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**Environmental Assessment
for
Liquid Waste Treatment
at the
Nevada Test Site, Nye County, Nevada**

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U. S. Department Of Energy Nevada Operations Office

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**U.S. DEPARTMENT OF ENERGY
FINDING OF NO SIGNIFICANT IMPACT**

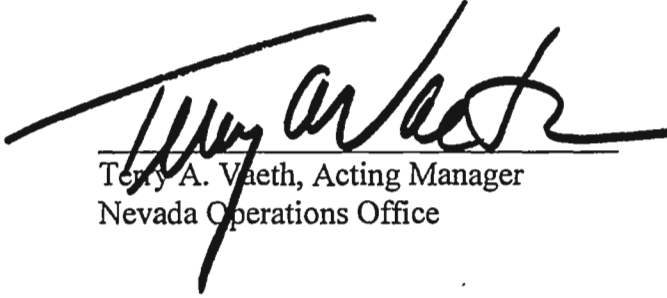
**LIQUID WASTE TREATMENT
AT THE NEVADA TEST SITE, NYE COUNTY, NEVADA**

The United States Department of Energy has prepared an Environmental Assessment (DOE/EA-1115) (EA) which analyzes the potential environmental effects of treating at the Nevada Test Site (NTS) low level radioactive liquid waste and low level mixed liquid waste generated primarily by DOE Environmental Restoration activities in the state of Nevada. The EA evaluates the potential impacts of constructing a liquid waste treatment system (LWTS) in Area 6 at the NTS, Nye County, Nevada. Three alternative actions are also evaluated: 1) Construction of a facility to treat only low-level mixed wastes while treating low-level radioactive wastes at project drill sites, 2) temporary storage of low-level mixed wastes at the Area 5 transuranic waste (TRU) pad while treating low-level radioactive wastes at project drill sites, and 3) taking no action. The purpose and need for treating the liquid wastes is found in Section 1.0 of the EA. A detailed description of the proposed action and alternatives is in Section 2.0. Section 3.0 describes the affected environment and Section 4.0 the environmental effects of the proposed action and alternatives. Health and transportation effects, accident scenarios, cumulative effects, and other relevant information are found in Sections 5.0 through 13.0 of the EA.

DOE determined that the alternative action of transporting low-level mixed wastes to the TRU pad while retaining low-level radioactive wastes at project drill sites would best meet the needs of the agency.

FINDING: Based on the information and analyses in the EA, DOE finds that neither the proposed action nor any of the alternatives would constitute a major federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*). Thus, an environmental impact statement is not required.

Signed in Las Vegas, Nevada, this 13th day of February, 1997.


Terry A. Vaeth, Acting Manager
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ENVIRONMENTAL ASSESSMENT
FOR
LIQUID WASTE TREATMENT
AT THE
NEVADA TEST SITE, NYE COUNTY, NEVADA

January, 1997

Prepared by
DOE Nevada Operations Office
Las Vegas, Nevada

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List of Acronyms and Abbreviations

APE	Area of Potential Effect
BLM	U.S. Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci/l	Curies per liter
cm	Centimeters
CP	Control Point
DAC	Derived air concentration
DCNR	Nevada Department of Conservation and Natural Resources
DNWR	Desert National Wildlife Range
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy Nevada Operations Office
DOT	U.S. Department of Transportation
DF	Decontamination Facility
DRI	Desert Research Institute
EA	Environmental Assessment
EDE	Effective dose equipment
EG&G	EG&G Energy Measurements, Inc.
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Administration
FEMA	Flood Emergency Management Agency
ft	Feet
FWS	U.S. Fish and Wildlife Service
g/m ³	Grams per cubic meter
gal	Gallon
in.	Inch
km	Kilometer
l	Liter
LWTS	Liquid Waste Treatment System
m	Meter
MCL	Maximum contaminant level
mi	Mile
mrem/yr	Millirem per year
mR/hr	Milliroentgen per hour
NAC	Nevada Administrative Code
NAAQS	National Ambient Air Quality Standards
NAFR	Nellis Air Force Range
NDWS	Nevada Drinking Water Standards
NEPA	National Environmental Policy Act
NESHAPS	National Emissions Standards for Hazardous Air Pollutants

List of Acronyms and Abbreviations (continued)

NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
pCi/l	Picocurie per liter
PM10	Particulate matter less than 10 micrometers in diameter
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
REEC	Reynolds Electrical & Engineering Co., Inc.
RSN	Raytheon Services Nevada
RWMS	Radioactive Waste Management Site
SCEPs	Steam Cleaning Effluent Ponds
TRU	Transuranic
USC	United States Code
UGTA	Underground Testing Area
μ Ci/ml	Microcuries per milliliter
°C	Degrees Celsius
°F	Degrees Fahrenheit

List of Technical Terms and Definitions

Algicide - A chemical (such as copper sulfate) used to kill or inhibit the growth of algae (phytoplankton) in a water body.

Alluvial - Relating to or composed of alluvium (clay, silt, sand, gravel, or similar detrital material deposited by running water).

Alluvial Fan - Geomorphological feature(s) characterized by a cone or fan-shaped deposition of boulders, gravel, and fine sediments that have been eroded from mountain slopes, transported by flood flows and then deposited on the valley floors.

Aquifer - Stratum or zone below the surface of the earth capable of producing water as from a well.

Aquifer Test - A test involving the withdrawal of measured quantities of water from or addition of water to, a well (or wells) and the measurement of resulting changes in head in the aquifer.

Beta Radiation - Electrons emitted from the decay of some radioactive elements. The beta particles that may cause skin burns can be stopped by a thin metal sheet.

Carbonate - A compound containing the anion radical of carbonic acid (CO_3 group).

Category 2 - Taxa for which existing information may warrant listing, but for which substantial biological data to support a proposed rule is lacking.

Clastic - Consisting of fragments of rocks or of organic structures that have been moved individually from their places of origin.

Downgradient - The direction that groundwater flows.

Effluent - The wastewater, treated or untreated, that flows out of a treatment plant, sewer or industrial out-fall. Generally refers to wastes discharged into surface waters.

Fission - The division of an atomic nucleus into parts of comparable mass, either naturally (spontaneously) or under bombardment (induced) with neutrons, alpha particles, gamma rays, deuterons or protons.

Flood or flooding - (1) A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland and/or tidal waters, and/or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Floodplain or flood-prone area - Any land area susceptible to being inundated by water from any source.

List of Technical Terms and Definitions (continued)

Freeboard - The distance between the top of the tank and the surface of the maximum liquid volume.

Fusion - The union of two chemical species by melting.

Groundwater - Water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table.

Half-life - The time required for half of the atoms of a radioactive element to undergo decay.

Hydrogeology - The geology of groundwater, with particular emphasis on the soil structure and the movement of water.

Impervious - Not allowing entrance or passage through.

Isotope - A variation of an element that has the same atomic number but different atomic weights because of the different number of neutrons.

Kinetics - A branch of dynamics that deals with the effects of forces upon the motions of material bodies.

Mixed Waste - Wastes that contain both hazardous waste subject to RCRA and radioactive waste subject to the Atomic Energy Act.

Organic - Referring to or derived from living organisms.

Oxidation - The chemical reaction process of converting a substance to another form by combination with oxygen.

Paleozoic - One of the eras of geologic time--that between the Precambrian and Mesozoic, approximately 544-244 million years before present.

Particulate Emissions - All finely divided solid or liquid materials, other than uncombined water, emitted to the ambient air as measured by applicable reference methods, equivalent or alternative method, specified in 40 CFR 51 or by a test method specified in a State implementation plan (40 CFR 51.100).

Perched ground water - Ground water separated from an underlying body of ground water by unsaturated rock. Its water table is a perched water table.

Permeable - Capable of being spread or diffused through.

List of Technical Terms and Definitions (continued)

Quaternary Age - The era of geologic time (approximately 1.6 million years before present) between the Tertiary and including the present.

Radioactivity - The process of unstable atoms trying to become stable by emitting radiation (energy).

Radionuclides - Radioactive particles, man-made or natural, with a distinct atomic weight number.

REM - Unit used to equate the biological effects of different radiation on man. Acronym for "Roentgen Equivalent Man."

Roentgen - Exposure is the intensity of the radiation to which an object is subjected and is measured in units of roentgen. It is a measure of the ionization produced in air by x-ray or gamma radiation.

Sedimentary Rocks - Rocks formed by the accumulation of sediment in water or from air.

Semi-solid - Having the qualities of both a solid and a liquid but being more closely related to a solid.

Sheetflow - The broad, relatively unconfined downslope movement of water across sloping terrain that results from . . . a channel that crosses a drainage divide . . . and overflow from the perched channel onto . . . plains of low topographic relief and poorly established drainage systems.

Slurries - A pumpable mixture of solids and liquids. A watery mixture of insoluble matter that results from some pollution control techniques.

Soil column - An in situ volume of soil down through which liquid wastes percolate from ponds, cribs, seepage basins or trenches.

Sump - A pit or tank that catches liquid run-off for drainage or disposal.

Titration - A method of measuring acidity or alkalinity. The determination of a constituent in a known volume of solution by the measured addition of a solution of known strength for completion of the reaction as signaled by observation of an end point.

Tuff - A rock formed of compacted volcanic fragments, generally smaller than four millimeters in diameter.

List of Technical Terms and Definitions (continued)

Tertiary Age - Of or relating to the time interval between the close of the Mesozoic era and the beginning of the Quaternary period, approximately 66.4 - 1.6 million years before present.

Vapor - A substance in the gaseous state which is considered condensable, e.g., the steam in a steam/air mixture is a condensable vapor. The same applies to a hydrocarbon/air mixture.

Water Table - The top of the saturation zone in which all rocks are saturated with water. The subsurface water that lies below the water table is called groundwater; that which lies between the water table and the earth's surface is called vadose water.

1.0 Introduction

This environmental assessment (EA) examines the potential impacts to the environment from treatment of low-level radioactive liquid and low-level mixed liquid and semi-solid wastes generated at the Nevada Test Site (NTS). The potential impacts of the proposed action and alternative actions are discussed herein in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended in Title 42 U.S.C. (4321), and the U.S. Department of Energy (DOE) policies and procedures set forth in Title 10 Code of Federal Regulations (CFR) Part 1021 and DOE Order 451.1, "NEPA Compliance Program."

The potential environmental impacts of the proposed action, construction and operation of a centralized liquid waste treatment facility, were addressed in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*. However, DOE is reevaluating the need for a centralized facility and is considering other alternative treatment options. This EA retains a centralized treatment facility as the proposed action but also considers other feasible alternatives.

1.2 Background

Hundreds of underground nuclear tests were conducted at the NTS from 1951 to 1992, resulting in the introduction of radionuclides into the subsurface environment including the groundwater. Previous groundwater sampling results indicated that the main contaminants include tritium and heavy metals. DOE/NV established the Underground Testing Area (UGTA) Operable Unit subproject to characterize and possibly remediate groundwater impacted by underground nuclear testing at the NTS. The UGTA subproject includes the drilling and installation of numerous deep groundwater wells to acquire data to meet the above-mentioned objectives. This project and its potential impacts on the environment are described in the *Environmental Assessment for the Groundwater Characterization Project, Nevada Test Site (DOE/EA-0532)*. Contaminated effluent is expected to be generated during saturated-zone drilling, well development, aquifer testing, and monitoring. The total estimated volume of liquid waste generated from a single well is 14,790 m³ (3.9 million gal). Current plans include the construction of over 100 new wells during the life of the 30-year program, with approximately 3,785,000 liters (l) (1,000,000 gallons [gal]) of low-level liquid waste expected to be generated each year. In addition, it is possible that low-level mixed liquid waste would be generated but none is anticipated at this time. Wastes generated during UGTA project activities are expected to consist primarily of groundwater and drilling effluent. Thus far, characterization activities have been conducted on a very limited basis due to a lack of adequate treatment facilities for low-level radioactive liquid and low-level mixed liquid wastes.

Based on "Pilot Study Risk Assessment for Selected Problems at the NTS" (Daniels, 1993), the main radioactive constituents that may be expected to occur in the low-level and mixed wastes generated by the UGTA include tritium, Strontium-90, Cesium-137, Cerium-144, Uranium-234, Uranium-235, Uranium-238 and others. Of these radionuclides, tritium is considered most likely to occur as an airborne contaminant.

The average tritium concentration in drilling and well-development effluent is estimated to be 10,000,000 pCi/l (Raytheon Services Nevada (RSN), 1995). Low-level mixed wastes may consist of tritiated drilling mud and well-development effluent, with heavy metals comprised of any or all of the following: Barium, chromium, cadmium, lead, and silver. These heavy metals may be regulated as characteristic hazardous waste under 40 CFR Part 261 depending on their concentrations in the wastes.

In addition to wastes expected from the UGTA Operable Unit subproject, liquid wastes will be generated from the decontamination of equipment and clothing from ongoing and future operations at the NTS. The Decontamination Facility (DF) in Area 6 currently produces approximately 18,900 l (5,000 gal) per month of low-level liquid wastes. Approximately 75,600 l (20,000 gal) are held in Baker tanks for sampling, analysis, and a determination of disposal requirements. No low-level mixed wastes are generated at the DF.

