--
	TTR01015	37.5	8 (J)	--	--	--	--	--
LF4-T1-40.0SEEP CENTER(2nd)-SB	TTR01032	34.0	--	6 (J)	--	--	--	--
LF4-T1-1.0SEEP (D/G)-SB	TTR01038	7.5	--	7 (J)	--	--	--	--
	TTR01039	12.5	--	5 (J)	--	--	--	--
	TTR01040	17.5	--	5 (J)	--	--	--	--
	TTR01041	22.5	--	5 (J)	--	--	--	--
	TTR01045	42.5	--	6 (J)	--	--	--	--

^aU.S. Environmental Protection Agency, Region 9 Preliminary Remediation Goals (PRGs) (EPA, 1996a)

-- Not detected above the minimum reporting levels specified in the CAIP (DOE/NV, 1997a).

µg/kg = Microgram(s) per kilogram

(J) = Estimated value

Scrutiny of the laboratory data indicates that constituents were either not present above the minimum reporting limits (DOE/NV, 1997a) or, if present, were present below the preliminary action levels. Low levels of acetone, 2-butanone, and methylene chloride were detected above minimum reporting limits (DOE/NV, 1997a), but below the preliminary action levels. These constituents are common laboratory contaminants. In addition, acetone detects were noted in two water (trip blank) samples at respective concentrations of 40 micrograms per liter ($\mu\text{g/L}$) and 32 $\mu\text{g/L}$ in sample numbers TTR01023 and TTR01026; 1,1,2,2-Tetrachloroethane was detected at 6 $\mu\text{g/kg}$ in sample numbers TTR00892 and TTR00918. The total xylene detected above the method detection limit of 5 $\mu\text{g/kg}$ was detected in sample number TTR00924. Both the 1,1,2,2-Tetrachloroethane and xylene detects were well below the preliminary action levels (EPA, 1996a). Carbon tetrachloride was detected in sample TTR00980 at the detection limit. All VOC detections were below preliminary action levels.

A.3.2 Total Semivolatile Organic Compound Analytical Results

An elevated level of pyrene was detected in sample number TTR00878 at a concentration of 880 $\mu\text{g/kg}$. This level does not exceed the preliminary action level of 100,000 $\mu\text{g/kg}$ (EPA, 1996a). This soil sample was collected at the 1965-1975 Leachfield and shows a correlation to detectable concentrations of TPH as waste oil, which is discussed in the following section. Septic Tank 33-5 outfall sample number TTR00931 showed results above the minimum reporting limit (DOE/NV, 1997a) of 660 $\mu\text{g/kg}$ for fluoranthene with a concentration of 710 $\mu\text{g/kg}$. Fluoranthene has a preliminary action level of 270,000,000 $\mu\text{g/kg}$ (EPA, 1996a).

A.3.3 Total Petroleum Hydrocarbon Results

Total petroleum hydrocarbons were not detected in the gasoline and diesel ranges above the action level. However, there were detectable concentrations of waste oil exceeding the NDEP regulatory action level of 100 mg/kg for TPH as waste oil ([Table A.3-4](#)). At the proximal end of the 1965-1975 Leachfield, all three upper interval trench samples (TTR00871, TTR00874, and TTR00878) had results exceeding 100 mg/kg, indicating a distinct horizon of waste oil contamination at the leachfield base, with a maximum concentration of 2,400 mg/kg. This concentration of waste oil did not affect the underlying native soil greater than 3 m (10 ft) below ground surface or migrate laterally, as all lower interval trench and borehole samples, including samples surrounding the leachfield boundary, did not contain elevated levels of TPH as waste oil. Abandoned Septic Tank 33-4 has contaminated

Table A.3-4
Summary of Total Petroleum Hydrocarbon Results Detected
Above Minimum Reporting Limit for Waste Oil

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Parameter- Waste Oil
			Units (mg/kg)
LF1-T1	TTR00867	4.6	120
LF2-T1 & LF2-T1- Cutback	TTR00871	5.5	2400
	TTR00872	7.7	62
	TTR00874	6.0	1600
	TTR00878	10.0	680
LF3-T1	TTR00885	5.5	370
LF4-T1	TTR00887	6.0	230
	TTR00896	12.0	39
	TTR00897	12.0	54
	TTR00898	7.0	1500
LF5-T5	TTR00925	9.5	31 (J)
Tank 33-4	TTR00929	5.0	2900
Tank 33-4-SB	TTR00945	10.0	1300
LF4-DBOX-SB	TTR00966	7.5	560
LF4-T1-20.0SEEP-SB	TTR00975	10.0	140
LF4-T1-40.0SEEP (U/G)-SB	TTR00990	12.5	180
	TTR00991	17.5	330
	TTR00993	27.5	1100
Tank 33-5	TTR0931, TR0933	7.4	610
Tank 33-6	TTR01048	8.5	42

J = Estimated value

soil underneath the outfall end (TTR00929) and the results for borehole Tank 33-4-SB indicate elevated concentrations at the 2.3- to 3-m (7.5- to 10.0-ft) interval (TTR00945) with underlying intervals below 100 mg/kg. The majority of the upper interval trench samples at the Post-1975 Leachfield (TTR00867, TTR00885, TTR00887, and TTR00898) also showed elevated levels for TPH as waste oil. Sample number TTR00966 (borehole LF4-DBOX-SB) collected at a depth of 2 to 2.3 m (6.5 to 7.5 ft) bgs indicates shallow waste oil contamination below the former distribution point. Underlying interval results were nondetectable. Small concentrations of waste oil contamination were detected in the vicinity of the central seepage pit and at the end of the northern

distribution pipe for the Post-1975 system. Core samples from borehole LF4-T1-20.0SEEP-SB, placed upgradient from the actual center-pipe seepage pit, resulted in a single elevated sample (TTR00975) at the depth interval of 2.3 to 3 m (7.5 to 10 ft) bgs. Waste oil was also detected at the terminating end of the northern distribution pipe. An elevated concentration was detected in sample number TTR01031 collected from borehole LF4-T1-40.0SEEPCENTER(2nd)-SB at 6.0 to 6.8 m (20.0 to 22.5 ft). Analytical results from borehole LF4-T1-40.0SEEP(U/G)-SB detected elevated waste oil concentrations in sample numbers TTR00990, TTR00991, and TTR00993. Respective depth intervals are 3.0 to 3.8 m (10.0 to 12.5 ft) bgs, 4.5 to 5.3 m (15.0 to 17.5 ft) bgs, and 7.5 to 8.3 m (25.0 to 27.5 ft) bgs.

A.3.4 Total RCRA Metals Results

The total RCRA metals detected above the minimum reporting limits (DOE/NV, 1997a) are presented in [Table A.3-5](#). The total RCRA metals results were all below the preliminary action levels for the metal constituents except for arsenic (EPA, 1996a). Arsenic was detected above the PRG (2.4 mg/kg) in all samples. The majority of the arsenic results was consistent with background levels (24.1 mg/kg) established in the TTR Area 3 CAU 424 corrective action investigation (DOE/NV, 1998). Septic Waste Systems 2 & 6 investigations indicate that a few isolated results exceeded 20 mg/kg, with a maximum of 25.2 mg/kg in sample number TTR00946. Two spatial groups of samples represent higher background concentrations apparently resulting from fill material placed in specific geographic locations. Specifically, these groups are located in the vicinity of the Pre-1965 Leachfield and at the north end of Building 03-70. These are upper and lower trench samples with concentrations ranging from approximately 10 to 20 mg/kg. Based on this information, the concentrations of arsenic are believed to be representative of ambient conditions.

A.3.5 PCB Analytical Results

There were no PCBs detected above the minimum reporting limits specified in the CAIP (DOE/NV, 1997a).

A.3.6 Gamma Spectroscopy Results

With the exception of potassium-40, all radiological results were within the preliminary action levels established through background locations and background levels for the State of Nevada (McArthur

Table A.3-5
Soil Sample Results for Total RCRA Metal Constituents Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 1 of 5)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Parameters in milligrams per kilogram (mg/kg)			
	Industrial PRG ^a (mg/kg)		Arsenic	Barium	Chromium	Lead
			2.4	100000	450	1000
LF1-T1	TTR00867	4.6	8.3 (J)	104 (J)	4.9 (J)	13.8 (J)
	TTR00869	9.8	5.3 (J)	124 (J)	3.1 (J)	6.2 (J)
LF2-T1 & LF2-T1- Cutback	TTR00871	5.5	13.6	124	5.3	27.6
	TTR00872	7.7	6.8	131	3.4	7.0
	TTR00874	6.0	7.0 (J)	150 (J)	4.2 (J)	21.4 (J)
	TTR00876	8.0	6.6 (J)	112 (J)	3.4 (J)	7.0 (J)
	TTR00878	10.0	7.9 (J)	120 (J)	3.9 (J)	14.2 (J)
LF2-T2	TTR00879	4.0	11.0	150	2.5	5.7
	TTR00880	7.5	11.8 (J)	168 (J)	2.7 (J)	8.5 (J)
	TTR00881	7.5	10.8 (J)	155 (J)	2.0 (J)	5.5 (J)
	TTR00882	4.0	12.3 (J)	129 (J)	2.4 (J)	5.5 (J)
	TTR00883	7.5	7.8	193	2.4	5.6
LF3-T1	TTR00885	5.5	3.7	70.2	3.4	8.1
LF4-T1	TTR00887	6.0	6.6	191	4.1	6.9
	TTR00888	9.0	7.1	164	3.6	6.1
LF5-T1	TTR00890	6.0	16.8	81.9	2.9	5.5
	TTR00891	9.0	12.0	84.6	3.4	5.5
	TTR00892	6.0	18.4	138	2.9	5.0
	TTR00893	9.0	13.7	146	3.5	5.7
LF4-T1	TTR00895	9.0	8.3	180	3.5	6.4
	TTR00896	12.0	6.5	157	3.8	8.4
	TTR00897	12.0	8.8	164	3.3	7.6
	TTR00898	7.0	5.8	114	5.7	17.1
	TTR00899	9.5	7.5	113	3.6	5.7
LF5-T2	TTR00900	6.0	11.5	135	4.2	7.7
LF3-T1	TTR00903	10.0	4.7	119	2.3	4.8
LF5-T2	TTR00904	10.0	7.7	177	3.6	6.5
LF5-T2- Cutback	TTR00906	7.0	9.3	177 (J)	2.1	6.6 (J)
	TTR00907	10.0	9.8	89.3 (J)	2.4	5.5 (J)
LF5-DBOX	TTR00908	8.0	8.2	90.2 (J)	2.7	4.1 (J)
	TTR00910	10.0	7.7	135 (J)	3.5	6.3 (J)

Table A.3-5
Soil Sample Results for Total RCRA Metal Constituents Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 2 of 5)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Parameters in milligrams per kilogram (mg/kg)			
	Industrial PRG ^a (mg/kg)		Arsenic	Barium	Chromium	Lead
			2.4	100000	450	1000
LF5-T3	TTR00911	7.0	12.6	174 (J)	3.1	4.2 (J)
	TTR00912	10.0	23.1	87.9 (J)	3.6	5.0 (J)
	TTR00913	7.0	21.6	109 (J)	2.7	4.7 (J)
	TTR00914	10.0	10.0	130 (J)	2.1	4.5 (J)
LF5-T4	TTR00915	8.0	6.3 (J)	118 (J)	1.6 (J)	6.7 (J)
	TTR00916	10.0	8.1	115 (J)	2.5	4.8 (J)
	TTR00918	7.0	10.8	74.1 (J)	2.2	5.9 (J)
	TTR00919	10.0	10.6	213 (J)	2.9	5.4 (J)
LF5-T5	TTR00921	7.0	13.7	559 (J)	3.0	22.3 (J)
	TTR00922	10.0	13.4	137 (J)	3.2	5.7 (J)
	TTR00923	10.0	12.6	174 (J)	3.8	6.1 (J)
	TTR00924	7.0	15.2	119 (J)	4.0	7.0 (J)
	TTR00925	9.5	16.1	143 (J)	3.8	7.3 (J)
Tank 33-4	TTR00929	5.0	9.6	150 (J)	5.7	29.9 (J)
Tank 33-5	TTR00931	7.4	14.7	136	6.0	11.0
Tank 33-4-SB	TTR00945	10.0	9.8	129	4.4	28.5 (J)
	TTR00946	14.5	25.2	133	3.7	6.1
LF2-SE CORNER-SB	TTR00948	10.0	8.5	132	4.5	8.0
	TTR00949	15.0	5.2	148	1.2	4.4
	TTR00950	15.0	5.1	82.4	1.8	3.3
	TTR00951	20.0	6.4	148	6.1	6.0
LF2-T1-3.0- SO-SB	TTR00955	10.0	6.5	99.3	3.0	4.9
	TTR00956	15.0	9.2	173	3.2	6.2
	TTR00957	20.0	7.6	200	3.1	8.4
LF2-WEST- SB	TTR00959	7.5	7.3	162	4.8	6.6
	TTR00960	12.5	4.5	69.5	2.2	3.2
	TTR00961	17.5	7.0	134	3.9	6.5
LF2-SW CORNER-SB	TTR00962	7.5	5.3	105	3.2	5.0
	TTR00963	12.5	5.4	95.2	2.0	3.3
	TTR00964	17.5	5.9	118	3.8	6.0