1.3 Purpose and Need for Action

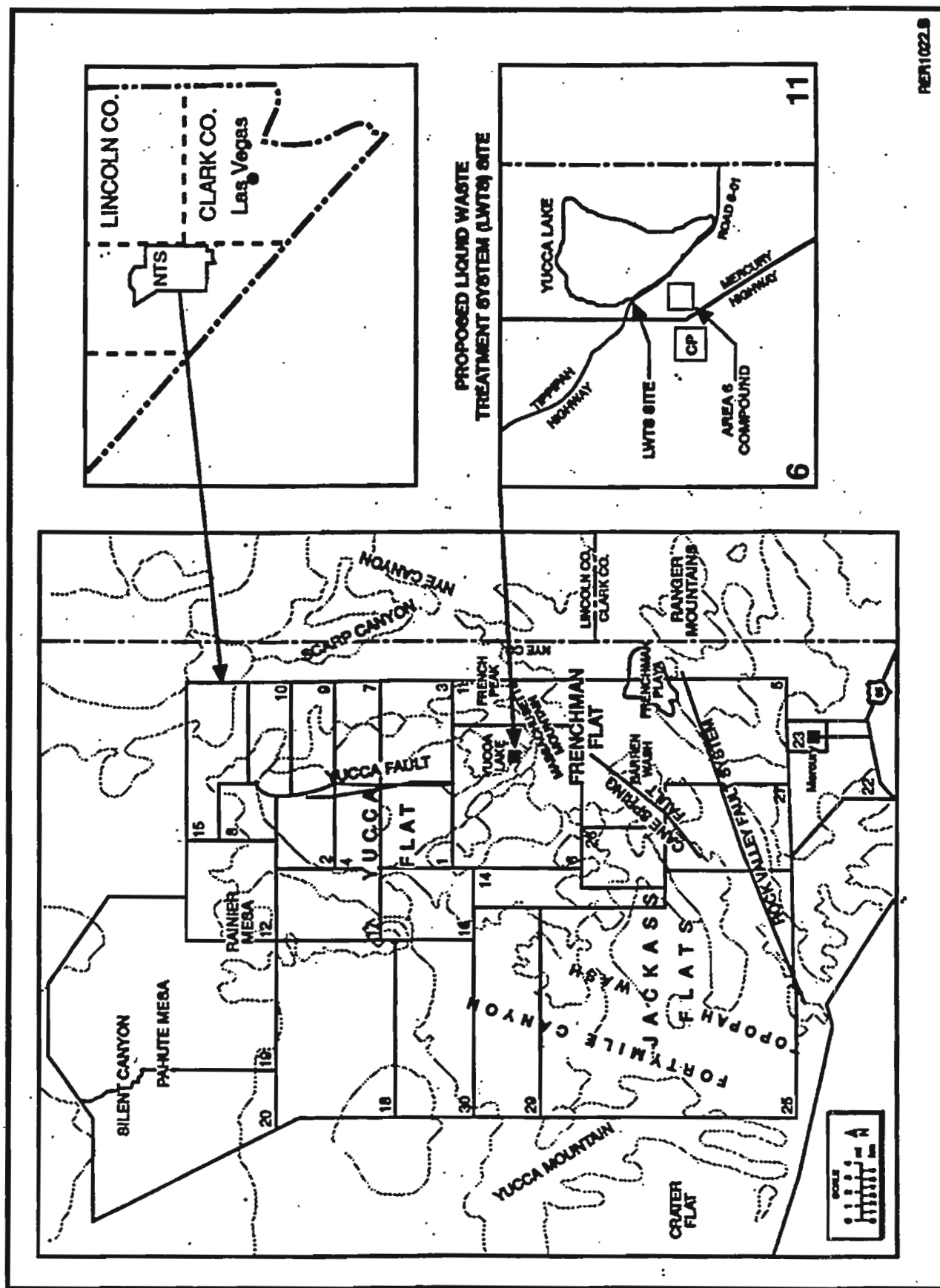
Under the Resource Conservation and Recovery Act (RCRA), low-level mixed liquid wastes may not be disposed in a landfill. Presently, there is no program at the NTS to safely dewater low-level radioactive liquids and low-level mixed wastes and package the waste sludges resulting from solids separation and evaporation. The DOE Nevada Operations Office (DOE/NV) needs to select a method of treatment and disposal for wastes from DOE/NV Environmental Management (EM) and defense programs. Without the capability of handling and treating these wastes, programs such as the UGTA subproject would need to be terminated.

2.0 Proposed Action and Alternatives

2.1 Proposed Action--Centralized Liquid Waste Treatment System

DOE/NV proposes to construct and operate a centralized Liquid Waste Treatment System (LWTS) to be located in Yucca Flat, on the west edge of Yucca Lake, in Area 6, NTS, Nye County, Nevada (Figure 1). The proposed LWTS would be located on a roughly triangular tract of land situated between Mercury Highway and the 6-05 Road south of the Area 6 gas station (Figure 2). Initially, the proposed LWTS would occupy approximately 12 acres; however, DOE would reserve a total of 38 acres for potential expansion of the facility.

The purpose of this facility would be to treat and prepare low-level radioactive and possibly low-level mixed-waste effluent for disposal at the NTS. Large volumes of both liquid drilling effluent and decontamination fluid would be transported to open, double-walled steel tanks. In accordance with Section 306 of Executive Order 12902, treatment would be accomplished through solar evaporation. Initially, the facility would be constructed to handle current estimated volumes of 3,785,000 l/yr [1,000,000 gal/yr] of waste effluent.



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Figure 1
Location Map of the Nevada Test Site
and the Area 6 Proposed Liquid Waste Treatment Site

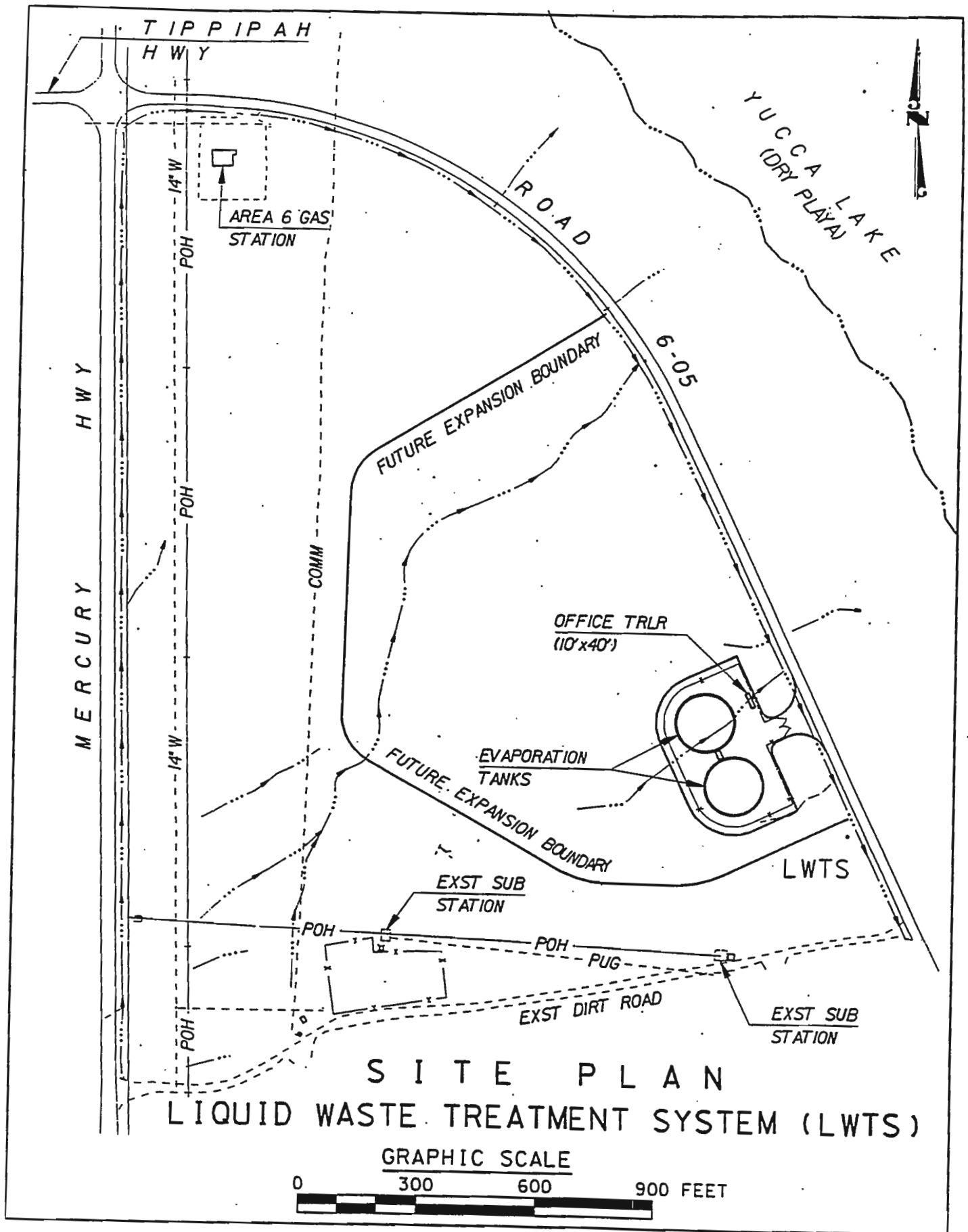


Figure 2
Diagram of Liquid Waste Treatment System

The initial phase of the LWTS would consist of two double-walled steel tanks, each with a capacity of 1,892,706 l (500,000 gal), a leak detection system, yard lights, a mobile home type trailer to house offices and monitoring equipment, control features, access, fencing, and stormwater protection. The double-walled steel tanks in the initial phase would be built to meet appropriate RCRA standards (40 CFR 264) for low-level mixed waste, should it become necessary to use one or both of the tanks for that type of waste.

In the event that remediation and associated decontamination activities increase, the LWTS could be expanded to handle greater volumes of liquid and drilling effluent and decontamination fluid. If required, the LWTS would ultimately be expanded to handle up to 15,141,648 l/yr (4,000,000 gal) per year. Tanks installed in subsequent phases of the project would be either double-walled or single-walled steel with a liner. The facility would become a permanent center for handling, treating, and packaging radioactively contaminated and possibly low-level mixed liquid wastes from DOE/NV EM and Defense Programs projects.

2.1.1 Construction of the LWTS

The site of the proposed LWTS is undisturbed. Preconstruction activities would include site grading and leveling.

Construction of the LWTS would require numerous construction workers over a period of several months. The estimated cost for building the facility would be \$2.1 million.

The LWTS would use aboveground, double-walled steel tanks. It is anticipated that both tanks would be used for treatment of low-level wastes. However, in the event that low-level mixed wastes were encountered, one of the tanks would be designated as a low-level mixed waste treatment tank. If it became necessary to treat low-level mixed waste, the portion of the site not bordered by the 6-05 Road would be surrounded by a flood protection channel designed to convey waters from a 25-yr, 6-hr storm to meet RCRA Title 40 CFR Part 264 standards and Nevada environmental regulations. Fences and guard rails would be maintained around the LWTS to prevent intrusion.

Two additional 189,270 l (30,000 gal) double-walled steel tanks with associated piping would be constructed immediately south of the Area 6 DF, which is approximately 2.4 kilometers [km] (1.5 miles [mi]) south of the proposed LWTS. The proposed location of the two tanks is disturbed, but would require grading prior to erecting the tanks. The tanks located near the Area 6 DF would be bordered on the southwest and southeast by a storm protection system which would extend from an existing channel that borders the DF on the southwest side. An access road would also be built. The approximate cost for erecting the two Area 6 DF tanks would be \$616,000.

2.1.2 Operation of the LWTS

Waste effluent would be delivered to the LWTS in tanker trucks from major NTS projects, including the UGTA Operable Unit and the Area 6 DF. Waste effluent would be pumped from a

tanker truck into one of the two 1,892,706-ℓ (500,000-gal) evaporation/receiving tanks. The waste would be characterized by the generator to determine whether it would be considered low-level radioactive or low-level mixed liquid waste prior to transport to the LWTS. If it became necessary to treat low-level mixed waste, one of the tanks would be emptied of low-level waste and used for the mixed waste. The two treatment tanks would be physically separated to avoid cross-contamination of waste streams. Each tank would be operated to ensure sufficient freeboard to prevent overtopping by wave or wind action, precipitation, or seismic activity. All valves in the tank system would be manually operated. In the event of an emergency, flow could be diverted from one tank to the other.

Operation of the facility would require five full-time workers plus occasional part-time support to run and maintain the plant, monitor the leak detection system, and monitor activities and equipment for radiological control of the facility. The annual cost to operate the LWTS would be approximately \$897,000. To ensure that the LWTS would be operated properly and equipment maintained, an Operations & Maintenance Plan would be developed. This Plan would enable personnel to manage the LWTS effectively and consistently.

Since the amount of solids is expected to be quite low (0.15 percent), the waste effluent would remain in the receiving/evaporation tanks for several years. The dried sludge would be removed and placed in appropriate U.S. Department of Transportation-approved containers. The containers would then be placed on the appropriate staging area. Low-level sludges would be disposed in either the Area 3 or Area 5 Radioactive Waste Management Site (RWMS) at the NTS. Mixed waste sludges would be treated, disposed of or stored at a RCRA-permitted facility.

The only chemicals used in the facility could be cement for stabilizing residual solids and slurries of mixed wastes, and possibly an algicide for preventing algae growth in the evaporation tanks.

Decontamination wastewaters at the Area 6 DF would be characterized and temporarily stored in one of two 189,270 ℓ (30,000-gal) capacity double-walled steel holding tanks that would be erected south of the Area 6 DF. Wastewater from the tanks that was characterized to be radioactive above regulatory limits would be transferred to tanker trucks and sent to the LWTS for treatment. If radioactivity was detected to be below regulatory limits, the waste effluent would be released into the Yucca Lake sewer system. No low-level mixed waste is expected to be generated at the Area 6 DF.

2.1.3 Closure of the LWTS

The LWTS would be scheduled for closure in the projected year 2024. All equipment would be characterized, decontaminated, and disposed of at the appropriate NTS disposal site. Upon closure of the LWTS, the site would be restored and the land would either be allowed to revegetate naturally or would undergo reclamation. The impacts of construction and use of the site would be mitigated as much as possible.

2.2 LWTS for Low-Level Mixed Waste Alternative

Under this alternative, the majority of low-level radioactive liquid wastes generated through UGTA and other projects would be treated and disposed of in situ in lined sumps or infiltration basins. Construction of the LWTS would be limited to a single tank for treatment of low-level mixed wastes. Section 2.3.1 describes the types of waste produced and their disposition. Section 2.3.2 discusses the criteria used to determine the disposition of the wastes. Excavation and construction activities required at each well site are described in the *Environmental Assessment for the Groundwater Characterization Project* and are summarized and included where applicable in this EA.

2.2.1 Description of Action

One or more lined sumps, each surrounded by a berm, would be used to contain fluids generated during drilling and initial well development operations. The average capacity of each sump would be 2000 m³ (527,380 gal). The number of sumps would depend on the well depth, types and quantities of effluent encountered, and any site constraints. Fluids would be transferred between sumps via transfer lines or hoses placed on the ground surface. Separate discharge lines would be used to transfer effluent from the well to either the lined sumps or the infiltration basin.

Disposition of fluids produced through well-site activities is described in two UGTA documents: The *Underground Test Area Operable Unit Waste Management Plan* and the *Fluid Management Plan*. The remainder of Section 2.3.1 is derived from the information presented in these two UGTA documents.

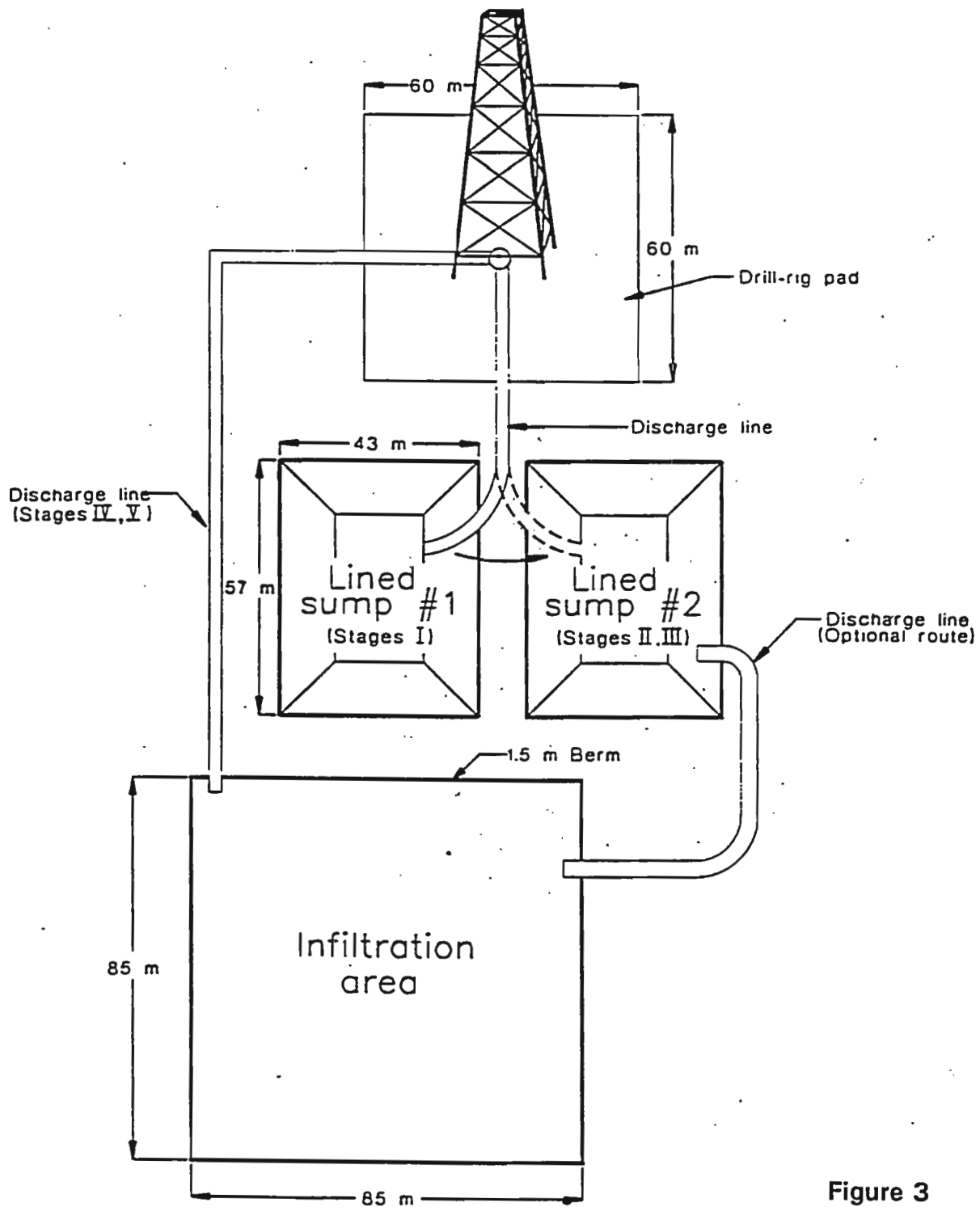
A generic layout of a well site (Figure 3) is shown in the *Fluid Management Plan*. The *Fluid Management Plan* describes the disposition of fluids for each stage of well development. The five stages of well development are listed below:

- Stage I: Vadose-Zone Drilling
- Stage II: Saturated-Zone Drilling
- Stage III: Initial Well Development
- Stage IV: Aquifer Testing
- Stage V: Well Completion and Final Development/Testing

Fluids produced during Stage I typically consist of water, bentonite and/or synthetic polymer solutions and soap. Fluids would initially be routed to a lined sump and allowed sufficient retention time for the settling of suspended solids. The fluids would then be routed to an infiltration basin and the remaining solids closed in place in the lined sump. The liners used in the sumps would consist of 40-mil tri-layer high density polyethylene (HDPE).

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Figure 3
Generic Diagram of
Project Drill Site

Source: DOE, 1994d

Stage II fluids include soap, makeup water, groundwater, and sometimes bentonite and/or synthetic polymer. Makeup water is either potable or non-potable process water used to mix drilling fluids or waters for downhole drilling. Stage III fluids consist of groundwater, residual cuttings and drilling fluids. Stage IV and V fluids mainly consist of groundwater. Fluids from Stages II through V would be transferred to a lined sump while awaiting characterization.

Low-level radioactive wastes could be generated by drilling into a contaminated aquifer. Contaminated solid wastes such as soil and drill cuttings would be placed in appropriate containers and disposed of at either the Area 3 or Area 5 RWMS. Contaminated liquid wastes would be managed in accordance with the criteria outlined below in Section 2.3.2. Based on these criteria, fluids could be routed to the ground surface, a constructed infiltration area, a lined sump, or managed per state of Nevada hazardous waste regulations. Low-level mixed wastes would be transferred to a tanker truck and transported to the LWTS.

Fluids generated through equipment decontamination would initially be routed to a lined sump and sampled and analyzed prior to discharge or disposal. Fluids from the decontamination of radioactively contaminated items would be placed in appropriate containers and transported to the Area 6 Decontamination Facility (DF). Decontamination of large equipment could result in the generation of several thousand liters of fluid from a single well site. At the Area 6 DF, decontamination wastewaters would be characterized and temporarily stored in one of two 189,000 l (50,000 gal) capacity single or double-walled steel holding tanks that would be erected south of the DF. Wastewater from the tanks that was characterized to be radioactive above regulatory limits would remain in one of the tanks and evaporate. Resulting solids would periodically be containerized and transferred to the Area 5 RWMS. If radioactivity was detected to be below regulatory limits, the waste effluent would be released into the Yucca Lake sewer system. No low-level mixed waste is expected to be generated or handled at the Area 6 DF. Existing Baker tanks would be retained at the Area 6 DF as a back-up and also for containment of laundry effluent.

It is not anticipated that hazardous wastes would be generated. Any hazardous wastes generated during project activities would be transferred to the Hazardous Waste Storage Pad in Area 5 and managed in accordance with state of Nevada hazardous waste criteria. Nonhazardous solid wastes not directly associated with drilling, including office and sampling supplies, drill-pipe plastic covers and other items, would be disposed of in an approved NTS sanitary landfill. Nonhazardous liquid wastes not directly associated with drilling, such as nonhazardous solvents, would be managed in accordance with applicable regulations.

Costs associated with this alternative include sump excavation, fencing, flagging, liners, piping, and labor. The cost of constructing a single lined sump, including labor, is approximately \$26,000. Assuming a typical drill site includes two single-lined sumps and an infiltration basin as shown in Figure 3, construction costs would be approximately \$72,000 per site.

2.2.2 Fluid Management Criteria

Criteria for determining the treatment and/or disposal of the fluids are based on the Nevada Drinking Water Standards (NDWS) (*Fluid Management Plan, 1995*). Parameters used for establishing the quality standards were based on process knowledge and included arsenic, barium, calcium, cadmium, chromium, lead, magnesium, mercury, nitrate-nitrite, potassium, selenium, sodium, silver, tritium, gross alpha, and gross beta. Treatment and disposition of fluids would be determined by levels of dissolved constituents, as shown below:

<5 x NDWS	= Route fluids to ground surface/infiltration area
5 to 10 x NDWS	= Route fluids to constructed infiltration area
10 to 100 x NDWS	= Route fluids to lined sump pending DOE/NV disposal criteria
≥ 100 x NDWS	= Manage in accordance with state of Nevada hazardous waste criteria

Tritium monitoring would be conducted during drilling to detect radioactive contamination in groundwater. The frequency of sampling would depend on tritium levels detected during previous sampling episodes. Disposition of fluids would be in accordance with the above criteria. Lead screening would be performed for uncharacterized fluids at least once during each eight-hour shift for fluids conveyed to the infiltration area. Rapid fluid characterization samples would be collected three times during well construction operations for analyses of RCRA metals, inorganics, and radiological constituents.

2.3 Well-site Treatment Alternative

For the well-site treatment alternative, the majority of fluids generated through UGTA and other projects would be treated and disposed of in situ in lined sumps or infiltration basins in the same manner described in Section 2.2.

It is not anticipated that mixed wastes would be generated during drilling activities. However, under this alternative, any mixed liquid wastes that were generated would be placed in appropriate containers and transported to the Area 5 Transuranic (TRU) mixed waste storage pad. Under a Mutual Consent Agreement between the NDEP and DOE/NV, mixed wastes may be retained at the TRU pad. Within nine months of generation of the waste, a plan for treatment and disposal would be developed and submitted to the NDEP for approval.

2.4 No Action Alternative

If no action were taken, the LWTS would not be constructed and methods would not be developed to treat and dispose of low-level radioactive liquid and low-level mixed liquid wastes. Without the capability of handling and treating these wastes, programs such as the UGTA subproject would need to be terminated. Only those EM and Defense Programs projects that are not expected to generate low-level radioactive liquid and low-level mixed-liquid wastes would be conducted.

This alternative would not meet the need to characterize the groundwater and to dispose of the

waste in accordance with state and federal regulations.

2.5 Alternative Actions Considered But Not Analyzed

An alternative that was considered but not selected for further evaluation was offsite disposal. Under this option, low-level radioactive waste could be treated and disposed of at the Area 3 or Area 5 RWMS. Low-level mixed waste could be shipped offsite but would not be accepted for disposal by any facility unless it was solidified. One facility which has the capability of low-level mixed-waste disposal is the Hanford facility in eastern Washington. Costs for building a treatment facility on the NTS and transporting the solidified waste to Hanford would be prohibitive.

3.0 Affected Environment

This section discusses the existing natural environment that could be affected by the proposed action and the alternative actions and past, current, and probable future land use. For purposes of comparison, portions of the discussion related to well-site treatment were summarized from the Environmental Assessment for the Groundwater Characterization Project and are included below.

3.1 Land Use

The NTS occupies 3,500 square kilometers [km] (1,350 square mi) of federally owned land in Nye County, Nevada and is located approximately 105 km (65 mi) northwest of Las Vegas. As shown in Figure 4, the NTS is mainly surrounded on the north and west by the Nellis Air Force Range (NAFR). Approximately 19 km (12 mi) of the western boundary and all of the southern boundary are adjacent to public land administered by the U.S. Bureau of Land Management (BLM). The western boundary of the Desert National Wildlife Range is approximately 3 km (2 mi) east of the NTS/NAFR boundary. Under a series of Public Land Orders, lands comprising the NTS have been withdrawn from public domain.

Since 1952, Area 6 has been used for national defense and energy-related purposes. The population of Area 6 is second only to the Mercury Base Camp in Area 23. Area 6 houses the administrative offices in support of field operations for the Lawrence Livermore and Los Alamos National Laboratories; waste management facilities, including sewage lagoons and decontamination facilities; a heavy equipment storage yard with machining and heavy duty repair shops; and, a gas station (Figure 5). The Area 6 gas station is approximately 183 meters [m] (600 feet [ft]) north of the proposed site location and is the nearest continuously occupied work area. Administrative offices for field operations and for the Control Point (CP) are located approximately 5 km (3 mi) north and 3.25 km (2 mi) south of the proposed LWTS site, respectively. The Mercury base camp is more than 30 km (19 mi) south of the proposed LWTS site. The nearest populated offsite locations are Indian Springs, approximately 40 km (25 mi) to the southeast and Alamo, approximately 80 km (50 mi) to the northeast.