Table A.3-5
Soil Sample Results for Total RCRA Metal Constituents Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 3 of 5)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Parameters in milligrams per kilogram (mg/kg)			
	Industrial PRG ^a (mg/kg)		Arsenic	Barium	Chromium	Lead
			2.4	100000	450	1000
LF4-DBOX- SB	TTR00966	7.5	9.1	142	6.0	21.2
	TTR00968	12.5	5.9	140	2.4	6.4
	TTR00969	17.5	7.7	148	3.8	6.8
LF4-T1-1.0 SEEP-SB	TTR00970	32.5	5.1	103	3.0	5.0
	TTR00971	37.5	5.9	117	3.1	7.2
	TTR00972	42.5	13.3	118	5.6	5.2
	TTR00974	42.5	6.0	90.1	3.5	5.0
LF4-T1-20.0 SEEP-SB	TTR00975	10.0	7.8	105	2.4	6.0
	TTR00979	22.5	6.5	145	3.8	5.4
	TTR00980	27.5	4.8	125	2.9	4.1
LF4-T1-20.0 SEEP(D/G)- SB	TTR00982	7.5	21.9	174	3.5	8.1
	TTR00983	12.5	5.8	133	3.1	5.4
	TTR00984	17.5	11.5	120	3.6	6.2
	TTR00985	22.5	7.8	110	2.4	5.5
	TTR00986	27.5	5.0	105	2.4	4.9
	TTR00987	32.5	7.1	168	27.3	6.1
	TTR00988	37.5	4.5	129	4.7	6.0
LF4-T1-40.0 SEEP(U/G)- SB	TTR00990	12.5	4.2	78.2	3.6	7.1
	TTR00991	17.5	3.6	58.8	3.2	7.7
	TTR00992	22.5	3.1	43.9	1.9	6.6
	TTR00993	27.5	6.8	127	3.8	5.9
	TTR00994	35.0	4.7	99.5	3.3	5.9
	TTR00995	42.5	4.9	95.5	3.2	5.0
40.0 SEEP- 29.0 (U/G)- SB	TTR00997	10.0	7.1	125	5.6	6.3
	TTR00998	15.0	7.6	146	2.8	9.3
20.0 SEEP- 29.0 (U/G)- SB	TTR00999	10.0	5.6	121	2.8	4.9
	TTR01000	15.0	24.3	142	3.0	5.4
DBOX-RS-SB	TTR01002	10.0	6.6	124	3.1	6.4
	TTR01004	19.0	8.4	142	2.7	9.5
	TTR01007	25.0	5.8	103	2.8	6.3

Table A.3-5
Soil Sample Results for Total RCRA Metal Constituents Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 4 of 5)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Parameters in milligrams per kilogram (mg/kg)			
	Industrial PRG ^a (mg/kg)		Arsenic	Barium	Chromium	Lead
			2.4	100000	450	1000
LF2-T1-17.0-RS-SB	TTR01008	10.0	8.2	135	5.3	8.6
	TTR01009	17.5	6.5	108	2.5	6.9
	TTR01010	22.5	7.3	126	2.6	5.5
LF4-T1-20.0 SEEP CENTER-SB	TTR01012	22.5	6.8	150 (J)	2.6	6.9 (J)
	TTR01013	26.0	6.2	132 (J)	3.0	4.4 (J)
	TTR01014	32.5	6.1	76.6 (J)	4.8	5.7 (J)
	TTR01015	37.5	6.8	91.3 (J)	4.1	5.9 (J)
LF4-T1-40.0 (D/G)-SB	TTR01016	10.0	11.3	139 (J)	2.0	5.4 (J)
	TTR01017	15.0	9.2	108 (J)	1.4	5.6 (J)
	TTR01018	20.0	8.2	143 (J)	1.9	8.9 (J)
	TTR01019	20.0	8.4	176 (J)	2.2	10.3 (J)
	TTR01020	25.0	5.5	95.2 (J)	2.2	3.8 (J)
	TTR01021	30.0	5.5	125 (J)	3.5	4.5 (J)
	TTR01022	35.0	5.5	101 (J)	10.0	4.5 (J)
	TTR01024	40.0	7.4	108 (J)	6.1	4.5 (J)
LF4-T1-40.0 SEEP CENTER (2nd)-SB	TTR01029	17.5	7.4	109 (J)	2.2	5.2 (J)
	TTR01030	22.5	9.8	156 (J)	2.3	5.7 (J)
	TTR01031	27.5	7.3	166 (J)	2.8	6.2 (J)
	TTR01032	34.0	7.4	117 (J)	7.7	6.0 (J)
	TTR01033	39.0	7.8	106	3.5	5.1
	TTR01035	44.0	5.3	100	4.6	3.7
	TTR01036	44.0	7.9	109	6.5	3.8

Table A.3-5
Soil Sample Results for Total RCRA Metal Constituents Detected
Above Minimum Reporting Limits, Area 3 SWS 2 & 6, TTR
(Page 5 of 5)

Sample Location/ Borehole	Sample Number	Sample Depth (ft bgs)	Parameters in milligrams per kilogram (mg/kg)			
			Arsenic	Barium	Chromium	Lead
	Industrial PRG ^a (mg/kg)		2.4	100000	450	1000
LF4-T1-1.0 SEEP(D/G)-SB	TTR01038	7.5	11.7	113	3.5	6.6
	TTR01039	12.5	7.1	164	3.0	6.6
	TTR01040	17.5	9.2	150	3.5	6.2
	TTR01041	22.5	6.5	121	2.2	5.0
	TTR01042	27.5	7.4	139	4.4	8.6
	TTR01043	32.5	6.9	172	4.8	6.3
	TTR01044	37.5	4.4	117	4.8	3.8
	TTR01045	42.5	6.5	83.5	5.1	5.1
Tank 33-6	TTR01048	8.5	7.7	116	3.4	6.0

-- = Not detected above minimum reporting limit as specified in the CAIP (DOE/NV, 1997a)

^aU.S. Environmental Protection Agency, Region 9 Preliminary Remediation Goals, 1996 (EPA, 1996a)

J = Estimated value

and Miller, 1989). Potassium-40 was detected at levels above background levels (10.5-30.7 pCi/g) (McArthur and Miller, 1989) in three samples: sample number TTR01012 from boring LF4-TI-20.0SEEPCENTER-SB at 6 m to 6.9 m (20 to 22.5 ft), sample number TTR01031 from boring LF4-TI-40.0SEEPCENTER(2nd)-SB at 7.6 m to 8.4 m (25 ft to 27.5 ft), and sample number TTR01043 from boring LF4-TI-1.0SEEP(D/G)-SB at 9 m to 9.9 m (30 ft to 32.5 ft). These samples were obtained from the terminal ends of the leachfield pipes at the 1965-1975 Leachfield. No process knowledge was identified during the development of the CAIP that would indicate the potential for radiological contamination. The presence of potassium-40 in nature is due to the fact that approximately 0.012 percent of all potassium atoms are radioactive potassium-40. It is not created during nuclear fission. The potassium-40 concentrations measured initially in these samples exceeded that found in pure potassium compounds such as potassium phosphate and potassium permanganate. A potassium-40 concentration of 861 pCi/g exceeds the theoretical potassium-40 concentration in pure potassium metal. Because of the unexpected nature of these radiological detections, the samples were reanalyzed at the laboratory to verify the results.

The second analysis demonstrated that the potassium-40 concentrations in these samples varied from 11 to 23.5 pCi/g and are not different than the concentrations found in soil samples taken from background locations; therefore, the results were within PALs discussed above and there is no potassium-40 contamination at this site.

A.3.7 *Septic Tank 33-5 Samples*

Most constituents were not detected in samples TTR-335-1 and TTR-335-2. Those constituents that were detected were at concentrations below Industrial PRGs as presented in Table A.3-6. Only enough fluid could be collected from the tank to request analysis for TPH and VOCs on sample TTR-335-1. Sample number TTR-335-2 was taken from the sludge within the tank and analyzed for TPH, VOCs, SVOCs, Pesticides, and TCLP Metals. Note that during this investigation, only sample TTR-335-2 was analyzed for Pesticides. Process knowledge did not indicate that pesticides should be considered COPCs. Beta-BHC, 4,4'-DDE, and Endosulfan Sulfate were detected in sample TTR-335-2 at levels below Industrial PRGs for soils. No evidence was encountered during the investigation to indicate that Septic Tank 33-5 had been breached.

A.3.8 *Geotechnical Results*

A geotechnical sample was collected from below each leachfield distribution box or point: sample number TTR00966 from the Post-1975 Leachfield, TTR00935 from the 1965-1975 Leachfield, and TTR00909 from the Pre-1965 Leachfield. The data were collected to provide input for closure options. The results of the geotechnical observations suggest that the subsurface soil ranges from a well-graded sand with silt and gravel to a clayey-sand with gravel. This is typical of alluvial materials found at the Area 3 Compound. The results of the laboratory analysis of the geotechnical samples are presented in Attachment 1.

Table A.3-6
Sample Results for Constituents Detected in Septic Tank 33-5,
Area 3 SWS 2 & 6, TTR

Sample Number	Analytical Method	Matrix	PRG ^a Parameter	Industrial PRG ^a	Results
TTR-335-1	EPA 8015M	Aqueous	Oil Range	NA	7.1mg/L
	EPA 8260A		Naphthalene	240,000µg/kg	5µg/L
TTR-335-2	EPA 8260A	Solid	Naphthalene	240,000µg/kg	550µg/kg
			1,4-Dichlorobenzene	8500µg/kg	1400µg/kg
			p-Isopropyltoluene	ND	28µg/kg
			Carbon Disulfide	24,000µg/kg	35µg/kg
			Toluene	880,000µg/kg	1500µg/kg
			1,2,4-Trimethylbenzene	ND	45µg/kg
	EPA 8081		beta-BHC	1100µg/kg	73µg/kg
			4,4'-DDE	5600µg/kg	30µg/kg
			Endosulfan Sulfate	4,100,000 µg/kg	270µg/kg

^aU.S. Environmental Protection Agency, Region 9 Preliminary Remediation Goals, 1996 (EPA, 1996a)

NA = Not applicable

ND = Not Determined

A.4.0 Quality Assurance

The results of QA/QC activities for the Area 3 SWS 2 & 6 Corrective Action Investigation sampling event are summarized in the following text. The QA/QC procedures related to the geotechnical samples and analyses are contained in the *Standard Specification for Transportation Materials and Methods of Sampling and Testing* (ASSHTO, 1995) and are not discussed further in this text. Detailed information on the QA program for this sampling event is contained in the *Industrial Sites Quality Assurance Project Plan*, Revision 1 (DOE/NV, 1996b).

Quality control results are typically judged in terms of the five PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters as described in the following sections.

A.4.1 Precision

Precision is a quantitative measure of the variability of a group of measurements from their average value. Precision is assessed by collecting and analyzing duplicate field samples and comparing the results with the original sample. Precision is also assessed by creating, analyzing, and comparing laboratory duplicates from one or more field samples. Precision is reported as relative percent difference (RPD) which is calculated as the difference between the measured concentrations of duplicate samples, divided by the average of the two concentrations, and multiplied by 100.

A.4.2 Accuracy

Analytical accuracy is defined as the nearness of a measurement to the true or accepted reference value. It is the composite of the random and systematic components of the measurement system and measures bias in the measurement system. The random component of accuracy is measured and documented through the analyses of spiked samples. Sampling accuracy is assessed by evaluating the results of spiked samples and laboratory control samples. Accuracy measurements are calculated as percent recovery by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

Field accuracy is assessed by confirming that the documents of record track the sample from its origin, through transfer of custody, to disposal. The goal of field accuracy is for all samples to be collected from the correct locations at the correct time, placed in a correctly labeled container with the correct preservative, and sealed with custody tape to prevent tampering. All samples in this sampling event were properly collected and forwarded to the laboratory as described above.

A.4.3 Representativeness

Representativeness expresses 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 (EPA, 1987). Sample representativeness was achieved through the implementation of a sampling program designed to ensure proper sampling locations, number of samples, and the use of validated analytical methods. Representativeness was assessed through analysis of duplicate samples. Representativeness of the samples taken in this sampling event was assured by collecting the required samples shown in Section A.2.0 and by analyzing them by the approved analytical methods shown in [Table A.3-2](#).

A.4.4 Completeness

Completeness is defined as a percentage of measurements made that are judged to be valid. A sampling and analytical requirement of 80 percent completeness was established for this project (DOE/NV, 1996a). The SWS 2 & 6 sampling data exhibit a high degree of completeness. The specified sampling locations were utilized as planned. All samples were collected as specified in the CAIP (DOE/NV, 1997a), and all sample containers reached the laboratory intact and properly preserved (when applicable). For all samples, sample temperature was maintained during shipment to the laboratory, and sample chain of custody was maintained during sample storage and/or shipment.