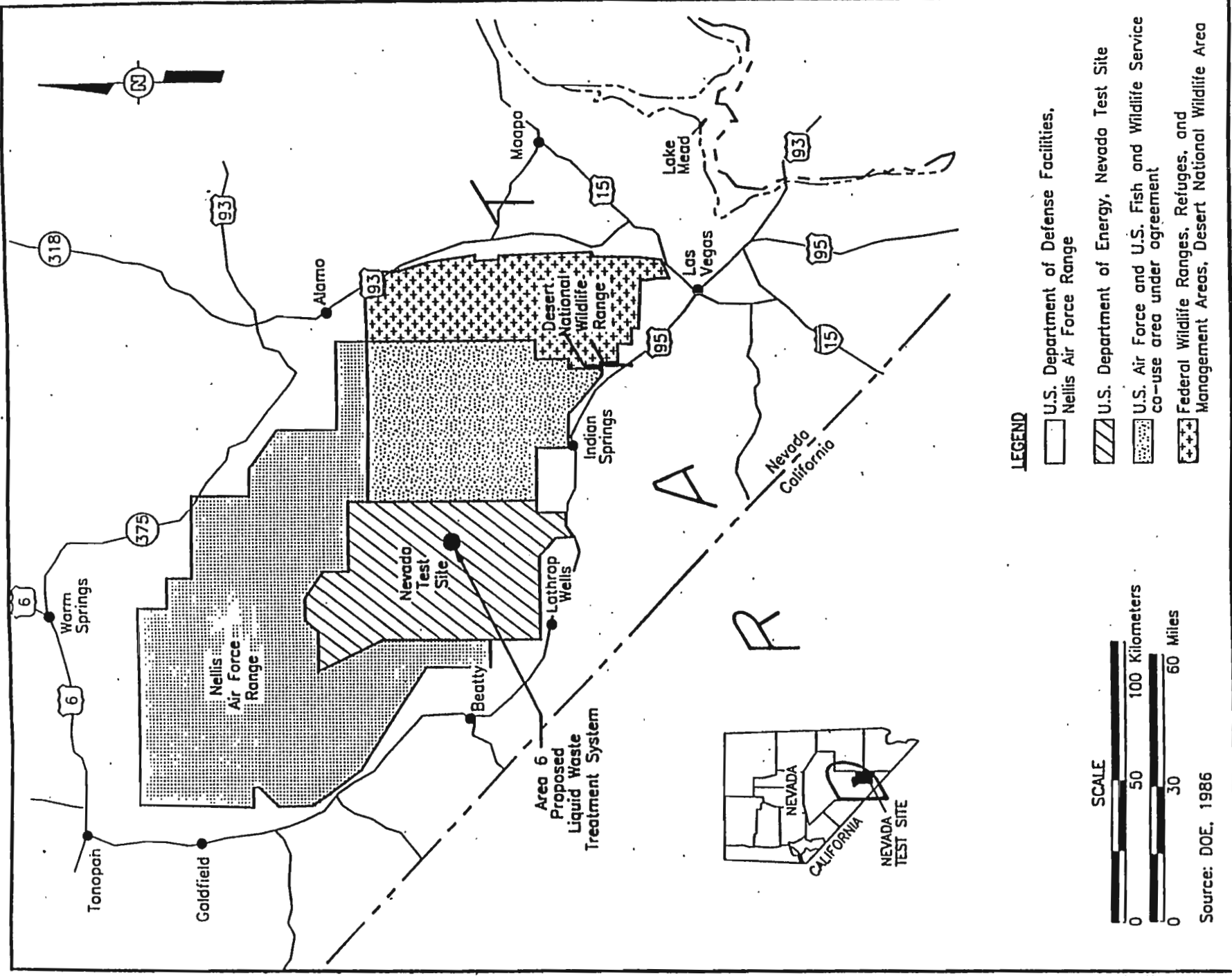


Figure 4
Land Use in the Vicinity of the NTS

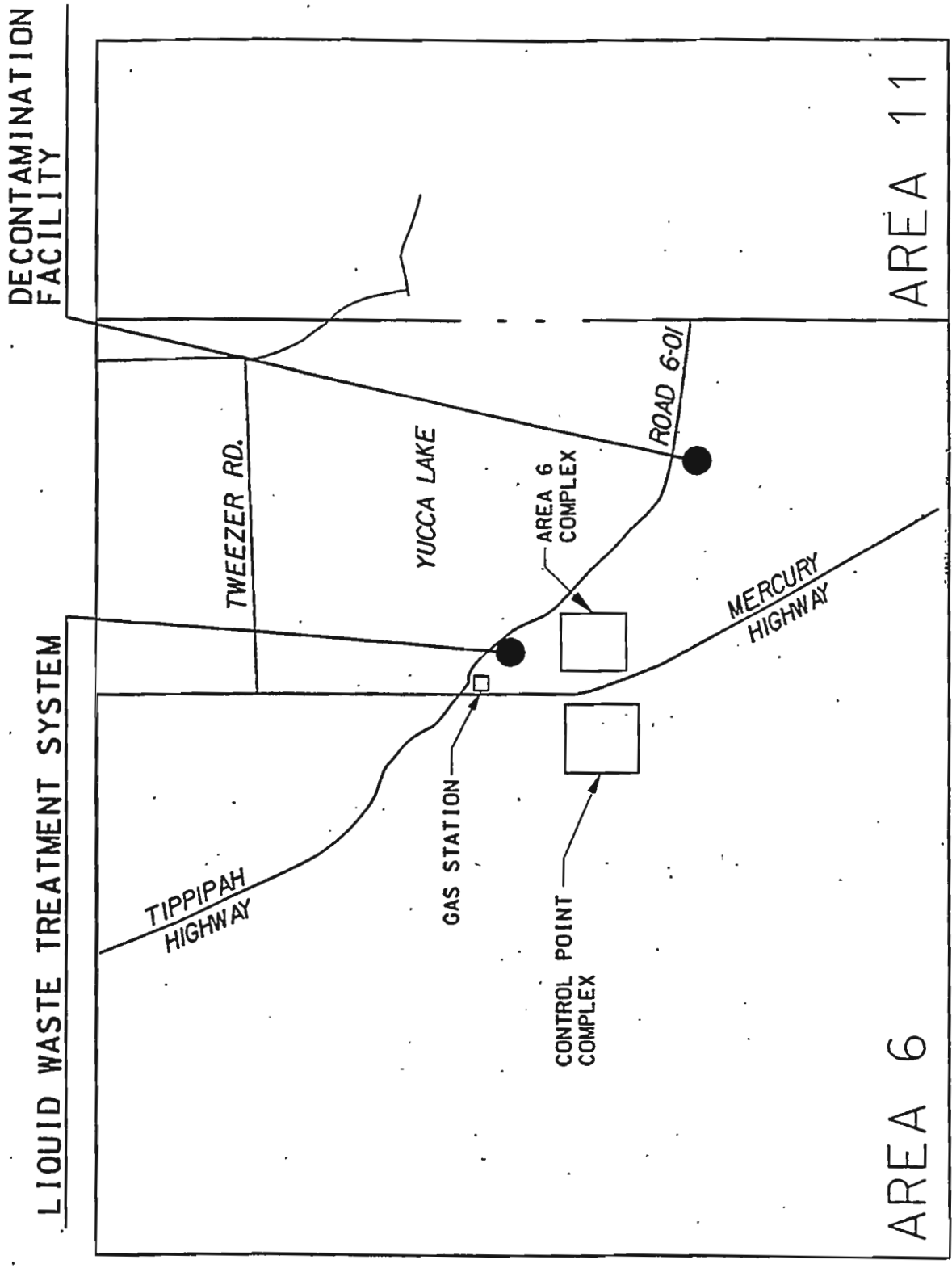


Figure 5
Diagram of the Area 6 Facilities

Underground nuclear tests conducted prior to 1992 were concentrated in Yucca Flat, Frenchman Flat, Rainier Mesa and Pahute Mesa. Potential drill sites for the UGTA subproject are located in each of these regions. Base camps previously established in the northern NTS near some of the drill sites are no longer populated and in some cases have been demolished. Approximately 40 personnel are stationed at the Area 5 RWMS, located in Frenchman Flat.

3.2 Topography, Geology, and Soils

The NTS is in the southern Great Basin region of the Basin and Range Physiographic Province. The Province is characterized by a series of north-south trending mountain ranges separated by broad alluvial valleys. The higher elevations on the NTS are on Pahute Mesa, approximately 2,205 m (7,235 ft) and Rainier Mesa, 2,345 m (7,649 ft) above sea level. The lowest elevations are in Frenchman Flat and Jackass Flat, both at approximately 910 meters (3,000 ft) above sea level (ERDA, 1977).

Yucca Flat is one of three principal valleys within the NTS. It is a north-south elongated closed basin, with Yucca Lake, a playa lake, at the southern end. Yucca Flat is approximately 100 km (80 mi) northwest of Las Vegas. It is 31 km (19 mi) long and 16 km (10 mi) wide; elevations range from 900 to 1,400 m (3,000 to 4,600 ft) (Desert Research Institute (DRI), 1988).

Three major rock units predominate at the NTS: complexly folded and faulted sedimentary rocks of the Paleozoic age, volcanic tuffs and lavas of the Tertiary age, and alluvium of late Tertiary and Quaternary age. In many places the Paleozoic sediments are overlain by the volcanic tuffs and lavas. The alluvium was derived from erosion of the nearby hills composed of Tertiary and Paleozoic rocks (Energy Research and Development Administration (ERDA), 1977). A discussion of the hydrogeology as it relates to the proposed LWTS is presented in Section 3.4.2.

The NTS soils are generally alkaline (pH 8 to 9) and tend to be well drained except through the hardpan where infiltration is very slow. They have a low moisture content of 3 to 9 percent (DOE, 1988a). Deep soil-water movement¹ is possible in areas where the surface is highly permeable (e.g., mesa tops, fractured bedrock surface, and wash bottoms). Boring logs from a 1990 exploratory borehole program indicate that the soil in the vicinity of the proposed location is a brown, silty clay with the amount of pebbles/gravel increasing in the zone from 6 to 20 m (20 to 70 ft) below ground surface (Reynolds Electrical & Engineering Co., Inc. (REECO), 1991).

3.3 Climate

The climate of the NTS is typical of a high desert basin, exhibiting low precipitation and low relative humidity. Annual precipitation in the Yucca Lake basin is generally less than 15 centimeters [cm] (6 inches [in.]) with the majority occurring during the winter months. The higher elevations are subject to more precipitation than the lower elevations, with the higher elevations

¹Below the depth of active evaporation and transpiration.

averaging 30 cm. (12 in) annually (DOE, 1993).

Typical temperatures range from -7 to 10 degrees Celsius ($^{\circ}\text{C}$) (20 to 50 degrees Fahrenheit [$^{\circ}\text{F}$]) during the winter and 16 to 38 $^{\circ}\text{C}$ (60 to 100 $^{\circ}\text{F}$) during the summer (RSN, 1994c).

Wind patterns at the NTS are influenced by the movement of major air-pressure systems, movements due to regional topography, and localized effects due to terrain (Quiring, 1968). Southerly winds predominate in the summer and northerly winds are more common in the winter. The wind direction also varies with the time of day, with southerly winds occurring during the day and northerly winds at night (ERDA, 1977). Wind speeds at the NTS are generally strong in the spring, with averages of 9 m/second (20 mi/hour) during spring afternoons, and mild in the fall. Gusts may occur throughout the year, usually in conjunction with late summer thunderstorms.

3.4 Water Resources

3.4.1 Surface Water

The direction and flow of surface water on the NTS is controlled by topography. There are eleven major drainages within the NTS. Five of these discharge west to the Amargosa River and south to the Amargosa Desert. The other six drainages discharge to valley bottom playas, including Yucca Flat and Frenchman Flat. Flow of surface water generally occurs from occasional flash floods or from spring flow (DOE, 1993).

The proposed LWTS would be located in southern Yucca Flat on the west edge of Yucca Lake. Although Yucca Lake does not meet the federal definition of a surface water, it is considered a water of the state of Nevada since the state's definition includes dry lakes or playas (van Drielen, 1994).

Yucca Flat is a closed basin. Surface water, when it exists, is not used for human consumption. There are no well-defined drainage channels in the vicinity of the proposed site. However, overland flow across the proposed site to Yucca Lake can occur from the adjacent uplands to the west during rare but severe storms or long-duration precipitation events. Because the playa is relatively impervious, water will collect on and then evaporate from the playa surface for periods of time ranging from several hours to a few months, depending on the size of the rain event and the time of year; conversely, most of the playa may be free of surface water for several years. Net water movement at the playa is upward since the evaporation rate exceeds the percolation rate (ERDA, 1977; O'Farrell and Emery, 1976, as cited in DOE, 1994c).

3.4.2 Hydrogeology and Groundwater

The occurrence and movement of groundwater at the NTS is controlled by the geologic formations discussed in Section 3.2 and the hydrogeologic units that are present in each formation. Groundwater may occur in local perched systems above the regional water table and in broad regional flow systems that flow generally southward beneath the NTS.

In general, the hydrogeologic units under Yucca Flat and the proposed Area 6 LWTS consist of unsaturated and saturated portions of the valley-fill aquifer that overlies a series of tuff volcanic aquifer and confining units, which in turn overlie the upper clastic confining unit and regional lower carbonate aquifer (Figure 6). The volcanic and carbonate rocks dip westward beneath Yucca Flat and are bounded on the west by the Topgallant fault. The thickest part of the valley-fill aquifer is just north of Yucca Lake; it thins to the west and south towards the proposed site so that, in the project area, the depth to the lower carbonate aquifer ranges from 910 to 1,520 m (3,000 to 5,000 ft) below ground surface (Drellack and McCall, 1994).