A.4.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). To ensure comparability, the SWS 2 & 6 field and sampling activities were performed and documented in accordance with approved procedures, and all samples were collected in accordance with the CAIP (DOE/NV, 1997a). Approved standardized methods and

procedures were also used to analyze and report the data (e.g., Contract Laboratory Program [CLP] and/or CLP-like data packages). This approach ensures that the data from this project can be compared to other datasets. Based on the minimum comparability requirements specified in the Industrial Sites QAPP (DOE/NV, 1996b), all requirements were met.

Sample-handling documentation, laboratory nonconformance reports, and the precision and accuracy of quality-control sample results were evaluated for their effect on the results of the associated environmental soil samples. The environmental sample results were then qualified according to processes outlined in the following section. Documentation of the data qualifications resulting from these reviews is retained in project files as both hard copy and electronic media and will be supplied upon request.

A.4.6 Tier I and Tier II Data Evaluations

All laboratory data from samples collected at SWS 2 & 6 have been evaluated for data quality according to the procedures outlined in IT-Las Vegas Standard Quality Practices (IT, 1993). These procedures, performed in a tiered process, are based upon EPA data validation guidelines and presented in the following text, resulted in modifications to the laboratory-generated qualifiers or results. No data rejected during the data evaluation process were used to draw the conclusions presented in [Section A.3.0](#). Only detections, whether estimated (i.e., J-qualified) or not, were used.

The changes resulting from the data evaluation process were documented in project files and were summarized in memoranda for each sample delivery group (SDG). These memoranda are maintained in IT project files and are available for inspection upon request.

A.4.6.1 Tier I Evaluation

Tier I evaluation for both chemical and radiological analysis examines (but is not limited to):

- Sample count/type consistent with chain of custody
- Analysis count/type consistent with chain of custody
- Correct sample matrix
- Significant problems stated in cover letter or case narrative
- Completeness of certificates of analysis (COAs)
- Completeness of CLP or CLP-like packages
- Completeness of signatures, dates and times on chain of custody

- Condition-upon-receipt variance form included
- Requested analyses performed on all samples
- Date received/analyzed given for each sample
- Correct concentration units indicated
- Correct detection limits achieved
- Electronic data transfer (EDT) supplied
- Results reported for field and laboratory QC samples
- Whether or not the deliverable met the overall objectives of the project

A.4.6.2 Tier II Evaluation

Tier II evaluation for both chemical and radiological analysis examines (but is not limited to):

Chemical:

- Sample date, preparation date and analysis date for each sample
- Holding time criteria met
- QC batch association for each sample
- Cooler temperature upon receipt
- Sample pH for aqueous samples, as required
- Detection limits properly adjusted for dilution, as required
- Blank contamination evaluated and applied to sample results/qualifiers
- Matrix spike/matrix spike duplicate percent recoveries (%R) and RPDs evaluated and applied to laboratory results/qualifiers
- Field duplicate RPDs evaluated and applied to laboratory results/qualifiers
- Laboratory duplicate RPDs evaluated and applied to laboratory results/qualifiers
- Surrogate %Rs evaluated and applied to laboratory results/qualifiers
- Laboratory control sample %Rs evaluated and applied to laboratory results/qualifiers

Radioanalytical:

- Whether or not blank contamination evaluated and applied to sample results/qualifiers
- Whether or not Certificate of Analysis is consistent with data package documentation
- QC sample results (duplicates, laboratory control samples, matrix spikes and matrix spike duplicates) evaluated and applied to laboratory result qualifiers
- Whether or not sample results, error, and minimum detectable activity evaluated and applied to laboratory result qualifiers
- Whether or not the detector system was calibrated to National Institute for Standards and Technology (NIST) traceable sources
- Whether or not calibration sources preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations
- Detector system response to daily, weekly, and monthly background and calibration checks for peak energy, peak centroid, peak full width half maximum, and peak efficiency
- Whether or not tracers were NIST-traceable, were appropriate for the analysis performed, and had recoveries that met QC requirements

- Whether or not documentation of all QC sample preparation was complete and properly performed
- Whether or not spectra lines, emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration

A.4.6.3 Tier III

Data quality considerations that are included in EPA data review functional guidelines as a Tier III review include the additional evaluations:

Chemical:

- Mass spectrometer tuning criteria
- Initial and continuing calibration verification
- Internal standard evaluation
- Organic compound quantitation
- Inductively coupled plasma (ICP) interference check sample evaluation
- Graphite furnace atomic absorption quality control
- ICP serial dilution effects
- Recalculation of all laboratory results from raw data

Radioanalytical:

- QC sample results (e.g., calibration source concentration, percent recovery, and RPD) verified
- Radionuclides and their concentration appropriate considering their decay schemes, half-lives, and process knowledge and history of the facility and site
- Each identified line in spectra verified against emission libraries and calibration results
- Independent identification of spectra lines, area under the peaks, and quantification of radionuclide concentration in a random number of sample results

Tier I and II data evaluations are summarized in a memorandum for each sample delivery group showing which results and qualifiers were changed and why these changes were made. A Tier III review of 5 percent of all the analytical data was performed by Lockheed Martin Technology Services in Las Vegas, Nevada. Changes to the data resulting from this review have been documented in IT project files and are included in the analytical summary tables in [Section A.3.0](#).

A.4.7 Quality Control Samples

Thirty-three trip blanks, 7 field blanks, 7 equipment rinsate blanks, 6 matrix spike/matrix spike duplicates, and 6 field duplicates were collected and submitted for laboratory analysis as shown in [Table A.3-1](#). The samples and duplicates were assigned individual sample numbers and sent to the

laboratory “blind.” Additional samples were selected by the laboratory to be analyzed as laboratory duplicates. The field blanks were taken by placing distilled water into appropriate sample bottles and preserving them according to the requirements specified in the Industrial Sites QAPP (DOE/NV, 1996b). The equipment rinsate blanks were obtained by collecting the final rinse solution (i.e., distilled water), which was poured over the decontaminated sampling equipment into the appropriate sample bottles and preserved as applicable. The trip blanks, which were received sealed and preserved from the laboratory, were placed in each cooler containing samples for VOC analysis. The results of the QC samples are discussed in the following sections.

A.4.7.1 Field Quality Control Samples

All blanks (i.e., field blanks, equipment rinsate blanks, and trip blanks) were analyzed for the parameters listed in [Table A.3-2](#) (trip blanks were analyzed for VOCs only) and showed only contamination associated with a common laboratory contaminant (acetone as defined in the EPA Functional Guidelines) with the exception of ButylBenzylPhthalate in sample TTR00865, an equipment rinsate blank. This blank detection was used to qualify the results of the associated environmental sample according to EPA Functional Guidelines (EPA, 1994a; 1994b).

The EPA Functional Guidelines state that no qualification action is taken if a compound is found in an associated blank, but not in the sample or if a compound is found in the sample, but not in an associated blank. The action taken when a compound is detected in both the sample and the associated blank varies depending upon the analyte involved and is described in the “The 5X/10X Rule.”

For most VOCs, SVOCs, pesticides, and PCBs, an analyte detected in the sample that was also detected in an associated blank is qualified as undetected (U) if the sample concentration is less than five times (5X) the blank concentration. For the common laboratory contaminants (methylene chloride, acetone, 2-butanone [methylethyl ketone or MEK], toluene, and phthalate esters [especially bis(2-ethylhexyl)phthalate]), the factor is raised to ten times (10X) the blank concentration. The sample result is elevated to the quantitation limit if it is not already reported at that level.

For inorganics (metals), sample results greater than the instrument detection limit, but less than five times (5X) the amount found in an associated blank, are qualified as undetected (U). There are no

metallic common laboratory contaminants, so there is no “10X Rule” for metals, and the sample result is never altered.

During the sampling event, six field duplicate soil samples were sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in [Table A.3-2](#). For these samples, the duplicate results precision (i.e., relative percent differences between the environmental sample results and their corresponding field duplicate sample results) were compared to criteria set forth in EPA Functional Guidelines (EPA, 1994b; 1994c), and the associated environmental sample results were qualified accordingly.

The EPA Functional Guidelines give no required review criteria for field duplicate analyses comparability, but allow the data reviewer to exercise professional judgement. Both detections and nondetections have been qualified as estimated (J and UJ, respectively) if the relative percent difference between an environmental sample and its field duplicate fell outside established criteria.

Six field samples were selected for use as matrix spike/matrix spike duplicate samples. The percent recoveries of these samples (a measure of accuracy) and the relative percent differences in these sample results (a measure of precision) were compared to EPA Functional Guideline criteria (EPA, 1994b; 1994c). The results were used to qualify associated environmental sample results accordingly.

The EPA Functional Guidelines for review of organic data state that no data qualification action is taken on the basis of matrix spike/matrix spike duplicate results alone. The data reviewer exercises professional judgement in considering these results in conjunction with the results of laboratory control samples (LCSs) and other QC criteria in applying qualifications to the data. Generally, if recovery criteria are greater than the upper acceptance limit, then positive sample results for the affected compounds are qualified as estimated (J), and nondetections are not qualified. If recovery criteria are less than the lower acceptance limit, then positive sample results for the affected compounds are qualified as estimated (J) and nondetections are qualified as unusable (R). The relative percent difference results of matrix spike/matrix spike duplicate samples that fall outside established criteria are applied to qualify detections and nondetections as estimated (J and UJ, respectively).

The inorganic data review in EPA Functional Guidelines allows professional judgement to be applied in evaluating the results of both matrix spikes and laboratory duplicates. Generally, if spike recoveries are greater than the upper acceptance limit or less than the lower acceptance limit, positive results are qualified as estimated (J) and nondetections are either unqualified or qualified as estimated (UJ), respectively. If spike recoveries are grossly low (less than 30 percent), positive results are unqualified, and nondetections are unusable (R). The relative percent difference between the environmental sample and its laboratory duplicate are compared to established criteria to qualify detections and nondetections as estimated (J and UJ, respectively).

Documentation of the data qualifications resulting from the application of these guidelines is retained in IT project files as both hard copy and electronic media and will be supplied upon request.

A.4.7.2 Laboratory Quality Control Samples

Analysis of method QC blanks and laboratory control samples was performed for each parameter analyzed by Quanterra Laboratory. In addition, laboratory duplicate analysis was performed on one metals analysis environmental sample per SDG. The results of these analyses were used to qualify associated environmental sample results according to EPA Functional Guidelines (EPA, 1994a; 1994b). The complete QC sample results are maintained in the IT project files.

A.4.8 Field Deficiencies/Nonconformance

During the SWS 2 & 6 corrective action investigation activities, one QA surveillance was conducted by the contractor to verify that sampling activities were performed in accordance with applicable requirements. The results of the surveillance indicated no findings, deficiencies, or nonconformances with sampling activities as they met the requirements of the plans and procedures governing the activities at the site. Documentation of these results is retained in IT project files and will be supplied upon request.

A.5.0 Summary

Analysis of the data generated from corrective action investigation activities conducted at the SWS 2 & 6 indicates the following:

- With the exception of arsenic, the industrial preliminary remediation goal levels and the NDEP regulatory level of 100 mg/kg for TPH were not exceeded in any of the samples collected from the Area 3 SWS 2 & 6 for Total VOC, Total SVOC, TPH (gasoline or diesel), Total RCRA Metals, and PCB analyses.
- TPH concentrations (as waste oil) were detected above the NDEP regulatory level of 100 mg/kg. The waste oil is limited laterally to the confines of the two discovered leach systems and has exhibited a low degree of vertical migration, with very few elevated levels at depths greater than 3.0 m (10.0 ft) bgs. There is a minor concentration of waste oil at the terminating ends of the northern and center distribution pipes of the Post-1975 Leachfield limited in vertical extent to 8.3 m (27.5 ft) bgs. Lateral extent of this waste oil is limited as defined by nondetectable concentrations downgradient at a similar borehole, separated horizontally by 2.1 m (7 ft).
- Arsenic concentrations were detected above the industrial PRG level; however, these concentrations were within the range of regional background concentrations detected for arsenic. Based on historical evidence (DOE/NV, 1997a) and the background concentrations, it is felt that arsenic is naturally occurring at these concentrations.
- With the exception of three Potassium-40 sample results, all initial results are below the preliminary action levels established and consistent with background levels established for the State of Nevada (McArthur and Miller, 1989), and radionuclide concentrations from the samples collected from SWS 2 & 6 locations are not different than the concentrations found at background locations. The three samples with greater than background concentrations of Potassium-40 were reanalyzed and found to be within background concentrations.

A.6.0 References

ASSHTO, see American Association of State Highway and Transportation Officials.

American Association of State Highway and Transportation Officials. 1995. *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*. Washington, DC.

ASTM, see American Society for Testing Materials.

American Society for Testing Materials. 1996. *Annual Book of American Society for Testing and Materials (ASTM) Standards*, Section 4, "Construction," Volume 04.08, "Soil and Rock (1)," and Volume 04.09, "Soil and Rock (11)." Philadelphia, PA.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

EPA, see U.S. Environmental Protection Agency.

FFACO, see *Federal Facility Agreement and Consent Order*.

Federal Facility and Consent Order. 1996. Agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense.

IT, see IT Corporation.

IT Corporation. 1993 as amended. *ITLV Program Procedures Manual*. Las Vegas, NV.

IT Corporation. 1997. *Site-Specific Health and Safety Plan* for the Tonopah Test Range (TTR) Corrective Action Investigation CAU No. 427. Las Vegas, NV.

McArthur, R.D., and Miller, F.L., Jr. 1989. *Off-site Radiation Exposure Review Project (ORERP), Phase II Soil Program*, DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

NAC, see *Nevada Administrative Code*.

Nevada Administrative Code. 1996. NAC 445A.227, "Contamination of soil: Order by director of corrective action; factors to be considered in determining whether corrective action is required." Carson City, NV.

USACE, see U.S. Army Corps of Engineers.

- U.S. Army Corps of Engineers. 1970. *Laboratory Soils Testing*, Engineer Manual (EM) 1110-2-1906, Appendix II. Washington, DC.
- U.S. Department of Energy. 1992. *Environmental Measurements Laboratory Procedures Manual*, HASL-300, 27th Edition, Volume 1. New York, NY.
- U.S. Department of Energy, Nevada Operations Office. 1996a. *Corrective Action Unit Work Plan Tonopah Test Range*. Las Vegas, NV: IT Corporation.
- U.S. Department of Energy, Nevada Operations Office. 1996b. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada*, Rev. 1. Las Vegas, NV.
- U.S. Department of Energy, Nevada Operations Office. 1997a. *Corrective Action Investigation Plan for CAU No. 427: Area 3 Septic Waste System Numbers 2 & 6, Tonopah Test Range, Nevada*, DOE/NV-488, UC-700. Las Vegas, NV: IT Corporation.
- U.S. Department of Energy, Nevada Operations Office. 1997b. *Final, Initial Surface Geophysical Survey Report for the Tonopah Test Range Environmental Restoration Sites*, DOE/NV-10972-93. Las Vegas, NV: IT Corporation.
- U.S. Department of Energy, Nevada Operations Office. 1998. *Final, Corrective Action Decision Document for the Area 3 Landfill Complex, Tonopah Test Range, CAU 424*, DOE/NV-496 UC-700, Rev. 0. Las Vegas, NV: IT Corporation.
- U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87-003. Washington, DC.
- U.S. Environmental Protection Agency. 1994a. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. Washington, DC.
- U.S. Environmental Protection Agency. 1994b. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA 540/R-94/012. Washington, DC.
- U.S. Environmental Protection Agency. 1994c. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013. Washington, DC.
- U.S. Environmental Protection Agency. 1996a. Memo from S.J. Smucker to PRG Table Mailing List regarding Region 9 Preliminary Remediation Goals (PRGs), 1 August. San Francisco, CA.
- U.S. Environmental Protection Agency. 1996b. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, CD ROM. Washington, DC.

Attachment 1

Geotechnical Data

Converse Consultants Southwest, Inc.

Moisture - Density - Porosity Determinations

PROJECT: IT Corporation

DATE: 1/22/98

JOB NO.: 96-33699-01

TESTED BY: NER

CHECKED BY: EGG

MOISTURE CALCULATIONS

Boring No. and Depth	909	935	967
Wt of samp + Dish (wet)	379.4	1815.7	1353.7
Wt of samp + Dish (dry)	363.4	1644.2	1283.2
Wt. of Moisture	16	171.5	70.5
Wt. of Dish	169.5	170.2	161.6
Dry Wt.	193.9	1474	1121.6
Moisture %	8.3%	11.6%	6.3%
Plasticity Index	*NP	6	*NP

* non-plastic

DENSITY CALCULATIONS

Length of Sample (inches)	2.735	5.867	5.412
Sample Diameter (inches)	1.924	3.350	3.365
Volume of Sample (ft ³)	0.0046	0.0299	0.0279
Wet Density	100.6	121.2	94.4
Dry Density	92.9	108.6	88.8

POROSITY CALCULATIONS

Assumed Specific Gravity, G_s	2.65	2.65	2.65
Void Ratio, e	0.78	0.52	0.86
Porosity, n	0.44	0.34	0.46

HYDROMETER ANALYSIS

Project Name: IT Corporation

Prepared By: NER

Project No.: 96-33699-01

Tested By: NER

Date tested: 01/01/98

Sample No.: #909

Boring No.: _____

Depth: _____

☐ Oven Dry

☒ Air Dry

Hygroscopic Moisture Correction Factor

Tare No:	
Wt of wet soil + tare:	1.00
Wt of dry soil + tare:	1.00
Wt of Tare:	0.00
Wt. of Water:	0.00
Wt. of Dry Soil:	1.00
Moisture Content:	0.0

Hydrometer Jar No.: _____

Hydrometer No.: 152H

Specific Gravity to 0.05 (2.55): 2.65

Wt. of sample used for Dispersment: 100.80

Computed dry wt. of sample used (W): 100.80

Correction Factor a: 1.00

Sieve used for control: #10

Percent Passing Control Sieve P %: 38%

Soil Description: _____

Time.	Temp.°C	Hydor. Rdg.	Correction	Corrected Reading $R_1 - C$	Values of K From Table 3	Effective Depth From Table 2		Effective Particle Diameter (mm)	Soil in Susp. % (R_a/W)x100	Percent of total Passing $P \times P\%$
t	T	R_1	C	R	K	L	L/t	D	P	P'
1	22	21	5	16	0.01332	12.9	12.9000	0.04784	15.9	6.0
2	22	20	5	15	0.01332	13	6.5000	0.03396	14.9	5.7
4	22	19	5	14	0.01332	13.2	3.3000	0.02420	13.9	5.3
8	22	18	5	13	0.01332	13.3	1.6625	0.01717	12.9	4.9
15	22	17.5	5	12.5	0.01332	13.5	0.9000	0.01264	12.4	4.7
30	22	16	5	11	0.01332	13.7	0.4567	0.00900	10.9	4.1
60	22	14	5	9	0.01332	14	0.2333	0.00643	8.9	3.4
250	21	12.5	5	7.5	0.01348	14.3	0.0572	0.00322	7.4	2.8
372	21	12	5	7	0.01348	14.3	0.0384	0.00264	6.9	2.6
1257	21	11	5	6	0.01348	14.5	0.0115	0.00145	6.0	2.3
1404	21	10	5	5	0.01348	14.7	0.0105	0.00138	5.0	1.9

GRAIN SIZE DISTRIBUTION GRAPH

HYDROMETER TEST SUMMARY

% GRAVEL =	42%	$D_{85} = 8.8$	$D_{15} = 0.3$
% SAND =	50%	$D_{60} = 5.0$	$D_{10} = 0.1$
% SILT & CLAY =	9%	$D_{50} = 3.4$	$C_U = 45.7$
		$D_{30} = 1.0$	$C_C = 2.0$

Project No.: 96-33699-01
Project Name: IT Corporation
Date: 01-Jan-98
Boring No.: Depth:
Sample No.: #909
Material Description: Well Graded Sand with Silt and Gravel

GRAIN SIZE DISTRIBUTION TEST REPORT with HYDROMETER
CONVERSE CONSULTANTS SOUTHWEST

Drawing No.

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY TEST ASTM D5084

Project Name: Industrial Sites
Project No.: 772848.05020300
Location: SWS2AND6
Sample No.: TTR00909 Depth: feet
Soil Description: Lt Brn F-C Sand with gravel
Test Condition: Saturated

Tested by AP
Calculated by AP
Checked by AP

Date 01/16/98
Date 01/20/98
Date 01/20/98

INITIAL CONDITION OF SPECIMEN

Diameter (d) 1.915 in
Sample Area (A) 2.88 in²
Length (L) 2.70 in
Weight Before 228.08 g

Wet Density 111.7 pcf
Dry Density 101.5 pcf

	Before	After
Container No.		
Wt. Wet Soil+Container(gms)	228.08	351.35
Wt. Dry Soil+Container(gms)	207.37	309.80
Wt. Container (gms)	0	102.43
Moisture, (%)	10.0	20.0

TEST RESULTS

Time (min)	Flow Rdg (cm)	Burette Factor	Q (cc)	Head, h (psi)	h/L	Q/t (cc/s)
0	34.0	1	0.0	2.0	20.5	0.000000
2	32.8	1	1.2	2.0	20.5	0.010000
9	30.6	1	3.4	2.0	20.5	0.005238
17	28.7	1	5.3	2.0	20.5	0.003958
32	25.4	1	8.6	2.0	20.5	0.003667
64	18.5	1	15.5	2.0	20.5	0.003594

Hydraulic Conductivity (cm/sec): 9.81E-06

Capillary-Moisture Relations for Soils
Fine-Textured Soils by Pressure-Membrane Apparatus
ASTM D 3152

Project Name: Industrial Sites

Tested By: JT Date: 01/08/98

Project No.: 772848.05020300

Checked By: AP Date: 01/20/98

Location.: SWS2AND

Sample No.: TTR00909 Depth: n/a

Soil Type: F-C Sand with gravel

Initial Moisture Content (%): 12.47

Initial Unit Weight (pcf): 92.7

Sample Diameter (in): 1.89

Sample Height (in): 0.4

Tension (bars)	0	0.1	0.3	0.5	1	2.5	5	10	15
Tension (feet of water)	0	3.4	8.5	17	33.9	84.8	169.5	339	508.5
Moisture Content by Wt (%)	28.85	18.44	18.07	17.41	17.12	16.46	16.20	15.85	15.25
Cor. Dry Unit Wt of Soil (pcf)	92.70	86.80	86.80	86.80	86.80	86.80	86.80	86.80	86.80
Moisture Content by Vol(%)	42.84	27.38	26.83	25.85	25.42	24.44	24.05	23.54	22.64

Wilting Point: 22.6

Field Capacity: 26.8

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Date: 06/24/98
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Prepared By: NER

Tested By: NER

Boring No.: TTR00935

Depth:

☐ Oven Dry☒ Air Dry

Hydrometer Jar No.:

Hydrometer No.:

Specific Gravity to 0.05 (2.55):	2.65
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Wt. of sample used for Dispersment:	80.70
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Computed dry wt. of sample used (W): 80.70

Correction Factor <u>a</u> :	1.00
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Sieve used for control: #10

Percent Passing Control Sieve	P%:	58%
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Soil Description: Clayey Sand with Gravel

[illegible]

GRAIN SIZE DISTRIBUTION GRAPH

HYDROMETER TEST SUMMARY

% GRAVEL =	28%	$D_{85} = 12.5$	$D_{15} =$
% SAND =	54%	$D_{60} = 2.2$	$D_{10} =$
% SILT & CLAY =	18%	$D_{50} = 1.2$	$C_U =$
		$D_{30} = 0.3$	$C_C =$

Project No.: 96-33699-01
Project Name: IT Corporation
Date: 1/98
Boring No.: TTR00935 Depth:
Sample No.:
Material Description: Clayey Sand with Gravel

GRAIN SIZE DISTRIBUTION TEST REPORT with HYDROMETER
CONVERSE CONSULTANTS SOUTHWEST

Drawing No.