The valley-fill aquifer is comprised of alluvium which is variably cemented and consists of moderately sorted deposits of gravel and sand that show high interstitial porosity and permeability and that transmit water efficiently. In the southern part of Yucca Flat, a thick and continuous playa occurs within the upper 61 to 213 m (200 to 700 ft) of the valley-fill aquifer. The playa thickness under the site is estimated to be 60 to 90 m (200 to 300 ft) (Drellack and McCall, 1994); the playa thickens to the south and east where it is 150 to 210 m (500 to 700 ft) thick below the western center portion of Yucca Lake (Figure 6). Playa lakebeds consist of siltstone and claystone deposits that are much less permeable than the coarser alluvium.

The water table across southern Yucca Flat has a very low gradient sloping to the south. The depth to the water table is shallowest in the center of the valley and increases to the west and east towards the valley edge due to increasing surface elevation. In southern Yucca Flat, the depth to the water table ranges from approximately 450 m (1,480 ft) to 475 m (1,560 ft) depending on surface elevation. Because of the westward dipping beds and the asymmetric shape of the alluvial-fill deposits, the water table lies within the valley-fill aquifer under the site and may have a saturated thickness of up to 600 m (2,000 ft). The water table beneath Ranier Mesa is in the carbonate aquifer at a depth of nearly 1,100 (3,609 ft) below the summit. Perched water also occurs in fracture zones of the overlying volcanics.

Four major areas of groundwater discharge occur downgradient of the NTS, including the Oasis Valley and Ash Meadows discharge areas in Nevada, and the Alkali Flat and Death Valley discharge areas in California (Winograd and Thordarson, 1975). The Yucca Flat area is encompassed by the Ash Meadows sub-basin, while Ranier Mesa lies at or near the western boundary of the subbasin. The lower carbonate aquifer is the principal aquifer in the Ash Meadow subbasin while the valley-fill and volcanic aquifers are locally important in the Yucca Flat area. Groundwater from the Ash Meadows subbasin discharges to the surface at Ash Meadows from a line of springs about 16 km (10 mi) long. This spring line is located about 64 km (40 mi) downgradient of Yucca Flat (Winograd and Thordarson, 1975). The rate of groundwater flow through the subbasin is highly variable and estimates vary over orders of magnitude, ranging from less than 0.01 ft/day to more than 100 ft/day for the different hydrogeologic units along various flow paths (O'Neill et al., 1993).

Groundwater is withdrawn from a few wells located throughout the subbasin. The subbasin provides about 50 percent of the water used to support operations at the NTS; some of this water is produced from nearby Water Wells C and C1, which are located at the southern edge of Yucca

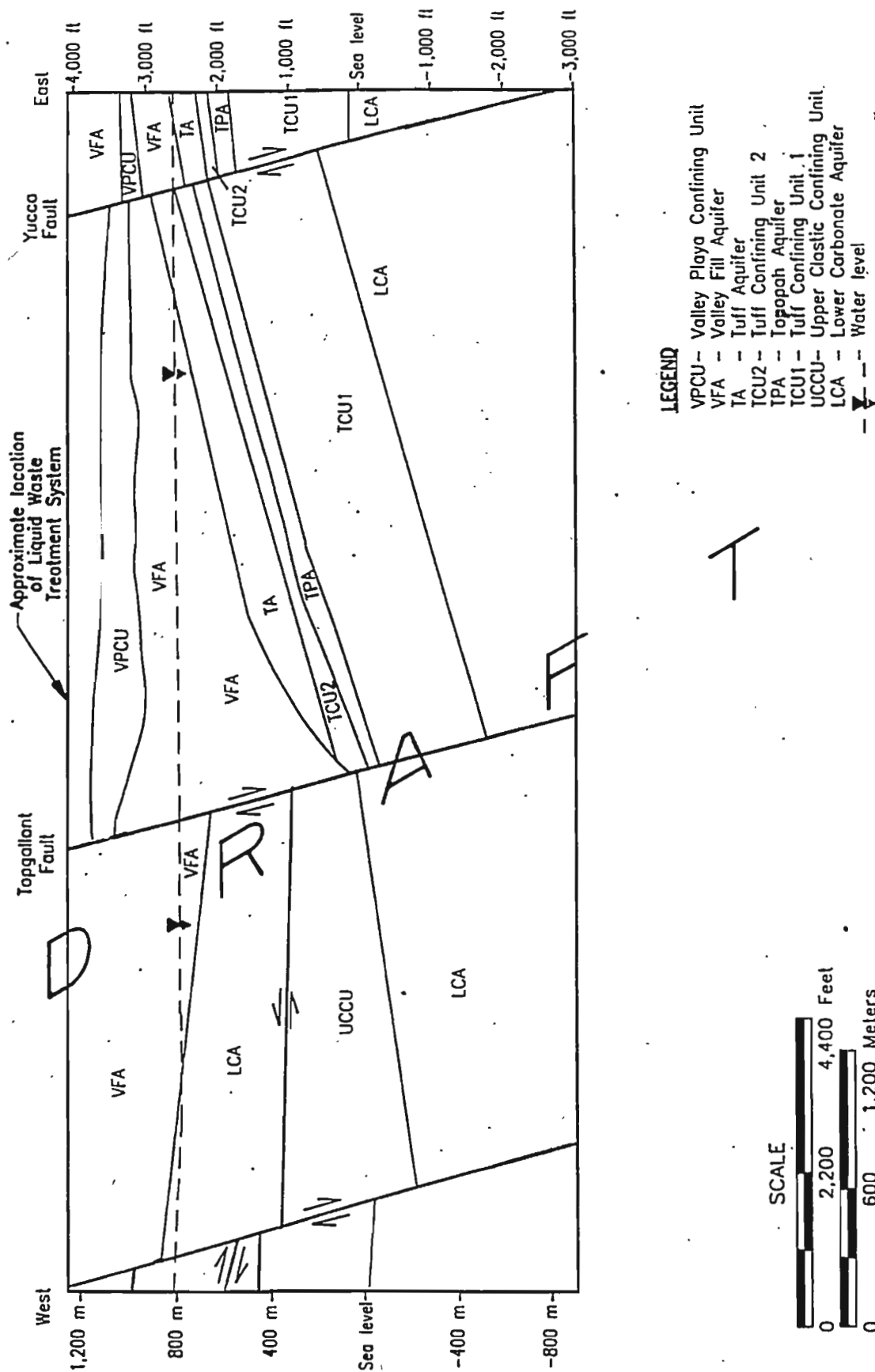


Figure 6
Hydrogeologic Units under Yucca Flat
and the Proposed Liquid Waste Treatment System

Source: Modified from McCall, R.L. and Winograd, I.J., and Thordarson, W.

Lake. Downgradient of the NTS, a few wells withdraw water primarily for domestic purposes.

3.5 Floodplains and Wetlands

Floodplains and wetlands are environmentally sensitive resources, as listed in Title 10 CFR Part 1021 B(4)(iii). No wetlands exist at the proposed site location.

The site of the proposed Area 6 LWTS is adjacent to the southwestern edge of Yucca Lake, a playa lake located at the topographic low of Yucca Flat basin. The watershed area for Yucca Flat is approximately 300 square mi, encompassing parts of the NTS and parts of the NAFR to the north and east in both Nye and Lincoln counties. Only the 1.7-square mi drainage basin to the west of the proposed site and the associated alluvial fans directly impact the proposed LWTS. A flood assessment was performed for DOE by RSN (1994a) to evaluate the occurrence of 25-year, 24-hour; 100-year, 6-hour; and 500-year, 6-hour floods on and near the LWTS. It was determined during the assessment that the proposed site is not located within any regulatory flood hazard zone caused by potential flooding of alluvial fans, sheetflow, or the rising water surface elevation of Yucca Lake. A discussion of the flood assessment can be found in Section 7.3, Natural Catastrophes.

To date, flood hazards have not been identified for the higher elevations in which the majority of UGTA wells would be located. Factors which would affect runoff potential include rainfall, snowmelt and frozen ground conditions, depending on the season.

3.6 Air Quality

Except for fugitive air emissions of particulate matter, the NTS has no significant known sources of pollutants for which air quality standards exist. Air quality at the NTS meets the applicable state and federal standards. In a study conducted in 1990, ambient monitoring stations were erected in Areas 6, 12, and 23. National Ambient Air Quality Standards (NAAQS) parameters that were monitored included nitrogen dioxide, sulphur dioxide, carbon monoxide, and particulate matter less than 10 microns in diameter. Maximum concentrations measured at the NTS were well below the limits set by the NAAQS. Instances of high concentrations of particulate matter in the air are common and are proportional to the wind strength/velocity and to the number of land disturbances in the area (Engineering-Science, 1990).

In addition to the NAAQS, emissions from hazardous and radioactive sources are regulated under Section 112 of the Clean Air Act by the National Emissions Standards for Hazardous Air Pollutants (NESHAPS). At present, airborne toxic or hazardous substances on the NTS, excluding radionuclides, do not exceed background amounts specified by the NAC. Nevada regulations (NAC 445B.339) define a substance as hazardous if it is included on the federal list of hazardous air pollutants appearing in 42 U.S.C. Sec. 7412(b).

Radioactivity measurements have been made using gross beta analysis of air samples from approximately 47 locations around the NTS. The site average for the 47 locations in 1985 was 1.7

x 10^{-14} microCuries/cc, which is considered normal background for the NTS (DOE, 1993).

In 1985 the average dose rate at the NTS stations was 100 to 160 mrem/yr, which is approximately 2% of the prospective annual limit for whole-body occupational exposure of 5 rems per year, as set forth by the National Council on Radiation Protection (DOE, 1993):

3.7 Biological Resources

In September 1994, a preliminary site assessment for biological and ecological resources was conducted for DOE by EG&G at the proposed LWTS site to identify any environmentally sensitive resources. The survey consisted of a 100-percent coverage of the staked project area and a 20 m (12.5 ft) wide buffer area. All sensitive plant habitats located during the survey, if found, were flagged in the field. The results of the survey were documented in a report (EG&G, 1994) that included map locations and recommendations for protection.

Preactivity surveys would be conducted at each of the well site treatment areas prior to any excavation or construction activities.

3.7.1 Vegetation

The NTS is in the transition zone between the Mojave Desert and the Great Basin Desert (Allred, et al., 1963; O'Farrell and Emery, 1976, as cited in DOE, 1994c). As a result, vegetation associations of the Great Basin are often found in cooler, high-elevation areas above 1,494 m (4,900 ft) while those characteristic of the Mojave Desert usually occur at lower elevations below 1,189 m (3,900 ft). Mid-elevations often support a mixture of vegetation types.

Vegetation has been described and classified by Beatley (1976). Vegetation found in the higher elevations on the NTS includes pinyon pine (*Pinus monophylla*), juniper (*Juniperus osteosperma*), and Big sagebrush (*Artemisia tridentata*). Intermediate elevations are characterized by blackbrush (*Coleogyne ramosissima*), and shadscale (*Atriplex confertifolia*). The lower elevations of the Mojave Desert are dominated by creosote bush (*Larrea tridentata*), bursage, (*Ambrosia dumosa*), and desert thorn (*Lycium andersonii*) and (*Lycium pallidum*).

Over 1,000 plant species have been collected from the NTS and vicinity. There are no known plant species in the Yucca Flat area that have been listed as threatened or endangered under the Endangered Species Act; however, species that are protected from commercial exploitation by the state of Nevada do occur in the area. These include cacti (members of the Cactaceae family) and the Joshua tree (*Yucca brevifolia*). Various species of cacti and approximately 400 to 500 Joshua trees were observed within the boundaries of the proposed LWTS site during the 1994 survey. No other species of concern were observed during the survey.

Beatley's milk-vetch (*Astragalus beatleyae*), is classified by the state of Nevada as a critically endangered species. It occurs on volcanic flat rock areas in scattered locations on Pahute Mesa (Blomquist et al., 1992). In 1996, the U.S. Fish and Wildlife Service (FWS) revised the current

candidate list for plants and animals. None of the former 12 candidate plant species potentially found on the NTS were included in the new list.

3.7.2 Wildlife

The animal species found on the NTS, like the vegetation, represent a mixture of species from both the Mojave and Great Basin Deserts (O'Farrell, T.P. and L.A. Emery, 1976).

There are no indigenous fish on the NTS. Reptiles of the NTS include the desert tortoise, lizards, and snakes. Seventeen species of snakes are known to inhabit the NTS. The most common species is the western shovel-nosed snake (*Chionactis occipitalis*). The most abundant lizard species include the side blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*) and desert spiny lizard (*Sceloporus magister*). The desert tortoise (*Gopherus agassizii*) is listed as a threatened species in Title 50 CFR Part 17.11 and has been listed by the state of Nevada as protected and rare (Nevada Administrative Code (NAC) §503.080). The proposed location for the LWTS is north of the known range of the desert tortoise (Rautenstrauch, et al, 1994). In addition, no tortoises or their sign were found by the 1994 survey of the proposed project site (EG&G, 1994).

Bird species that reside at the NTS year-round include raptors (hawks, owls, and eagles), game birds (Gambel's quail and chukar), woodpeckers and perching or song birds. There are no known birds regularly found in the NTS that are currently listed as threatened or endangered under the Endangered Species Act of 1973. A few sightings of the endangered American peregrine falcon (*Falco peregrinus anatum*) in the vicinity of the Yucca Flat probably involved transient individuals (O'Farrell and Emery, 1976, as cited in DOE, 1994c) although these and other species may pass through Yucca Flat during the spring and fall migrations. Migrating species use water sources as temporary refuge and for foraging and rest during the spring and fall migrations. Four species of concern that may occur within a 5-km radius of the proposed location of the LWTS and that are protected by the Migratory Bird Treaty Act include the Golden eagle (*Aquila chrysaetos*), the Ferruginous hawk (*Buteo regalis*), the American peregrine falcon and the Loggerhead shrike (*Lanius ludovicianus*) (EG&G, 1994). Additionally, the western burrowing owl (*Speotyto cunicularia*) a state protected species may occur within a 5-km radius of the proposed location of the LWTS.

There are approximately 50 species of mammals that have been reported to occur on the NTS. Almost half of all these species are rodents, including kangaroo rats (*Dipodomys* spp.), and various species of mice, gophers and ground squirrels. Other common mammals include the black-tailed jackrabbit (*Lepus californicus*) and coyotes (*Canis latrans*). Mule deer (*Odocoileus hemionus*) and wild horses (*Equus caballus*) inhabit the high mesas except during winter. Burros (*Equus asinus*) and pronghorn (*Antilocarpa americana*) have been seen in the lower portions of the NTS. There are no known mammals on the NTS that are currently listed as threatened or endangered under the Endangered Species Act of 1973. Species of concern that are known to occur or may occur within a 5-km radius of the proposed site locations for the LWTS and which are protected under state of Nevada regulations (NAC §503.020-.104) include the bobcat (*Lynx rufus*), the kit

fox (*Vulpes velox macrotis*), and the desert cottontail (*Sylvilagus audubonii*). The preliminary site assessment reported that desert cottontails were observed at the proposed and alternate site locations. No other species of concern, their sign, or their habitat were found.

3.8 Cultural Resources

Human occupation of the NTS and its environs extends back to about 10,000 B.C. A number of aboriginal hunting and gathering cultures were present during this long prehistoric period. When the first European settlers entered the area in 1849, it was occupied by the Paiute Indians. From about 1849 until the establishment of the NTS, the land was mainly used for livestock grazing and mining (ERDA, 1977, as cited in DOE, 1994c).

Investigations of archaeological and historical features of the NTS, largely conducted by Worman in the 1960s, have resulted in the identification of numerous archaeological sites, and several locations have historical interest. These sites have been recorded in the Site Record File of the Nevada State Museum. Both historic and prehistoric sites on the NTS tend to be located near springs, in canyons, and at or near the bases of mountains. The larger valleys show little sign of early human occupation.

At the direction of DOE, in September 1994, Desert Research Institute conducted a cultural resources inventory encompassing the area of potential effect (APE) of the proposed undertaking. The purpose of the inventory was to identify any cultural resources within the APE. One historic site (26NY8789) and one prehistoric site (26NY8790) were discovered by the inventory. No other cultural resources are known to exist within the APE. Based on the criteria for evaluation at 36 CFR 60.4, DOE determined and the Nevada State Historic Preservation Officer (SHPO) concurred that neither site is eligible for listing on the National Register of Historic Places.

Cultural resource inventories would be conducted prior to well site drilling, construction, or excavation activities. As discussed in the *Environmental Assessment for the Groundwater Characterization Project*, projects within boundaries specified in the Long Range Study Plan which could affect sample study areas would be altered to avoid them if necessary.

4.0 Environmental Effects

Potential effects to the environment from the proposed action and the alternative actions are described below. The impacts identified for action alternatives are based upon development of the full 38-acre site, although development of the LWTS would be phased to reduce environmental impacts to those that were absolutely necessary. Effects from the alternative action of retaining low-level liquid wastes at UGTA sites have been summarized when possible from the *Environmental Assessment for the Groundwater Characterization Project, Nevada Test Site* (DOE/EA-0532).

4.1 Topography, Geology, and Soils

Minor changes to site topography would result from leveling and excavation operations associated with construction of pads and tanks for the LWTS. The geology of the proposed LWTS site would not be affected by construction or operation of this facility. During operation of the LWTS and DF, soils could be directly affected by failure of the storage tanks. The facility would have design features to prevent pollutant migration to the soil, as discussed in Section 2.1.1.

Surface disturbances for each project well site would vary from only a few acres to approximately 19 acres per site, according to the number of sumps and whether access roads would need to be widened or built. Construction of lined sumps and infiltration basins associated with retention of low-level liquid wastes at project drill sites would result in minor changes to site topography. Soils could be affected by leakage from the sumps or basin. Sumps would be lined to prevent leakage of low-level radioactive and low-level mixed wastes. If only the mixed waste portion of the LWTS was built, an area of approximately ten acres would be disturbed, compared with a disturbance of 38 acres for the entire LWTS. Effects to the geology and soil are similar to those discussed in the previous paragraph.

Under the no action alternative, topography, geology, and soils would not be affected.

4.2 Climate

The climate would not be affected as a result of the proposed action or the alternative actions.

4.3 Water Resources

4.3.1 Surface Water

Direct effects to surface water by the proposed action would not be likely, since there are no perennial surface waters on the NTS and the probability of flash flooding is very low. Effects to the LWTS and DF tanks by surface water are discussed under Section 7.0, Accident Scenarios.

Any drainage from within the facility would be routed to prevent flow to the playa. All accumulated liquids would be handled within the system and would be removed within 24 hours of the rainfall event. Surface water would be protected from surface spills, as described in Section 4.1.

Surface water could be affected by the alternative action of retaining low-level wastes in sumps or basins if flood flow entered the sumps or basins. Berms would surround the sumps or basins to minimize the chances of this happening. Effects from constructing a mixed waste portion of the LWTS would be similar to those described in the previous paragraph.

Under the no action alternative, there would be no effects to the surface water.

4.3.2 Groundwater

Because the proposed site of the LWTS and the DF tanks is underlain by thick impervious playa deposits, groundwater resources would not be affected by the downward migration of a release; however, this does not preclude utilizing prudent controls to prevent a release to the near-surface soils.

Groundwater would not be affected by retention of low-level wastes in lined sumps. Wastewater routed to a ground surface/infiltration area or a constructed infiltration basin would meet parameters relative to Nevada Drinking Water Standards (DOE, 1994d). Effects from construction of a mixed waste portion of the LWTS are similar to those described in the previous paragraph.

Groundwater would not be affected if the no action alternative were chosen.

4.4 Floodplains and Wetlands

As stated previously, there are no wetlands on the NTS and, therefore, no effects to wetlands. Floodplains could be indirectly affected by floodwaters coming in contact with waste effluent at the LWTS or sumps located at project drill sites. Flood assessments would be conducted for project drill sites such as those located in Frenchman Flat. Construction of a LWTS facility or project drill sites could slightly decrease the capacity of the floodplains but would not increase the potential for flooding outside of the normal floodplain. Mitigating measures would be similar to those described in Section 4.1.

Under the no action alternative, there would be no effects to floodplains.

4.5 Air Quality

Particulate emissions would be generated during construction of the LWTS and during solidification of the low-level mixed waste. During construction and operation of the proposed LWTS, diesel emissions and dust would be generated by trucks hauling construction materials, water, and waste effluent. Effects to the air quality from particulate emissions would be minor. If only the mixed waste portion of the LWTS were built, particulate emissions would be less than if the entire facility were constructed. Particulate emissions would be generated through excavation and construction of sumps at UGTA drill sites for both the LWTS mixed waste and well-site treatment alternatives. Amounts of particulate emissions generated during these activities would vary according to the number of sumps needed at each well site and the extent of road grading or construction activities. Particulate emissions would be minimized by wetting soil during construction activities.

Emissions from the waste effluent being held and then treated at the LWTS would be regulated under NESHAPS (40 CFR Part 61). The only NESHAPS-regulated substance which would be expected to be released is tritium in the form of tritiated water vapor. An analysis of the potential release of this tritium is discussed in the *Hazard Assessment Report for Liquid Waste Treatment*

System (1995). The results of this analysis are discussed in Appendix A and summarized below.

Offsite exposure rates to tritium must meet the NESHAPS criteria of 10 mrem/yr. Calculations to determine compliance with the NESHAPS criteria were performed using the EPA-approved computer model, CAP88-PC. The results indicate that it would take a release of tritiated water vapor of 2.5×10^6 Ci/yr for an individual to meet the 10 mrem/yr limit. The total volume of liquid waste which would need to be evaporated to reach this limit would be approximately 6×10^{10} gal/yr. Since the total amount of low-level radioactive liquid and low-level mixed waste to be received per year is estimated at 2.3×10^6 gal, exposure to the offsite population would be minimal.

Dose rates to NTS workers are calculated using a Derived Air Concentration (DAC) limit for tritiated water vapor which was obtained from 10 CFR Part 835, Occupational Radiation Protection. Calculations were performed for workers at the Area 6 gas station and for LWTS workers. The maximum airborne tritium concentration calculated for the LWTS would be a factor of 2.5×10^{-2} below the DAC value. The maximum concentration at the gas station would be a factor of 10^{-4} below the allowed DAC.

The total quantity of tritium at the LWTS would be controlled by maintaining an inventory. Under DOE Order 5480.2B the maximum amount of tritium that may be present at a site is limited to 1,000 Ci. The volume of waste and concentrations of tritium for each shipment would be used to determine quantities that could be accepted in order to maintain the 1,000 Ci limit. Exceeding this limit would lead to reclassification of the LWTS as a nonreactor nuclear facility.

If only the mixed waste portion of the LWTS were built, emissions from the tritiated water vapor of the individual drill sites would be less than those projected for the LWTS in the previous discussion since the capacity of the sumps is much smaller than the holding tanks at the LWTS. Wastes from the sumps and basins at each site would be tracked and inventoried to comply with DOE Order 5480.2B.

Assuming that a typical well site contains two sumps, each with a capacity of $2,000 \text{ m}^3$ (527,380 gal) the total volume which could be evaporated in one year from a single well would be approximately $4,000 \text{ m}^3$ (1,054,760 gal). This figure is much less than the 6×10^{10} gal/yr that would need to be evaporated for an individual to meet the 10 mrem/yr exposure to tritium. Using this example, even if 100 wells were drilled in a single year rather than 30 years, the volume of liquid waste which could be evaporated would only be 1.05×10^8 gal.

Under the no action alternative, the air quality would not be affected.

4.6 Biological Resources

4.6.1 Vegetation

Grading and levelling activities for the proposed LWTS site would result in a direct loss of

vegetation over approximately 38 acres. This is a small percent of total area comprising the NTS, and would be of common vegetation association. There would be no loss of unique or important habitat. Actions would be taken to minimize land disturbance and to protect species of concern. Vehicles would remain on existing paved, graded, or utility-access roads. Joshua trees and cacti

within the proposed site could be salvaged for possible use in revegetation or landscaping projects on the NTS or for donation to local municipalities.

Construction of only a mixed waste portion of the LWTS would result in a loss of vegetation over approximately ten acres for the mixed waste tanks plus the sumps at each well site. The site of the proposed DF tanks has been previously disturbed. There would be no additional loss of vegetation from the placement of tanks at this location.

For each of the UGTA drill sites, loss of vegetation would occur during clearing activities for drill pads, sumps, and borrow areas. Existing roads would be used wherever possible to minimize disturbance. Where practicable, populations of cacti and yucca would be avoided or relocated. Reclamation of unused areas would be instituted.

Under the no action alternative, vegetation would not be affected.

4.6.2 Wildlife

Wildlife would be directly affected by construction of the proposed LWTS facility or only the mixed waste portion of the LWTS. Grading and levelling activities would result in a minor loss of habitat at the proposed site. Mitigative measures would be taken to avoid impact to wildlife by the proposed action. Actions would be taken to minimize land disturbance and to protect species of concern. Vehicles would remain on existing paved, graded, or utility-access roads. Fencing would surround the LWTS and DF tanks to discourage entry by mammals. The tanks would be approximately 2 m (6 ft) in height to prevent or deter animals from falling in. In the event that a tank should rupture as described in Section 3.1, exposure could effect future generations of wildlife.

The open tanks of the LWTS are potential water sources for migratory birds, as well as for resident species; therefore, the facility would contain engineered features to deter migratory birds from entering the tanks. The FWS would be consulted in the event that endangered or protected migratory birds are observed at the site of the proposed LWTS.

Preactivity and tortoise zone-of-influence surveys would be conducted at project drill sites or other areas within tortoise habitat prior to project activities. If tortoises or their sign were found, the project would be subject to the terms and conditions of the Biological Opinion for DOE/NV activities at the Nevada Test Site. Effects to wildlife could occur during retention of low-level liquid wastes at project drill sites. Sumps would be fenced and flagged to discourage entry by animals and waterfowl. Mesh or some other device would be placed around the inside of each sump to provide footing for egress in the event that any animals entered the sump. Sumps would

be monitored quarterly to ensure that no wildlife or waterfowl were present.

There would be no effects to wildlife under the no action alternative.

As noted in Section 3.7.2, the site of the proposed LWTS is north of the known range of the desert tortoise, eliminating potential impacts to threatened and/or endangered species. As many as 20 project drill sites could be located in or near Frenchman Flat, within the range of the desert tortoise.

Preactivity surveys conducted from 1989 to 1995 have indicated very little activity at Frenchman Flat, so that impacts to the desert tortoise would be minimal.

4.7 Cultural Resources

Direct effects on cultural resources could include the destruction of historic properties² during grading and construction activities associated with the LWTS and the UGTA project drill sites. There are no historic properties within the APE of the proposed LWTS. DOE determined and the SHPO concurred that the proposed undertaking would have no effect on significant cultural resources.

There would be no effects to cultural resources from retention of low-level liquid wastes at project drill sites. Cultural resource surveys at drill sites would be conducted as specified in the *Environmental Assessment for the Groundwater Characterization Project, Nevada Test Site (DOE/EA-0532)*. Any proposed drill sites containing historic properties would be relocated or modified so as to not adversely impact the significant cultural resources, or impacts would be mitigated through preactivity archeological investigations and data recovery.

There would be no effects to cultural resources under the no action alternative.

5.0 Health Effects

Direct effects to workers during construction of the LWTS and well-site excavation and grading activities would be minimal and temporary. Use of heavy equipment could produce a temporary noise hazard. Drill site workers potentially exposed to noisy conditions would use hearing protection, as specified in DOE/NV 54XH.1 and 29 CFR 1920.52.