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY TEST ASTM D5084

Project Name:	Industrial Sites	Tested by	AP	Date	01/16/98
Project No.:	772848.05020300	Calculated by	AP	Date	01/20/98
Location:	SWS2AND6	Checked by	AP	Date	01/20/98
Sample No.:	TTR00935	Depth:	feet		
Soil Description:	Red Brn Clayey Sand trace gravel				
Test Condition:	Saturated				

INITIAL CONDITION OF SPECIMEN

Diameter (d)	2.875	in		
Sample Area (A)	6.49	in ²		
Length (L)	2.36	in		
Weight Before	520.85	g		
Wet Density	129.4	pcf		
Dry Density	113.4	pcf		

Container No.		Before	After
Wt. Wet Soil+Container(gms)	258.37	716.95	
Wt. Dry Soil+Container(gms)	230.57	653.17	
Wt. Container (gms)	34.49	196.22	
Moisture, (%)	14.2	14.0	

TEST RESULTS

Time (min)	Flow Rdg (cm)	Burette Factor	Q (cc)	Head, h (psi)	h/L	Q/t (cc/s)
0	7.4	2.449	0.0	3.0	35.2	0.000000
2	7.6	2.449	0.5	3.0	35.2	0.004082
12	9.0	2.449	3.9	3.0	35.2	0.005714
25	10.2	2.449	6.9	3.0	35.2	0.003768
47	12.3	2.449	12.0	3.0	35.2	0.003896
65	14.0	2.449	16.2	3.0	35.2	0.003855

Hydraulic Conductivity (cm/sec): 2.60E-06

Capillary-Moisture Relations for Soils
Fine-Textured Soils by Pressure-Membrane Apparatus
ASTM D 3152

Project Name: Industrial Sites

Tested By: JT Date: 01/08/98

Project No.: 772848.05020300

Checked By: AP Date: 01/20/98

Location.: SWS2AND

Sample No.: TTR00935 Depth: n/a

Soil Type: Clayey Sand w/ gravel

Initial Moisture Content (%): 14.25

Initial Unit Weight (pcf): 116.6

Sample Diameter (in): 1.9

Sample Height (in): 0.4

Tension (bars)	0	0.1	0.3	0.5	1	2.5	5	10	15
Tension (feet of water)	0	3.4	8.5	17	33.9	84.8	169.5	339	508.5
Moisture Content by Wt (%)	16.47	13.75	13.42	13.21	13.09	12.59	12.41	11.99	11.81
Cor. Dry Unit Wt of Soil (pcf)	116.60	86.80	86.80	86.80	86.80	86.80	86.80	86.80	86.80
Moisture Content by Vol(%)	30.76	25.68	25.06	24.67	24.45	23.51	23.18	22.39	22.06

Wilting Point: 22.1

Field Capacity: 25.0

HYDROMETER ANALYSIS

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Project Name: 1T Corporation

Prepared By: NER

Project No.: 96-33699-01

Tested By: NER

Date tested: 01/01/98

Sample No.: #967

Boring No.: _____

Depth: _____

☐ Oven Dry

☒ Air Dry

Hygroscopic Moisture Correction Factor

Tare No:	
Wt of wet soil + tare:	1.00
Wt of dry soil + tare:	1.00
Wt of Tare:	0.00
Wt. of Water:	0.00
Wt. of Dry Soil:	1.00
Moisture Content:	0.0

Hydrometer Jar No.: _____

Hydrometer No.:	152H
Specific Gravity to 0.05 (2.55):	2.65
Wt. of sample used for Dispersment:	80.80
Computed dry wt. of sample used (W):	80.80
Correction Factor <u>a</u> :	1.00
Sieve used for control:	#10
Percent Passing Control Sieve <u>P</u> %:	64%

Soil Description: _____

Time.	Temp.°C	Hydor. Rdg.	Correction	Corrected Reading $R_1 - C$	Values of K From Table 3	Effective Depth From Table 2		Effective Particle Diameter (mm)	Soil in Susp. % (R_a/W)x100	Percent of total Passing $P \times P\%$
t	T	R_1	C	R	K	L	L/t	D	P	P'
1	22	13	5	8	0.01332	14.2	14.2000	0.05019	9.9	6.3
2	22	11.5	5	6.5	0.01332	14.5	7.2500	0.03587	8.0	5.1
4	22	10.5	5	5.5	0.01332	14.7	3.6750	0.02553	6.8	4.4
8	22	10	5	5	0.01332	14.7	1.8375	0.01806	6.2	4.0
15	22	9	5	4	0.01332	14.8	0.9867	0.01323	5.0	3.2
30	22	8	5	3	0.01332	15	0.5000	0.00942	3.7	2.4
60	22	7.5	5	2.5	0.01332	15.2	0.2533	0.00670	3.1	2.0
250	21	6	5	1	0.01348	15.3	0.0612	0.00333	1.2	0.8
393	21	6	5	1	0.01348	15.3	0.0389	0.00266	1.2	0.8
1278	21	6	5	1	0.01348	15.3	0.0120	0.00147	1.2	0.8
1420	21	5	5	0	0.01348	15.5	0.0109	0.00141	0.0	0.0

Project No.: 96-33699-01
Project Name: IT Corporation
Date: 01-Jan-98
Boring No.: **Depth:**
Sample No.: #967
Material Description: Well Graded Sand with Silt and Gravel

Drawing No.

FLEXIBLE WALL HYDRAULIC CONDUCTIVITY TEST ASTM D5084

Project Name:	Industrial Sites	Tested by	AP	Date	01/16/98
Project No.:	772848.05020300	Calculated by	AP	Date	01/20/98
Location:	SWS2AND6	Checked by	AP	Date	01/20/98
Sample No.:	TTR00967	Depth:	feet		
Soil Description:	Red Brn F-C Sand trace gravel				
Test Condition:	Saturated				

INITIAL CONDITION OF SPECIMEN

Diameter (d)	2.875	in		
Sample Area (A)	6.49	in ²		
Length (L)	2.36	in		
Weight Before	449.32	g		
Wet Density	111.7	pcf		
Dry Density	102.0	pcf		

Container No.		Before	After
Wt. Wet Soil+Container(gms)		190.4	332.82
Wt. Dry Soil+Container(gms)		176.99	282.08
Wt. Container (gms)		34.6	35.04
Moisture, (%)		9.4	20.5

TEST RESULTS

Time (min)	Flow Rdg (cm)	Burette Factor	Q (cc)	Head, h (psi)	h/L	Q/t (cc/s)
0	2.1	0.474	0.0	3.0	35.2	0.000000
3	6.1	0.474	1.9	3.0	35.2	0.010533
6	9.6	0.474	3.6	3.0	35.2	0.009217
9	13.4	0.474	5.4	3.0	35.2	0.010007
13	17.8	0.474	7.4	3.0	35.2	0.008690
16	21.0	0.474	9.0	3.0	35.2	0.008427

Hydraulic Conductivity (cm/sec): 6.13E-06

Capillary-Moisture Relations for Soils
Fine-Textured Soils by Pressure-Membrane Apparatus
ASTM D 3152

Project Name: Industrial Sites

Tested By: JT Date: 01/08/98

Project No.: 772848.05020300

Checked By: AP Date: 01/20/98

Location.: SWS2AND

Sample No.: TTR00967 Depth: n/a

Soil Type: SP

Initial Moisture Content (%): 10.35

Initial Unit Weight (pcf): 95.4

Sample Diameter (in): 1.9

Sample Height (in): 0.4

Tension (bars)	0	0.1	0.3	0.5	1	2.5	5	10	15
Tension (feet of water)	0	3.4	8.5	17	33.9	84.8	169.5	339	508.5
Moisture Content by Wt (%)	24.64	12.61	11.44	10.91	10.69	10.09	9.91	9.63	9.48
Cor. Dry Unit Wt of Soil (pcf)	95.40	86.80	86.80	86.80	86.80	86.80	86.80	86.80	86.80
Moisture Content by Vol(%)	37.65	19.27	17.48	16.67	16.34	15.42	15.14	14.72	14.49

Wilting Point: 14.5

Field Capacity: 17.4

Appendix B

Soil Boring Logs

SOIL BORING LOG		BORING NUMBER: LF4-DBOX-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/12/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-1 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/12/97	
HOLE SURFACE ELEVATION (feet): 5504.00		EASTING: 474084.90	
TOTAL DEPTH OF HOLE (feet): 22.50		NORTHING: 1105170.00	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Hard pack frozen soil, fill	
				Loose gravel fill, angular clasts to 4 inches, sandy silt matrix.	
	1.0				
5.0			GM	Silty gravel, reddish brown (5 YR 4/4), subangular clasts to 2 inch; with 40% silt, minor sand, dry, loose.	
	2.0
		SW	Gravelly sand, brown (7.5 YR 4/4), coarse to medium grained subrounded; 10% gravel, clasts to 2 inch; minor silt, dry, loose, no odor. At 12 feet gravel increases to 30%, clasts to 4 inch.	
10.0	3.0				
	4.0				12.5 to 13.0 feet lost to rock in bit.
15.0			ML	Sandy silt; brown (7.5 YR 4/4), firm, nonplastic; with 25% fine to coarse sand; minor gravel to 0.5 inch, firm, dry.	
	5.0
		SW	Gravelly sand; brown (7.5 YR 4/4), firm, medium to coarse grained, subrounded with 20% subangular gravel to 1.5 inch, loose, dry.	
20.0	6.0				20.5 to 21 feet, lense of sandy silt. At 22 feet gravel increases to 30%.

SOIL BORING LOG		BORING NUMBER: LF4 T1.0 SEEP-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/13/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-2 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/13/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473991.40	
TOTAL DEPTH OF HOLE (feet): 42.50		NORTHING: 1105145.80	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Gravelly sand; brown (7.5 YR 4/4) coarse to medium grained sand; with 20% subangular gravel.	
	1.0			Silty gravel; brown (7.5 YR 4/4) subangular clasts to 4 inch, 30-40% silt.	
5.0	2.0			Silty sand-fill; brown (7.5 YR 4/4) coarse to medium grained; subrounded nonplastic silt, loose, dry.
		LEACH ROCK	Sorted gravel (leach rock), 0.25-1 inch subangular gravel, loose, damp, no odor, no stain, minor sand and silt.	At 7.5 to 10 feet run, loose pea gravel, fill, sluff.
10.0	3.0				
	4.0				
15.0	5.0		SW	Fines increasing, moist.	At 32.5 to 33.5 feet, short run due to rock.
20.0	6.0			Silty sand, reddish brown (5 YR 4/4), coarse to fine grained, subrounded; 20% silt, minor gravel to 1/4 inch, slightly firm, moist, no odor.	
	7.0				
25.0	8.0		SW	Gravelly sand, brown (7.5 YR 4/4) subrounded, coarse to fine with 30% gravel, subrounded to 4 inch, damp, no odor, slightly firm, minor silt	
	9.0			Decreasing gravel size to 2 inch.	
	10.0			Same as above	
35.0	11.0		SW	Same as above, slight damp, no odor, no stain.	
	12.0				
40.0					

SOIL BORING LOG		BORING NUMBER: LF4-TI-20.0 SEEP-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/14/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-3 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/14/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473991.00	
TOTAL DEPTH OF HOLE (feet): 30.00		NORTHING: 1105146.45	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Gravelly sand, (fill), brown (7.5 YR 4/4), coarse to fine, subrounded with 20% gravel to 1 inch, minor silt, loose dry.	
	1.0				
5.0			LEACH ROCK	Well graded gravel - leach rock, 0.5 to 1-inch, subangular gravel; minor sand and silt, loose to moist.	At 6 feet, fragments of black pvc pipe, perforated.
	2.0				
10.0	3.0		SW	Gravelly sand, reddish brown (5 YR 4/4), medium to coarse grained, subrounded; 20% subangular gravel, clasts to 4 inch, minor silt, slightly moist, no odor, no stain.	
	4.0				
15.0	5.0				
	6.0			Gravelly sand as above, slightly moist, no odor, slightly firm.	
20.0	7.0			Gravelly sand same as above.	
	8.0				
25.0				Same as above, drill through 4 inch plus clast at 29 feet.	
	9.0				

SOIL BORING LOG

BORING NUMBER: LF4-TI-20.0 SEEP(D/G)-SB

PROJECT NAME: TTR Septic Waste System

DATE HOLE STARTED: 12/14/97

PROJECT NUMBER: 772848.05020200

DATE HOLE COMPLETED: 12/14/97

HOLE SURFACE ELEVATION (feet): 5402.00

EASTING: 473982.80

TOTAL DEPTH OF HOLE (feet): 37.50

NORTHING: 1105164.00

ENVIRONMENTAL CONTRACTOR: IT Corporation

GEOLOGIST: RD ATKINSON

DRILLING METHOD: HOLLOW STEM AUGER

QA CHECK: G EVENSON

DRILLING CONTRACTOR: Stewart Brothers

COMMENTS: Boring destroyed with bentonite grout.

ELEVATION DATUM: Mean Sea Level

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Appendix B
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Date: 06/24/98
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Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SM	Silty gravelly sand, brown (7.5 YR 4/4), coarse to fine subrounded sand; 30% silt; 10% gravel to 1 inch; slightly firm, dry.	
	1.0		ML	Sandy silt, light brown (7.5 Y/R 6/4), soft silt with 30% sand as above; minor gravel to 1/4 inch, dry, slightly firm.	
5.0	2.0
	3.0		SW	Gravelly sand, reddish brown (5 YR 4/4), coarse to fine grained, subrounded to round; 30% gravel clasts to 4 inch, minor silt, slightly damp, slightly firm, no odor. From 12.5 to 15 feet gravel decreases to 20%, no odor.	
10.0	4.0
	5.0			Sand as above	
15.0	6.0
	7.0			Sand as above	
20.0	8.0			Gravelly sand as above, 25% gravel clast to 1 inch.	At 19 feet boulder in bit, short core run.
	9.0
	10.0			Gravelly sand as above, max clast increase to 2 inch.	At 29 feet, boulder in bit.
25.0	11.0
	12.0			Gravelly sand as above.	
	13.0			Gravelly sand as above, gravel 10%.	
30.0	14.0			Gravelly sand as above, silt increases to 10%	
	15.0			Gravelly sand as above, 30% gravel with clast to 4 inch.	
35.0	16.0
	17.0			Sandy gravel bed 50% gravel, clasts to 1/2 inch, silty sand matrix.	