During operation of the LWTS, workers would be exposed to vapors and residual solids from the receiving/evaporation tanks. These tanks would contain tritiated water and possibly low concentrations of other radionuclides, including Strontium-90, Cesium-137, Cerium-144, Uranium-234, Uranium-235, Uranium-238 and others. Drill site workers could be exposed to radioactively contaminated liquids discharged to sumps. Exposure to sump contents would be less

²Cultural resources eligible for inclusion in the National Register of Historic Places.

due to the much smaller volumes.

Inhalation and absorption are considered to be the most significant exposure pathways for tritium. Up to 99 percent of inhaled oxidized tritium (tritiated water) can be absorbed by the body within

seconds. Oxidized tritium has a retention that is characteristic of water, and when absorbed can be uniformly distributed in all biological fluids within 1-2 hours. (EG&G, 1991).

Acute effects of radiation are those effects which extend over a period of up to a few months following a radiation dose and which were received over a period of up to a few hours. Chronic effects of radiation which could include cancer or leukemia result from doses received over a period of many years. In doses from 0 - 100 rem, any effects would be so small that they would not be detected by a routine medical examination (Gollnick, 1986). In the discussion presented in Appendix A on emissions generated during operation of the LWTS, the emissions from tritiated water vapor were estimated to be 125 mrem/yr for the LWTS worker and only 0.5 mrem/yr for personnel at the nearby Area 6 gas station. There would be few, if any, health effects from these dose rates.

Hazardous constituents including lead, cadmium and chromium could also be present in the low-level mixed waste treatment train. These heavy metals are human carcinogens. The most probable pathway into the body is by inhalation. DOE would ensure that the LWTS would be operated in compliance with Occupational Safety and Health Administration and other relevant requirements at a minimum and to minimize risks to workers and the public.

6.0 Transportation Effects

A minor increase in traffic along the Mercury Highway and other main NTS arteries would result from construction and operational activities.

Once the LWTS became operational, waste effluent would be delivered to the facility in 5,000-gal tanker trucks. The transfer of waste effluent from project sites to the LWTS would be limited to the NTS and would comply with DOT and/or EPA standards insofar as practicable. When not practicable, transfers would follow procedures described in the *Hazardous Material Onsite Transportation Manual, Nevada Test Site* (DOE, 1994a). Transportation of radioactive wastes would comply with requirements and documentation requirements specified in the *NTS Waste Acceptance Criteria, Certification, and Transfer Requirements* (DOE, 1992b).

If the LWTS were to receive 8,747,100 l (2,310,000 gal) of waste effluent per year, 450 trips would be required to transport the waste effluent from the project sites to the LWTS. Under the alternative action, 150 trips would be needed to transfer 2,838,750 l (750,000 gal) of mixed waste to the LWTS. Treatment of wastes at the project drill sites could require transport of large quantities of equipment decontamination fluids to the Area 6 DF, wastes exceeding the NDWS criteria to the Area 5 RWMS, and solid wastes to on-site landfills.

Accidents could occur during transportation, resulting in leakage of diesel fuel and radioactive and hazardous liquids. Any seepage into the ground would require sample analysis to determine concentrations of hazardous constituents and appropriate remedial actions. Accidents would be minimized by trucks using the main NTS roads as much as possible. Speed limits in and around the facility would be posted at 5 mi per hour (RSN, 1995). Personnel involved in transporting the waste effluent would be trained in accordance with Title 49 CFR Parts 177.816 and 172.704 and DOT Rules and Regulations as defined in HM126F (DOE, 1994a).

7.0 Accident Scenarios

The probability of a major accident occurring at the LWTS during its construction and operation is low. The probability of transportation-related accidents occurring is also low. Scenarios of accidents which could occur are described below:

7.1 Accidents Caused by Human Error

Accidents could occur through carelessness, inadequate training or misuse of equipment, and could include heavy equipment accidents, falling into a tank or sump, getting hit by a truck, or getting sprayed with waste effluent during the transfer of liquids to trucks and to receiving tanks.

Personnel involved with construction and operation of the LWTS would receive all relevant and required training and would be required to follow the LWTS *Health and Safety Plan* (REECo, 1995) and other codes and policies. A fence would surround the LWTS to limit access and provide protection against vehicle accidents. The access road to the receiving tanks would have concrete barriers for additional protection. Any work areas adjacent to the top of a tank, including temporary scaffolding, would be protected by guard rails, as required by the OSHA. Tanks would be approximately 6 feet above ground level with no adjacent structures, so that falling into a tank would be impossible. A rigid-pipe delivery system would be included to help prevent the inadvertent spraying of contaminated water during transfer from truck to receiving tank (RSN, 1995). Plastic fencing would be placed in each sump to provide footing for egress in the event of a fall.

7.2 Accidents Caused by Equipment Failure

Malfunctions of equipment at the LWTS could occur due to structural flaws, poor design, or excessive wear. A flawed tank could burst or split, releasing great volumes of waste effluent. Loss of brakes on a tanker truck could result in it running off the road or running into one of the tanks. A resultant puncture of the tank could release thousands of gallons of untreated waste effluent, causing serious physical injuries and possible radiation exposure to animals and humans. Failure of protective equipment could also result in radiation exposure. Equipment failure related to the sumps at project drill sites could include torn liners or puncture of transfer lines.

To prevent accidents from equipment failure, equipment would be inspected regularly.

Technicians would check alarms and monitoring systems on a regular basis to ensure reliability in warning of malfunctioning equipment.

7.3 Natural Catastrophes

Natural catastrophes which could occur include flooding and earthquakes. These could result in structural damage and the release of untreated effluent.

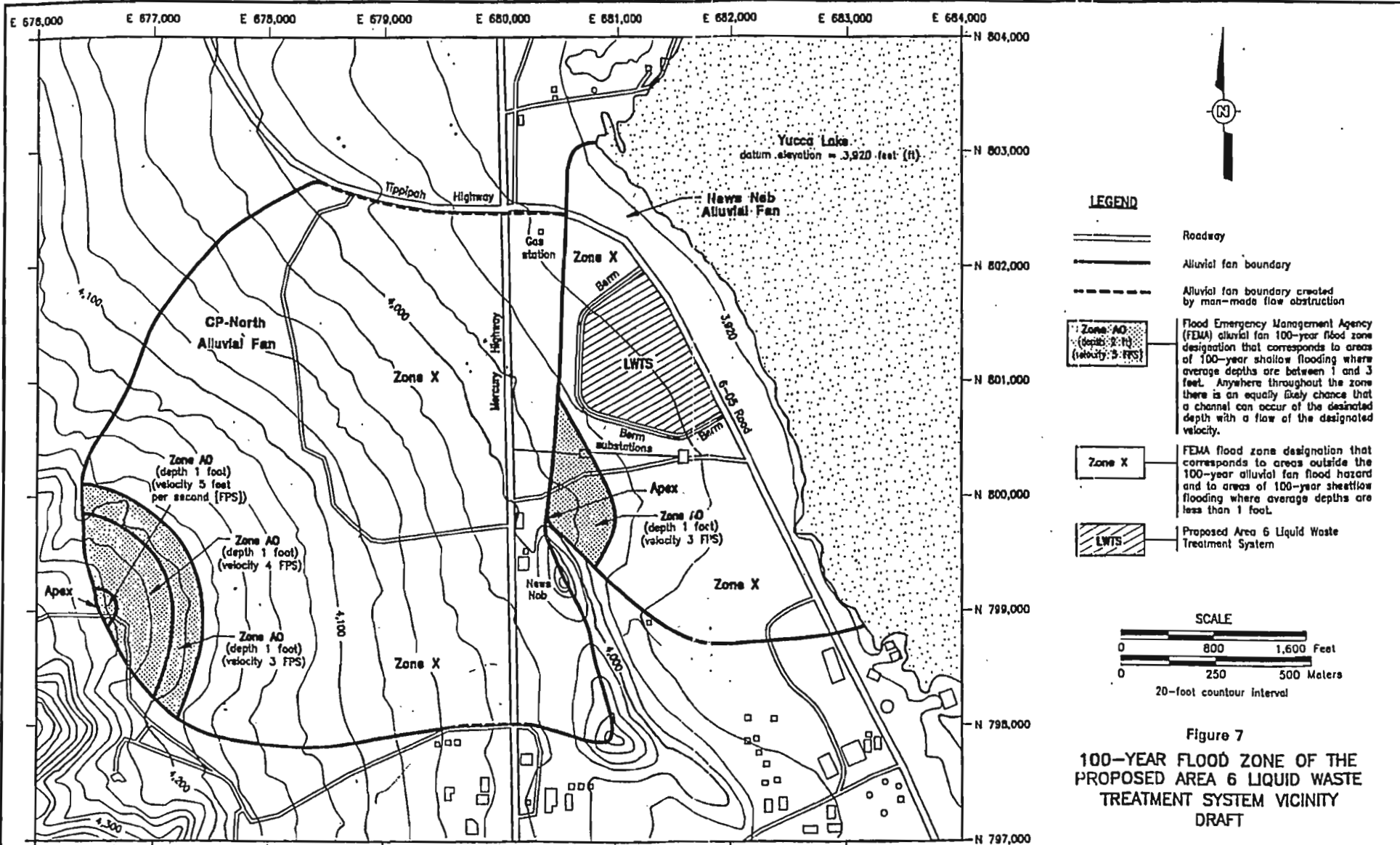
A flood assessment was conducted for the proposed LWTS (RSN, 1994a). Flood Emergency Management Agency (FEMA) criteria were used to determine the 25-year, 24-hour; 100-year, 6-hour; and 500-year, 6-hour flood hazards on and near the proposed LWTS. The three flood hazard concerns that were addressed in the flood assessment include potential flooding caused by alluvial fans, sheetflow, and/or the rising water surface elevation of Yucca Lake.

Two alluvial fans, CP-North and News Nob, were identified that could impact the site of the proposed LWTS. The 100-year flood hazard zones from these alluvial fans are shown on Figure 7. It was determined during the assessment that the proposed site is not located within the 100-year flood hazard zone (where 100-year flow depths are 1 foot or greater) from either CP-North or News Nob alluvial fans, but is located in the Zone X area of News Nob Alluvial Fan (where 100-year flow depths are less than 1 foot). Mitigative efforts to offset the possible flow of water from the Zone X area could include building a berm and channel system around the proposed LWTS facility. FEMA (1991) also describes areas that experience sheetflow with depths less than 1 foot as Zone X. Calculated 100-year depths within the proposed LWTS vicinity were all less than 1 foot; therefore, the proposed facility is not located within a FEMA-designated 100-year flood hazard zone from flow draining from the CP Hills. The calculated 25-year, 24-hour and 500-year, 6-hour sheetflow depths were also less than 1 foot; therefore, the facility is not located within a 25-year, 24-hour or 500-year, 6-hour flood hazard zone from sheetflow.

Potential flooding from water accumulated in Yucca Lake was also examined. Runoff resulting from precipitation over all or part of the 300-square mi Yucca Flat watershed may increase the water surface elevation of the usually dry Yucca Lake, depending on antecedent moisture conditions of the basin prior to the rainfall event. The rising water surface elevation of Yucca Lake was calculated using lake area, water volume, and corresponding rainfall values and compared to rainfall values necessary to fill the lake to the specified elevations.³ The 100-year, 6-hour; 25-year, 24-hour; and 500-year, 6-hour rainfall events would produce enough runoff to create a water surface elevation high enough to flood elevations less than approximately 3,930 ft. The proposed site for the LWTS is located at an elevation greater than 3,930 ft mean sea level, and is therefore outside any of these specified flood hazard areas of Yucca Lake.

Although the LWTS is not located within a flood hazard zone, mitigative efforts to prevent run-on

³Specified elevations are defined and calculated in *Appendix G* of the RSN Flood Assessment.



Source: RSN, 1994c

Figure 7
100-YEAR FLOOD ZONE OF THE
PROPOSED AREA 6 LIQUID WASTE
TREATMENT SYSTEM VICINITY
DRAFT

from impacting the facility might include building a berm and channel system around the proposed LWTS facility. In addition, an on-site storm drainage system to prevent runoff would be designed to comply with the requirements of Title 40 CFR Part 264.193. Potential flood hazards at drill sites could be mitigated in a similar manner.

Ground motion from earthquakes is not likely to occur, since the NTS is located in an area of relatively low seismicity (DOE, 1986). Based on a review of applicable DOE Orders and Standards, the LWTS would be categorized as a low hazard. The LWTS has been designed in accordance with Uniform Building Code specifications to withstand ground motion (RSN, 1995).

7.4 Fire or Explosion

Fire could occur through natural actions, such as lightning strikes, or from malfunctions of equipment, such as an electrical fire. Explosions due to combustion of materials could also occur.

The nature of the LWTS is such that there is no credible risk from fire or explosion. Although the possibility of a minor electrical fire exists from the pumps, it would pose no significant risk to safety and health. There are no materials, fuels, and chemicals that could cause an explosion. Due to the nature of the sumps at the project drill sites, occurrence of a fire or explosion would be unlikely.

8.0 Compliance with Regulations

Regulations and associated regulated activities which were not directly addressed but which could affect or be affected by operation of the LWTS or sumps located at project drill sites are discussed below.

8.1 State/Federal Clean Water Regulations

Sewage lagoons located along the west edge of Yucca Lake are regulated under state of Nevada, Water Pollution Control General Permit Number GNEV93001. It is not anticipated that construction and operation of the LWTS would affect or be affected by operation of these lagoons.

8.2 Safe Drinking Water Act

Regulatory limits have been established for drinking water supplies by the EPA and DOE. The EPA has established a dose limit of 4 mrem total body dose equivalent for concentrations of radioactivity in drinking water. DOE Order 5400.5 establishes a level of protection that is equivalent to public community drinking water standards cited in Title 40 CFR Part 141, National Primary Drinking Water Regulations. The Nevada Administrative Code specifies that public water systems must meet the requirements of the National Primary Drinking Water Regulations. Since the location of the nearest potable wells to the proposed LWTS is approximately 4.8 km (3 mi) it is not likely that the dose limit or drinking water standards will be exceeded.