SOIL BORING LOG		BORING NUMBER: LF4-TI-40.0 SEEP U/G-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/14/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-5 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/15/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473989.10	
TOTAL DEPTH OF HOLE (feet): 42.50		NORTHING: 1105185.60	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Silty gravelly sand; brown (7.5 YR 4/4) 50% sand, 30% silt, 20% gravel to 1 inch.	
	1.0			Sandy gravel; brown, clasts to 3 inch, coarse to fine sand, minor silt	
5.0			LEACH ROCK		6.5 to 7 feet, pieces of black PVC pipe.
	2.0			Poorly sorted gravel, graded clean gravel, little sand or silt, subrounded to subangular, slightly damp, no odor.	
10.0			SW	Gravelly sand; reddish brown (5 YR 4/4), coarse to fine grained, subrounded, with 30% subround to subangular gravel to 1/2 inch, slightly moist, no odor.	Stop for night at 20 feet, core barrel left in hole overnight.
	3.0				
	4.0			Gravelly sand as above.	
15.0				Gravelly sand as above, at 19 to 20 feet, 40% gravel.	
	5.0				
	6.0			Gravelly sand as above.	
20.0				Gravelly sand as above, 4 inch clast stuck in bit, 1/2 core run lost.	
	7.0				
	8.0			Gravelly sand as above. At 27 feet 6 inch gravelly sandy silt bed, slightly damp, no odor.	
25.0				Gravelly sand as above.	
	9.0			Rig encounters boulders, no recovery.	At 28.5 feet rock in bit drill out to 30 feet.
30.0					Rock in bit no recovery, drilling through a series of boulders, little core recovered.
	10.0				
	11.0			Gravelly sand; reddish brown (5 YR 4/4), coarse to fine grained, subrounded, with 30% subround to subangular gravel to 1/2 inch, slightly moist, no odor, scattered boulders make coring difficult.	
35.0					
	12.0			Gravelly sand as above, 20% gravel to 2 inch.	
40.0					

SOIL BORING LOG		BORING NUMBER: 40.0 SEEP-29.0 U/G-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/15/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-6 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/15/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 474015.10	
TOTAL DEPTH OF HOLE (feet): 15.00		NORTHING: 1105186.80	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Silty sand fill; brown; (7.5 YR 4/4); fine to medium grained, subround, 30% silt, minor gravel.	
	1.0		LEACH ROCK	Graded gravel-leach rock, clean gravel 1-2 inch, no fines, no stain or odor.	
5.0					
	2.0		SW	Gravelly sand, reddish brown (5 YR 4/4); coarse to fine grained, subround 10/20% gravel subround to 3 inch, minor silt, 6 inch bed of sandy silt at 9 ft.	
				Gravelly sand, as above.	
10.0	3.0			Gravelly sand, as above.	
				Gravelly sand, as above	At 11.5 feet rock in bit drill out to 12.5 feet.
	4.0			Sandy silt bed, firm.	

SOIL BORING LOG			BORING NUMBER: 20.0 SEEP-29.0 U/G-SB	
PROJECT NAME: TTR Septic Waste System			DATE HOLE STARTED: 12/15/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-7 of B-21
PROJECT NUMBER: 772848.05020200			DATE HOLE COMPLETED: 12/15/97	
HOLE SURFACE ELEVATION (feet): 5404.00			EASTING: 474016.30	
TOTAL DEPTH OF HOLE (feet): 16.50			NORTHING: 1105166.00	
ENVIRONMENTAL CONTRACTOR: IT Corporation			GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER			QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers				
ELEVATION DATUM: Mean Sea Level				

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Sandy silt; brown (7.5 YR 4/4), soft, nonplastic with 40% fine to medium sand, minor gravel.	
	1.0		LEACH ROCK	Graded gravel - leach rock; subrounded to subangular clasts 1 - 2 inch, slight septic odor, loose, dry.	
5.0					
	2.0		SW	Gravelly sand, brown (7.5 Y/R 4/4); coarse to fine gravel, subround with 20% gravel subround to 2-inch, minor silt, loose slightly moist, no odor.	
10.0	3.0			Gravelly sand, as above.	
	4.0			Gravelly sand, as above	
15.0				Boulders to 6-inches	
				TD clean sample	At 16.5 feet rock in bit, stop hole when field screen clean.

SOIL BORING LOG		BORING NUMBER: LF4-T1-20.0 SEEP-CENTER-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/17/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-8 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/17/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473987.30	
TOTAL DEPTH OF HOLE (feet): 40.00		NORTHING: 1105164.30	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		LEACH ROCK	Silty gravelly sand, fill.	
				Clean graded gravel leach rock.	
5.0	1.0			Sandy silt fill, reddish brown (5 YR 4/4), nonplastic silt; 40% fine to medium grained subrounded sand, loose, no odor.	
	2.0			Graded clean gravel, leach rock, loose, dry, clasts from 1 to 2 inch. At 14 feet, leach rock fining with depth, clast 0.5 to 1 inch, 10% sand.	
10.0	3.0		SW	At 17.5 feet drill out of leach rock into native material.	
15.0	4.0				
	5.0			Gravelly sand, brown (5 YR 4/4), coarse to fine grained subrounded; 15% gravel to 2 inch, minor silt, no odor, slightly damp.	
20.0	6.0				
	7.0			Gravelly sand as above; 30% subrounded gravel to 3 inch.	
25.0	8.0			Gravelly sand as above.	At 26 feet rock in bit, use center bit.
	9.0			Gravelly sand as above; scattered cobbles to 4 inch.	
30.0	10.0			Gravelly sand as above; 30% gravel clast to 3 inch.	At 29 feet hit rock, drill out.
	11.0			Sandy silt, reddish brown (5 YR 4/4), nonplastic silt; 40% fine to medium grained sand; minor gravel to 1/4 inch, firm, slightly damp.	
35.0	12.0			Silty gravelly sand; reddish brown (5 YR 4/4), medium to fine subrounded; 20% nonplastic silt; 10% subrounded clasts to 1 inch, firm, slightly damp.	

SOIL BORING LOG		BORING NUMBER: LF4-TI-40.0 SEEP (D/G)-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/17/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-9 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/17/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473981.50	
TOTAL DEPTH OF HOLE (feet): 40.00		NORTHING: 1105185.00	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Sandy silt, reddish brown (5 YR 4/4), nonplastic silt, 40% sand, fine to medium grained, minor gravel, loose.	At 6 feet, hit rock drill through it to 7.5 feet.
	1.0		GRADED FILL	Sandy gravel, graded gravel, 1 to 2 inch, 30% sand and silt.	
5.0	2.0		FILL	Silty sand, reddish brown, medium to fine grained, subrounded, 30% silt, 10% gravel to 2 inch, loose, dry.	
10.0	3.0		SW	Gravelly sand, brown (7.5 YR 4/4), coarse to fine grained, subround, 5 to 20% gravel, clasts to 2 inch, slightly firm, slightly damp.	
	4.0				
15.0	5.0			Gravelly sand, as above, 20% gravel clast to 3 inch.	
	6.0			Gravelly sand as above, at 19 feet a 4 inch silty sand bed.	
20.0	7.0			Gravelly sand as above, 20% gravel clast to 3/4 inch.	
	8.0			Gravelly silty sand, brown (7.5 YR 4/4) coarse to fine grained; 30% gravel clast to 4 inch; 10% silt moderately firm, slightly damp. At 27.3 feet sandy silt, 4 inch bed.	
25.0	9.0			Gravelly silty sand as above.	
	10.0			Gravelly silty sand as above. At 31.5 sand size decreases to medium to fine grained.	
30.0	11.0			Silty sand, reddish brown (5 YR 4/4), fine to medium grained, 30% nonplastic silt, minor gravel, firm, slightly damp. At 36.0 to 36.5 bed of gravelly sand.	
35.0	12.0			Silty sand as above, sparse cobbles to 4 inch plus.	

SOIL BORING LOG		BORING NUMBER: LF4-T1-40.0 SEEP CENTER(2ND)-SB	
PROJECT NAME: TTR Septic Waste System	DATE HOLE STARTED: 12/18/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-10 of B-21	
PROJECT NUMBER: 772848.05020200	DATE HOLE COMPLETED: 12/18/97		
HOLE SURFACE ELEVATION (feet): 5402.00	EASTING: 473986.70		
TOTAL DEPTH OF HOLE (feet): 44.00	NORTHING: 1105184.70		
ENVIRONMENTAL CONTRACTOR: IT Corporation	GEOLOGIST: RD ATKINSON		
DRILLING METHOD: HOLLOW STEM AUGER	QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.	
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Sandy gravelly, silt, fill.	
				Sandy Gravel, fill, clast to 2 inch.	
	1.0			Silty gravelly sand, fill	
5.0			SW		
	2.0			Sandy gravel, fill, brown (7.5 YR 4/4), subrounded clast range, 1/4 to 2 inch; 40% sand, subrounded, coarse to fine, minor silt, loose.	
10.0	3.0				
	4.0				
15.0	5.0			Gravelly sand, brown (7.5 YR 4/4) coarse to fine grained, subrounded; with 30% gravel clasts to 1 inch, minor silt, slightly firm.	
	6.0			Gravelly sand as above, 10% gravel clast to 2 inch.	
20.0	7.0			Gravelly sand as above, 20% gravel with clast to 3 inch.	At 19.5 feet, rock in bit, drill out.
	8.0			Gravelly sand, 40% gravel to 4 inch plus, altered felsite clast, soft easily broken.	
25.0	9.0			Gravelly sand as above, 10% gravel, scattered 4 inch plus clasts.	
	10.0				At 27 feet rock in bit, drill out.
30.0	11.0			Gravelly sand as above, 30% gravel, clast to 3 inch plus.	
	12.0				At 30 feet, rock in bit, drill out.
35.0	13.0			Gravelly sand as above, decreasing grain size, medium to fine, 15% gravel to 5% silt.	
				Gravelly sand, coarse to fine grained, 20% gravel, rare clasts to 4 inch plus.	
40.0				Gravelly sand as above.	At 40 ft rock in bit.
				Gravelly sand as above.	
				Gravelly sand as above.	

SOIL BORING LOG		BORING NUMBER: LF4-T1-1.0 SEEP (D/G)-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/18/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-11 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/19/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473988.30	
TOTAL DEPTH OF HOLE (feet): 42.50		NORTHING: 1105195.30	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Sandy silt, fill; reddish brown (5 YR 4/4), nonplastic silt with 40% fine to medium grained sand.	
1.0					
5.0				Silty sand, reddish brown (5 YR 4/4), medium to fine grained subrounded sand with 35% silt and 5% gravel to 1 inch, loose, dry.	
2.0					
10.0			SW	Gravelly sand, brown (7.5 YR 4/4) coarse to medium grained, subround; with 20% subround gravel with clasts to 1 inch, minor silt slightly firm, slightly damp.	At 6.5 ft rock in bit, drill out.
3.0				Gravelly sand as above. At 17 feet sandy silt bed (6 inch).	
4.0					
15.0					
5.0				Gravelly sand as above; 20% gravel, clasts to 3 inch plus.	
20.0				Gravelly sand as above. At 22.3 feet 3 inch sandy silt bed.	
7.0				Gravelly sand as above; 20% gravel, rare clasts to 3 inch plus.	
25.0				Gravelly sand as above. Rock at 27 feet is cemented gravelly sand - caliche.	
8.0				Cemented gravel sand caliche - drill out.	At 27 ft rock in bit, drill out.
30.0				Gravelly sand as above. At 32 feet a 4 inch bed of silty sand.	
10.0				Gravelly sand as above. At 34 feet cobbles to 4 inch plus.	
35.0				Gravelly sand as above.	
11.0					
40.0				Silty sand, reddish brown (5 YR 4/4), medium to fine grained, 30% silt; 10% gravel to 1 inch, slightly firm, slightly damp.	At 39.5 feet, rock in bit, drill out
12.0					

SOIL BORING LOG		BORING NUMBER: LF2-DBOX-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/08/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-12 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/10/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474084.80	
TOTAL DEPTH OF HOLE (feet): 22.50		NORTHING: 1105195.00	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	0 TO 4' Fill.	
5.0	1.0		LEACH ROCK	4 to 6' Leach Rock.	
2.0	2.0		GW	Sandy gravel, 2.5 Y 5/4, 40% gravel; 30% coarse gravel; 30% coarse sand; minor fines; maximum grain size 2".	Geotechnical samples.
				Sandy gravel, 2.5 Y 4/2, 60% gravel; 30% coarse sand; 5% medium sand; 5% fine sand.	
				Cobble, 2.5 YR 3/4.	
10.0	3.0		SC	Gravelly sand, 2.5 Y 4/2, 40% medium sand; 20% gravel; 20% coarse sand; 10% fine sand; 10% plastic fines.
		SM	Gravelly sand, 2.5 Y 4/2, 45% medium sand; 20% gravel; 20% coarse sand; 10% fine sand; 5% silt.	
4.0	4.0		SC	Gravelly sand, 10 YR 4/4, 30% medium sand; 20% fine sand; 20% gravel; 10% coarse sand; 10% fines.	Poor recovery.
15.0	5.0		SM	Silty sand, 2.5 Y 5/4, 40% medium sand; 20% coarse sand; 20% fine sand; 10% gravel; 10% silt.	
20.0	6.0			Silty sand, 10 YR 6/6, 80% fine sand; 10% medium sand; 10% silt.	Poor recovery.

SOIL BORING LOG		BORING NUMBER: TANK 33-4-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/09/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-13 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/09/97	
HOLE SURFACE ELEVATION (feet): 5406.00		EASTING: 474126.40	
TOTAL DEPTH OF HOLE (feet): 14.50		NORTHING: 1105193.50	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SM	Drill out	
	1.0				
	5.0				
	2.0			Silty sand (10 YR 6/3), about 30% medium sand; about 20% fine sand; about 20% coarse sand; about 20% gravel; about 10% silt, maximum grain size 2 inch.	
				Silty sand (10 YR 5/3), about 30% coarse sand; 20% medium sand; 20% coarse gravel; 10% gravel; 10% fine sand, 10% silt.	
10.0	3.0		GW	Sandy gravel (10 YR 5/4), about 30% coarse sand; about 30% gravel; about 30% coarse gravel; about 10% silt.	
	4.0		SM	Gravelly sand (2.5 YR 6/3), about 30% coarse sand; about 30% gravel; about 20% coarse gravel; about 10% fine sand; about 10% silt.	
					Drilling stopped, large volcanic rock fragment blocking shoe.

SOIL BORING LOG		BORING NUMBER: LF2 SE CORNER-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/10/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-14 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/10/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474089.20	
TOTAL DEPTH OF HOLE (feet): 22.50		NORTHING: 1105186.40	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	
DRILLING CONTRACTOR: Stewart Brothers		COMMENTS: Boring destroyed with bentonite grout.	
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SM	Drill out	
	1.0				
5.0				Silty sand (2.5 Y 6/4), about 40% medium sand; about 30% gravel; about 20% fine sand; about 5% coarse sand; about 5% silt.	
	2.0			Silty sand (10 YR 4/2), about 30% coarse sand; about 30% gravel; about 30% medium sand; about 5% fine sand; about 5% silt.	
10.0	3.0		GW	Sandy gravel (10 YR 5/3), about 30% gravel; about 30% coarse sand; about 20% cobbles; about 10% medium sand; about 5% fine sand; about 5% silt maximum grain size is 3.5 inch.	
	4.0		SW	Gravelly sand (2.5 Y 6/4), about 50% coarse sand; about 30% gravel; about 10% medium sand; about 10% fine sand; <1% silt.	
15.0	5.0		SM	Silty sand (10 YR 6/4), about 30% medium sand; about 20% coarse sand; about 20% fine sand; about 10% gravel; about 10% coarse gravel; <10% silt, maximum grain size 2.5 inch.	
	6.0		SW	Gravelly sand (10 YR 5/3), about 30% medium sand; about 20% coarse sand; about 20% fine sand; about 20% gravel; about 10% coarse gravel.	
20.0			SM	Silty sand (10 YR 5/4), about 30% medium sand; about 20% coarse sand; about 20% fine sand; about 10% gravel; about 10% coarse gravel; <10% silt, maximum grain size 2.5 inch.	
			SW	Gravelly sand (2.5 Y 6/3), about 30% medium sand; about 30% coarse sand; about 30% gravel; about 10% fine sand.	At 21.5 feet, purple volcanic rock fragment.

SOIL BORING LOG		BORING NUMBER: LF2-T1-3.0SO-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/10/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-15 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/10/97	
HOLE SURFACE ELEVATION (feet): 5504.00		EASTING: 474061.40	
TOTAL DEPTH OF HOLE (feet): 22.50		NORTHING: 1105187.40	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SW	Drill out	
	1.0				
5.0				Gravelly sand (10 YR 7/3), about 40% medium sand; about 30% gravel; about 20% coarse sand; about 10% coarse gravel, maximum grain size 3.5 inch.	
	2.0			Gravelly sand (10 YR 7/2), about 40% gravel; about 30% medium sand; about 20% coarse sand; about 10% fine sand.	
	3.0			Gravelly sand (10 YR 6/3), about 50% gravel; about 30% medium sand; about 10% coarse sand.	Split spoon stopped (on rock?) Tripping out sample, drilling through rock.
10.0			GW	Sandy gravel (10 YR 6/4), about 40% coarse gravel; about 30% medium sand; about 20% coarse sand; about 10% gravel, maximum grain size 3 inch.	Yellow staining from weathering tuff clasts.
	4.0				
15.0			SW	Gravelly sand (10 YR 6/3), about 30% medium sand; about 20% coarse sand; about 20% fine sand; about 10% coarse gravel, maximum grain size 4 inch.	
	5.0			Gravelly sand (10 YR 7/4), about 40% medium sand; about 30% gravel; about 20% coarse sand; about 10% fine sand.	
	6.0			Gravelly sand (10 YR 6/3), about 40% medium sand; about 30% coarse sand; about 20% gravel, about 10% fine sand; less than 1% silt.	
20.0					

SOIL BORING LOG		BORING NUMBER: LF2 WEST-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/11/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-16 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/11/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474061.80	
TOTAL DEPTH OF HOLE (feet): 22.50		NORTHING: 1105198.20	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SW	Drill out	
	1.0				
5.0				Gravelly sand, (10 YR 6/6), about 40% gravel; about 30% coarse sand, about 20% medium sand; about 10% fine sand.	
	2.0			Gravelly sand, (10 YR 6/4), about 50% gravel; about 30% coarse sand; about 15% medium sand; about 5% fine sand.	
10.0	3.0		GW	Sandy gravel, (2.5 Y 6/3), about 60% gravel; about 15% coarse sand; about 10% medium sand; about 5% fine sand; <1% silt.	
	4.0		GC	Clayey gravel, (7.5 Y/R 4/2), about 50% coarse gravel; about 20% gravel; about 20% fine sand; about 10% clay; maximum grain size 4-inch.	Purple volcanic rock fragment, highly weathered volcanic rocks.
15.0	5.0		SM	Silty sand, (10 YR 6/4), about 50% fine sand; about 30% medium sand; about 15% gravel; <5% silt.	
	6.0		SW	Gravelly sand (2.5 Y 6/3) about 40% coarse sand; about 30% gravel; about 20% medium sand; about 10% fine sand.	White weathered volcanic rock zone approximately 6 inch long.
20.0				Gravelly sand (2.5 Y 6/3), about 30% coarse sand; about 20% medium sand; about 10% fine sand; about 10% coarse gravel; maximum grain size 4 inch.	

SOIL BORING LOG		BORING NUMBER: LF2 SW CORNER-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/11/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-17 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/11/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474074.10	
TOTAL DEPTH OF HOLE (feet): 22.50		NORTHING: 1105180.00	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SW	Drill out.	
	1.0				
5.0				Gravelly sand (10 YR 7/4), about 40% medium sand; about 30% gravel; about 20% fine sand, about 10% coarse sand.	
	2.0				Black staining from 6.0 to 7.0 feet.
				Gravelly sand (10 Y 6/4), about 40% medium sand; about 30% gravel; about 20% coarse gravel; about 10% fine sand.	
			GW		
10.0	3.0			Gravelly sand (10 YR 6/4), about 30% medium sand; about 30% coarse sand; about 30% gravel; about 10% fine sand.	
					Cobble at 9 feet, pervasive black staining from 8.5 to 9.0 feet, no black staining observed from 9.0 to
	4.0			Gravelly sand (10 Y 6/4), about 40% gravel; about 30% coarse sand; about 10% medium sand; about 10% fine sand.	
					Drilling on rock, trip out split spoon and use cutting bit.
15.0	5.0		SW	Sandy gravel (10 YR 5/3), about 60% gravel; about 30% coarse sand; about 10% medium sand.	
				Gravelly sand (10 YR 6/3), about 40% coarse sand; about 30% gravel; about 20% medium sand.	
20.0	6.0		SW		
				Gravelly sand (10 YR 5/3), about 40% gravel; about 20% coarse sand; about 20% medium sand; about 20% fine sand.	

SOIL BORING LOG		BORING NUMBER: DBOX-RS-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/16/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-18 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/16/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474082.40	
TOTAL DEPTH OF HOLE (feet): 25.00		NORTHING: 1105199.40	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Silty sand; reddish brown (5 YR 4/4), fine to medium grain, 40% silt, minor gravel to 1 inch.
		LEACH ROCK	Graded gravel-leach rock, 1-2 inch subround, clean, loose, thin black coating; odor. At 4 ft rusty layer - distinct septic odor; silty gravel, 0.5 - 1 inch clasts.
		FILL	To 9 ft material disturbed by trenching.
		SW	Gravelly sand; brown (7.5 YR 4/4), coarse to medium grained; subrounded with 20% gravel to 2 inch, silt, damp, no odor.	
10.0	3.0		SW	Gravelly sand as above, slightly damp, slightly firm.
		Rock in bit drill out to 15 feet.
15.0				Hit rocks in bit, no usable core recovered.	At 15.1 feet, rock, change to center bit to break.
		Gravelly sand as above, 40% gravel clasts to 3 inch.	At 16 feet rock stops core.
		Gravelly sand as above, 30% gravel clasts to 4 inch.	
20.0	6.0			Gravelly sand as above.
		Sandy silt; reddish brown (5 YR 4/4), firm, nonplastic silt, 40% fine to medium grained sand, minor gravel to 1/4 inch, slightly moist.
		ML		

SOIL BORING LOG		BORING NUMBER: LF2-T1-17.0RS-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/16/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-19 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/16/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474090.00	
TOTAL DEPTH OF HOLE (feet): 22.00		NORTHING: 1105196.00	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
	1.0	LEACH ROCK		Clean gravel, leach rock, 1 to 2 inch graded gravel, clean, loose, sparse thin black stain, no odor.	
5.0					
	2.0	SW		Gravelly sand, brown (7.5 YR 4/4), coarse to fine grained, subrounded with 20% gravel subrounded clast to 2 inch, slightly damp, no odor. At 16.5 to 17.5 feet alternating sandy silt and gravelly sand in 3 inch layers.	
10.0					
	3.0				
	4.0				
15.0				Gravelly sand, as above. At 16.5 to 17.5 feet alternating sandy silt and gravelly sand in 3 inch layers.	
	5.0				
	6.0			Gravelly sand as above. At 19 to 20 feet large clasts 4 inch plus, gravel 30%.	
20.0					
					At 22 feet hit rock, stop core run.

SOIL BORING LOG		BORING NUMBER: LF2-T1-17.0SO-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/09/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-20 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/10/97	
HOLE SURFACE ELEVATION (feet): 5404.00		EASTING: 474100.70	
TOTAL DEPTH OF HOLE (feet): 20.00		NORTHING: 1105195.80	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: JM MOORE	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		SW	Drill out	
	1.0				
	5.0				Resistance (ROCK?)
	2.0			Gravelly sand (2.5 YR 6/4), about 40% medium sand; about 30% fine sand; about 20% coarse sand; about 10% gravel.	
				Sandy Gravel (10 YR 6/2), about 40% gravel; about 20% coarse sand; about 10% medium sand.	
			GW	Clayey sand (10 YR 6/4), about 30% fine sand; about 20% medium sand; about 20% coarse sand; about 20% gravel; about 10% clay.	
			SC		
10.0	3.0		GW		
				Sandy gravel (2.5 Y 6/3), about 30% coarse sand; about 30% gravel; about 25% coarse gravel; about 10% medium sand; about 5% fine sand.	
	4.0				13.0 to 15.0 clasts up to 3 inch in diameter.
15.0			SC	Clayey sand (10 YR 6/6), about 40% fine sand; about 20% medium sand; about 10% coarse sand; about 10% gravel; about 10% clay.	
	5.0				
				Clayey sand (10 YR 6/2), about 40% medium sand; about 20% coarse sand; about 20% gravel; about 10% coarse gravel; about 10% clay.	
	6.0				

SOIL BORING LOG		BORING NUMBER: LF4-TI-40.0 SEEP-CENTER (1ST)-SB	
PROJECT NAME: TTR Septic Waste System		DATE HOLE STARTED: 12/18/97	CAU 427 CADD Appendix B Revision: 0 Date: 06/24/98 Page B-21 of B-21
PROJECT NUMBER: 772848.05020200		DATE HOLE COMPLETED: 12/18/97	
HOLE SURFACE ELEVATION (feet): 5402.00		EASTING: 473954.50	
TOTAL DEPTH OF HOLE (feet): 15.00		NORTHING: 1105185.90	
ENVIRONMENTAL CONTRACTOR: IT Corporation		GEOLOGIST: RD ATKINSON	
DRILLING METHOD: HOLLOW STEM AUGER		QA CHECK: G EVENSON	COMMENTS: Boring destroyed with bentonite grout.
DRILLING CONTRACTOR: Stewart Brothers			
ELEVATION DATUM: Mean Sea Level			

Depth Feet	Depth Meters	Legend	USCS	Classification (Description)	Remarks
0.0	0.0		FILL	Sandy gravelly silt, reddish brown, nonplastic silt; 30% fine to medium grained sand, 10% gravel to 1 inch.	
	1.0		GW	Gravel layer, leach rock.	
	2.0			Sandy gravelly silt, fill as above.	
	3.0
10.0	4.0			Sandy gravel/gravelly sand; brown (7.5 YR 4/4), mix of gravel clast to 3 inch plus and coarse to fine sand. TD hole at 15 feet, missed target move east.	

Appendix C

Cost Estimates

EST: CAU 427	BN ENVIRONMENTAL RESTORATION COST ESTIMATE SUMMARY	Prep Date: 3/25/98 Print Date: 4/14/98																				
TO: JEFF SMITH Environmental Restoration Task Manager FROM: ABDEL AGALLOUCH - ER Project Controls																						
SUBJECT: REMEDIATION ALTERNATIVES		TEC: (see costs below)																				
WORK PKGE: CAU 427 - Area 3, Septic Waste Systems 2 & 6		WBS: N/A																				
TAP: INACTIVE TANKS SOURCE GROUP		LOCATION: TTR																				
<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th colspan="2" style="text-align: center;">TYPE OF ESTIMATE</th></tr></thead><tbody><tr><td>☐ ORDER OF MAGNITUDE</td><td>☐ PRELIMINARY TITLE II</td></tr><tr><td>☐ PLANNING/STUDY</td><td>☐ WORK ORDER</td></tr><tr><td>☒ CONCEPTUAL/BUDGET</td><td>☐ COMPARATIVE</td></tr><tr><td>☐ TITLE I / PRELIMINARY</td><td>☐ OTHER</td></tr></tbody></table>		TYPE OF ESTIMATE		☐ ORDER OF MAGNITUDE	☐ PRELIMINARY TITLE II	☐ PLANNING/STUDY	☐ WORK ORDER	☒ CONCEPTUAL/BUDGET	☐ COMPARATIVE	☐ TITLE I / PRELIMINARY	☐ OTHER	<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th colspan="2" style="text-align: center;">TYPE OF WORK</th></tr></thead><tbody><tr><td>☐ RI / FS</td><td></td></tr><tr><td>☒ REMEDIATION</td><td></td></tr><tr><td>☒ CONSTRUCTION</td><td></td></tr><tr><td>☐ OTHER</td><td></td></tr></tbody></table>	TYPE OF WORK		☐ RI / FS		☒ REMEDIATION		☒ CONSTRUCTION		☐ OTHER	
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<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th colspan="2" style="text-align: center;">BN REMEDIATION PROJECT</th></tr></thead><tbody><tr><td>ESTIMATOR:</td><td>Abdel Agallouch 702-295-5275</td></tr><tr><td>TASK MGR:</td><td>Jeff Smith 702-295-7775</td></tr><tr><td>PROJ MGR:</td><td>Dave Cowser 702-295-1632</td></tr></tbody></table>		BN REMEDIATION PROJECT		ESTIMATOR:	Abdel Agallouch 702-295-5275	TASK MGR:	Jeff Smith 702-295-7775	PROJ MGR:	Dave Cowser 702-295-1632	<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th colspan="2" style="text-align: center;">WORK TO BE PERFORMED BY</th></tr></thead><tbody><tr><td>☒ DOE PRIME CONTRACTOR</td><td>☐ NATIONAL LAB</td></tr><tr><td>☐ NTS GENERAL</td><td>☐ SUBCONTRACT</td></tr><tr><td>☐ NTS MAINTENANCE</td><td>☐ OTHER</td></tr></tbody></table>	WORK TO BE PERFORMED BY		☒ DOE PRIME CONTRACTOR	☐ NATIONAL LAB	☐ NTS GENERAL	☐ SUBCONTRACT	☐ NTS MAINTENANCE	☐ OTHER				
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☐ NTS MAINTENANCE	☐ OTHER																					
<p><u>STATEMENT OF WORK:</u></p> <p>This estimate has been prepared at the request of DOE/NV to provide remediation alternative costs for closure of Corrective Action Unit (CAU) 427, an environmental restoration site listed in the Federal Facilities Agreement and Consent Order (FFACO).</p> <p><u>SCOPE:</u></p> <p>Provide site closure using one or more of the following alternatives:</p> <ul style="list-style-type: none">• NO FURTHER ACTION• CLOSURE OF SEPTIC TANK 33-5:<ul style="list-style-type: none">* Pump out sludge and clean close tank in place OR* Remove, haul, and dispose of sludge and tank• CIP of TPH-CONTAMINATED SOIL by ADMINISTRATIVE CONTROLS: Only administrative activities and associated costs• EXCAVATION & DISPOSAL of TPH-CONTAMINATED SOIL <p><u>BASIS OF ESTIMATE:</u></p> <ul style="list-style-type: none">• Offsite Travel, Feeding and lodging will be provided• The administrative closure alternative includes:<ul style="list-style-type: none">1) Survey and engineering support will be required for as-built drawing preparation. Site inspection is not anticipated for engineering techs.2) Implement administrative controls (ie., digging restrictions)• The tank will be filled with sand, topped out with concrete and cap will be cemented under clean closure in place.• The utilities (gas, phone, electric, and water lines) will be rerouted accordingly.• Backfill material for the utilities will be compacted in 8" lifts, 4 passes using a tamper vibrator.• TPH-contaminated soil will be removed from the site and disposed of at Area 6 Hydrocarbon landfill.• The foundation of the building will be grouted after removal of the TPH contaminated soil.• Backfill material will be imported from borrow pit approximately 6 to 7 miles from the site• A crane will be used to support the tank while disconnecting from the piping and to remove the tanks from the pad. <p style="text-align: center;">See following page/s for continuation and cost summary</p>																						
<table style="width: 100%;"><tr><td style="width: 33%;">Review / Concurrence: Estimator</td><td style="width: 33%; text-align: center;">4/14/98 Date</td><td style="width: 33%; text-align: center;"> Checked By</td></tr><tr><td></td><td></td><td style="text-align: center;">4/14/98 Date</td></tr></table>			Review / Concurrence: Estimator	4/14/98 Date	Checked By			4/14/98 Date														
Review / Concurrence: Estimator	4/14/98 Date	Checked By																				
		4/14/98 Date																				

EST: CAU 427	BN ENVIRONMENTAL RESTORATION COST ESTIMATE SUMMARY	Prep Date: 3/25/98 Print Date: 4/14/98												
<p><u>ASSUMPTIONS:</u></p> <ul style="list-style-type: none">• Assume sludge volume of 1360 gallons in septic tank 33-5• Assume material non hazardous and will be disposed of in form of a solidified rinseate.• Assume three full suites (TPH, VOCs, SVOCs, PCBs, Metals Total RCRA) will be required for field sampling from tank.• Assume 8 verification samples of TPH impacted soil will be required.• Assume a total volume of 230 CY and 5 days will be needed to haul material from TTR to Area 6 Hydrocarbon Landfill.• Assume a 20% total volume expansion factor for the soil• Assume tank 33-5 can be disposed of as LLW based on process knowledge.• Assume access to tank interiors will not be required. All openings will be sealed with metal caps prior to removal from the site. <p><u>ESCALATION:</u> Escalation is not included in this estimate. All costs are in FY98 dollars.</p> <p><u>CONTINGENCY:</u> Contingency costs are not included in this estimate.</p> <p><u>RATES</u> FY98 indirect rates, effective 12/29/97 were applied using the BN FY98 cost model.</p> <p><u>COST SUMMARY - TOTAL ESTIMATED COST:</u></p> <table><tr><td>• NO FURTHER ACTION:</td><td>\$0</td></tr><tr><td>• CLOSURE OF SEPTIC TANK 33-5:</td><td></td></tr><tr><td> * Pump out sludge and clean close tank in place</td><td>\$40,272</td></tr><tr><td> * Remove, haul, and dispose of sludge and tank</td><td>\$44,396</td></tr><tr><td>• CIP of TPH-CONTAMINATED SOIL by ADMINISTRATIVE CONTROLS:</td><td>\$30,206</td></tr><tr><td>• EXCAVATION & DISPOSAL OF TPH-CONTAMINATED SOIL:</td><td>\$105,610</td></tr></table> <p>See attached sheets for detailed estimated costs.</p>			• NO FURTHER ACTION:	\$0	• CLOSURE OF SEPTIC TANK 33-5:		* Pump out sludge and clean close tank in place	\$40,272	* Remove, haul, and dispose of sludge and tank	\$44,396	• CIP of TPH-CONTAMINATED SOIL by ADMINISTRATIVE CONTROLS:	\$30,206	• EXCAVATION & DISPOSAL OF TPH-CONTAMINATED SOIL:	\$105,610
• NO FURTHER ACTION:	\$0													
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* Pump out sludge and clean close tank in place	\$40,272													
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• CIP of TPH-CONTAMINATED SOIL by ADMINISTRATIVE CONTROLS:	\$30,206													
• EXCAVATION & DISPOSAL OF TPH-CONTAMINATED SOIL:	\$105,610													

Appendix D

Response to NDEP Comments

NEVADA ENVIRONMENTAL RESTORATION PROJECT

DOCUMENT REVIEW SHEET

(Page 1 of 2)

1. Document Title/Number: Draft CADD for CAU 427, Area 3 Septic Waste Systems 2 and 6, Tonopah Test Range			2. Document Date: April, 1998	
3. Revision Number:			4. Originator/Organization: IT Corporation	
5. Responsible DOE/NV ERP Subproject Mgr.:			6. Date Comments Due:	
7. Review Criteria:				
8. Reviewer/Organization/Phone No.: Gregory A. Raab			9. Reviewer's Signature:	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
Page ES-1 of ES-3		According to convention, the individual words are spelled out the first time the acronym is defined, not afterwards. The last set of bullets on page ES-1 of ES-3 should read: Prevent mitigate human exposure . . . at concentrations greater than 100 milligrams per kilogram, <i>Nevada Administrative Code</i> (NAC, 1996b). Close Septic Tank 33-5 in accordance with NAC 459, (NAC 1996c). Prevent . . .	“(NAC, 1996b)” and “(NAC, 1996c)” are citations of references and are in accordance with bibliographical rules for citations in text.	No
Page 4 of 28		The Appendices need the following corrections: Appendix B: Soil Core Borings. Appendix C: Cost Estimates	No change to Appendix B title. Modified Appendix C title as requested.	No
Page 8 of 28, 1 st paragraph, 1 st sentence		Although it may be understood by most of the audience reading this document, it should be stated as to why a septic tank is not closed by the Department of Human Resources, Health Division regulations, and falls under a corrective action. Include this paragraph with the last on the previous page with a simple transition as follows: As a result of these values exceeding the action levels, Septic Tank 33-5 must be closed in accordance with NAC 459.9921 . . . inclusive, and therefore does not fall under Department of Human Resources, Health Division regulations.	Text was modified as follows: “The samples taken from within Septic Tank 33-5 indicated the presence of listed hazardous waste. As a result, Septic Tank 33-5 must be closed in accordance with NAC 459.9921 ... inclusive, and therefore, does not fall under Department of Human Resources, Health Division regulations.”	Yes
Page 18 of 28, 4 th paragraph		The same as above applies: Septic Tank 33-5 would be closed in accordance with NAC 459 (NAC, 1996c) as described in Section 2.3 and 3.3.2.	Modified text as requested.	Yes

NEVADA ENVIRONMENTAL RESTORATION PROJECT

DOCUMENT REVIEW SHEET

(Page 2 of 2)

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
Page A-8 of A-59, 1 st paragraph, 8 th sentence		The term "potholed" should be clarified.	Delete "potholed," insert the word performed.	Yes
Page A-13 of A-59, 1 st paragraph, 3 rd sentence		Begins with a 28This. It appears to be a typographical error and the 28 should be deleted.	Modified text as requested.	Yes
Page A-28 of A-59, 2nd paragraph		The fourth and second to the last sentences refer to background levels. They should be listed here.	Modified text as requested.	Yes
Page A-33 of A-59, 1 st paragraph, 2 nd sentence		Refers to Potassium-40 exceeding background levels. List the activity for background.	Modified text as requested.	Yes
Page A-33 of A-59, 3 rd sentence		Implies that the leachfield pipes may be a source of the ⁴⁰ K. If this is the case, say so. The human body contains ⁴⁰ K, and sheds it with other natural waste products.	Modified text as follows to remove implication: Delete "sample locations represent," insert "samples were obtained from."	Yes

^a Comment Types: M = Mandatory, S = Suggested.

Return Document Review Sheets to DOE/NV Environmental Restoration Division, Attn: QAC, M/S 505.

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*Provide copy on initial distribution of Rev. 0; remainder of list gets Rev. 0 if approved without changes, and entire list receives distribution of Rev. 1, if issued.

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