The majority of the UGTA project drill sites would be in isolated areas, generally several miles from potable wells.

8.3 State/Federal Clean Air Regulations

Particulate emissions from surface disturbing activities which encompass an area equal to or greater than five acres are regulated at the NTS by state of Nevada Air Quality Operating Permit AP9711-0555. Surface disturbance activities may include construction of the proposed LWTS and use of unpaved roads. During operation of the proposed LWTS, fugitive dust must be controlled in accordance with NAC 445B.365: "No person may cause or permit the handling, transporting or storing of any material in a manner which allows or may allow controllable particulate matter to become airborne." Particulate emissions generated during construction and operation of the proposed LWTS would be minimized through watering.

NESHAPS emissions which exceed 10 mrem/yr must be reported annually to the EPA. In order to demonstrate compliance with the NESHAPS reporting requirements, the CAP88-PC model or another approved method of determining emissions must be performed annually and the results documented.

8.4 Resource Conservation and Recovery Act

Design of the proposed LWTS, as discussed in Section 4.1, would meet the requirements of RCRA (Title 40 CFR Part 264). Construction of a storm drainage system would also be governed by these requirements.

The LWTS would require a RCRA permit issued by the state of Nevada prior to construction of the low-level mixed waste portion of the LWTS. Waste effluent and sludge would be characterized using EPA test method SW-846 (EPA, 1982). Disposal and/or storage of low-level mixed waste would meet RCRA standards and regulations.

8.5 Federal Radiation Protection Regulations

Radiation protection standards have been established to limit public exposure to radioactive constituents in liquid wastes. These standards are set forth in DOE Order 5400.5 and in 10 CFR Part 834, Radiation Protection of the Public and the Environment. Releases of untreated process streams to surface water, soil columns, or aquifers may result in contamination of surface and ground water resources and possible violation of Federal or State drinking water standards. Levels of radionuclides in process wastes must meet the primary dose limit of 100 mrem per year for the general public (10 CFR 834) and 5 rem per year for radiation workers (10 CFR Part 20). ALARA (As low as reasonably achievable) guidelines must be adhered to in the discharge of tritium-bearing water to the soil column.

Title 10 CFR Part 834, Section 212, prohibits the use of soil columns for the discharge of liquid waste streams containing suspended or dissolved radionuclides. However, this requirement does

not apply to liquid waste streams treated by Best Available Technology, and such that there is a lesser risk than other waste management practices of adverse impacts on human health or ecological resources.

9.0 Pollution Prevention Measures

A guidance memorandum issued by the Council on Environmental Quality in the January 29, 1993 *Federal Register* recommended that all federal departments and agencies incorporate pollution prevention measures into their planning and decision-making processes. Accordingly, the proposed action and alternatives presented in this EA were evaluated to determine applicable pollution prevention techniques. A summary of this evaluation is presented in Table 1.

TABLE 1
Pollution Prevention Measures

Action	Pollution Prevention Measure
Proposed Action: Centralized Treatment at LWTS	<ul style="list-style-type: none"> • Initial clearing/grading activities restricted to acreage needed for the two tanks rather than 38 acres • Proposed site is located outside of known range of desert tortoise, an endangered species • Double-walled tanks would be used to minimize contact of effluent with groundwater • Double-walled tanks would eliminate need for liner, reducing amount of waste for disposal • Proposed site is located near existing highway • Proposed site is centrally located to reduce transportation impacts • Wastes would be minimized through evaporation
Alternate Action: Well-site Treatment	<ul style="list-style-type: none"> • Sumps would be lined to minimize contact with soils and groundwater • Localized treatment would reduce transportation impacts • Localized treatment would disperse emissions • Wastes would be minimized through evaporation
Alternate Action: LWTS for Mixed Waste Only	<ul style="list-style-type: none"> • Proposed mixed waste LWTS site is located outside of known range of desert tortoise; • Sumps would be lined to minimize contact of effluent with groundwater • Double-walled tanks at the mixed waste LWTS would eliminate need for a liner, reducing the amount of waste for disposal • Proposed mixed waste LWTS site is located near an existing highway • Proposed mixed waste LWTS is centrally located to reduce transportation impacts

10.0 Cumulative Effects

Cumulative effects are the consequences of multiple impacts which, when added together, can become potentially significant. Cumulative effects from operating a LWTS can be determined by examining present and future activities at the NTS.

Approximately 4,000 personnel are currently employed at the NTS. Although a moratorium on nuclear testing is in effect, other programs continue to operate, including the Area 3 and Area 5 RWMS, the Liquid Gaseous Fuels Spill Test Facility, and the Groundwater Characterization Program. Other future activities planned for the NTS include expansion of facilities in support of waste disposal activities at the Area 5 RWMS.

Particulates and fugitive dust would be emitted mainly from construction and excavation of the LWTS and UGTA well sites. Once these facilities were in operation, the amount of particulate matter generated would be primarily due to travel on unpaved access roads. Emissions related to the LWTS or UGTA-associated sites would represent a very minor contribution to airborne particulate matter when considering the amounts of particulate emissions generated through on-going road maintenance, construction, and travel on other unpaved roads.

Emissions from evaporation of the waste effluent from either the LWTS or UGTA sumps would contribute approximately 61 Ci/yr of tritium. Main sources of tritium on the NTS currently include the Area 5 RWMS and the Area 12 Tunnel Ponds, which contributed approximately 48 Ci in 1993.

Waste resulting from the evaporation process would be minimal. Sludge build-up in the LWTS pond liners would necessitate sludge/liner removal approximately once every eight years. Liners from sumps containing wastes exceeding certain NDWS criteria would be removed only once, after evaporation of the contents. The liners and solidified sludge from the LWTS tanks and UGTA sumps which, if disposed of at the Area 5 RWMS, would constitute only a very minimal amount of waste in comparison to the approximately 25,050 m³ (884,600 ft³) of LLW received for disposal in 1995.

Operation of the LWTS would increase traffic in Area 6 and on the main NTS roads, but the increase would be very minor. Traffic resulting from activities at project drill sites would represent a small percentage of NTS traffic.

Impacts on geology, hydrology and soils would not be expected due to activities related to either the LWTS or sumps at the UGTA well sites, and therefore cumulative impacts would not be anticipated. Effects to biological resources from the proposed action and alternatives, except for the no action alternative, would be minor. Construction of sumps for approximately 20 UGTA wells could be located in desert tortoise habitat, resulting in loss of habitat and possible accidental tortoise deaths. However, the potential for accidental tortoise deaths and loss of habitat for the desert tortoise in the Frenchman Flat area is very low, due to an unfavorable habitat and resulting

scarcity of tortoises. Cumulative impacts would be negligible and would add little to impacts generated by other projects located in desert tortoise habitat. The Biological Assessment for the NTS for the period from 1991 to 1995 concludes that losses at the NTS would not threaten the continued existence of the species (DOE, 1993).

11.0 Summary

The UGTA subproject has been established to characterize groundwater at the NTS. In order for groundwater remediation to proceed in an effective and environmentally-sound manner, a system needs to be developed to treat wastes derived from these remedial activities.

A proposed action and three alternatives were described in this EA. Briefly, these include:

- Proposed Action: Construct a Liquid Waste Treatment System in Area 6
- Alternative 1: No Action, e.g., do not provide a method of treating low level liquid radioactive wastes and low level liquid mixed wastes
- Alternative 2: Construct a Liquid Waste Treatment System in Area 6 to treat only mixed liquid wastes, with low level radioactive wastes to be treated at project well sites
- Alternative 3: Treatment and disposition of wastes would be based on levels of dissolved constituents according to the NDWS. The majority of the wastes would be treated at the drill sites.

Advantages and disadvantages for the proposed action and each alternative are summarized in Table 2.

TABLE 2
Comparison of Proposed Action with Alternatives

ACTION	ADVANTAGES	DISADVANTAGES
Proposed Action: Centralized Treatment at LWTS	<ul style="list-style-type: none"> • uniform treatment • constant monitoring with onsite personnel 	<ul style="list-style-type: none"> • surface disturbance of 38 acres • potential hazardous emissions concentration at a single location
Alternate Action: LWTS for MW only	<ul style="list-style-type: none"> • emissions dispersed • less truck traffic, and therefore, less chance of accidents 	<ul style="list-style-type: none"> • no onsite treatment capacity for liquid low-level waste other than at the UGTA drill sites • continuous radionuclide monitoring and tracking for each site • surface disturbance of ten acres for LWTS plus acreage at each site
Alternate Action: Well-site Treatment	<ul style="list-style-type: none"> • emissions dispersed • minimal impacts from transportation of wastes • minimal transportation costs • less adverse visual impact than proposed action or MW only alternative 	<ul style="list-style-type: none"> • maximum surface disturbance of approx. 19 acres at 100 sites • higher maintenance and monitoring costs for numerous sites
No Action	<ul style="list-style-type: none"> • no emissions • no construction costs • no disturbance to the environment 	<ul style="list-style-type: none"> • would greatly limit groundwater remediation activities

12.0 Agencies and Persons Consulted

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Appendix A

Summary of Dose Calculations for Tritiated Water Vapors for the Proposed Liquid Waste Treatment System

Summary of Dose Calculations for Tritiated Water Vapors for the Proposed Liquid Waste Treatment System

An analysis of the potential release of tritium in the form of tritiated water vapor from operation of the LWTS was performed by RSN in the *Hazard Assessment Report for Liquid Waste Treatment System* (1995). A summary of the results and their significance to the onsite worker and the offsite population was compiled by the REEC Co Analytical Services Department and appears below.

The LWTS is designed to treat liquid and semi-solid waste by evaporation, with solidification of residual sludge. The only NESHAPS-regulated substance which would be expected to be released as a result of this process is tritium in the form of tritiated water vapor. For the purpose of this analysis, it was assumed that the difference in evaporative rates for tritiated and nontritiated water was negligible.

The maximum airborne concentration of tritium would occur immediately above the surface of the water in each tank and would be limited to the saturation value for water in air at the current ambient temperature. For air at 38°C (100°F), this saturation value is approximately 50 grams per cubic meter (g/m^3) of air, increasing to 67 g/m^3 at 43°C (110°F). At a tritium concentration of 10^7 pCi/l (assumed to be the controlling value for LWTS operations) in the liquid waste, 50 g/m^3 would result in a maximum airborne concentration of tritium of 5×10^{-7} Ci/ml of air.

NESHAPS regulations limit the effective dose equivalent (EDE) to the maximally exposed individual offsite to 10 mrem/yr. DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (1990), cites an airborne tritiated water vapor concentration of 10^{-7} $\mu\text{Ci/ml}$ for an EDE of 100 mrem/yr. Accordingly, the concentration could not exceed 10^{-8} $\mu\text{Ci/ml}$ at the site of the maximally exposed individual to meet the NESHAPS criterion of 10 mrem/yr EDE. A dilution and dispersion value of 2×10^{-2} for the maximum LWTS tritium concentration discussed above would be required to meet this concentration limit. Previous analyses using NTS windrose data (RSN, 1995; Smith, 1994) performed to demonstrate NESHAPS compliance for facilities close to the LWTS have shown the maximally exposed individual to reside in Lathrop Wells, over 40 km from the LWTS. A calculation performed by the Weather Service Nuclear Support Operations of the National Oceanic and Atmospheric Administration in Las Vegas suggests that a conservative dilution and dispersion value for distances of 32 to 80 km is 10^{-4} , greatly exceeding the value necessary to meet the NESHAPS limit.

The Analytical Services Department of REEC Co has performed calculations to confirm that the LWTS would meet the NESHAPS EDE limit. These calculations were performed using the computer code CAP88-PC which has been approved by the EPA to demonstrate compliance with NESHAPS regulations. Using this code, a nominal release of one Ci of tritiated water vapor from the LWTS would result in an EDE of approximately 4×10^{-6} mrem/yr to the maximally exposed individual in Lathrop Wells. An EDE of 10 mrem/yr to this individual would require a release of tritiated water vapor from the LWTS of:

$$10 \text{ mrem/yr} \div 4 \times 10^{-6} \text{ mrem/Ci} = 2.5 \times 10^6 \text{ Ci/yr}$$

Since the controlling tritium concentration in liquid waste is 10^7 pCi/l, or approximately 4×10^{-5} Ci per gal, the total volume of liquid waste which would need to be evaporated to reach an EDE of 10 mrem/yr is:

$$2.5 \times 10^6 \text{ Ci/yr} \div 4 \times 10^{-5} \text{ Ci/gal} \sim 6 \times 10^{10} \text{ gal/yr}$$

This volume is approximately 48,000 times the total capacity of the LWTS. The total LWTS capacity would have to be evaporated 131.5 times each day of the year to achieve an EDE of 10 mrem/yr to the maximally exposed individual, a highly improbable occurrence.

The closest occupied onsite facility to the LWTS is the Area 6 gas station, located approximately 270 m (900 ft) from the LWTS boundary. The appropriate concentration limit for this location is the DAC for continuous occupational exposure. For tritiated water vapor the DAC is cited as 2×10^{-5} $\mu\text{Ci/ml}$ in 10 CFR Part 835, Occupational Radiation Protection. The maximum airborne tritium concentration calculated by RSN for the LWTS, as discussed above, is a factor of 2.5×10^{-2} below this DAC value. Additionally, a conservative dilution and dispersion value of 10^{-2} would be expected for the distance from the LWTS to the gas station. Accordingly, the tritiated water vapor concentration at the gas station would be approximately a factor of 10^{-4} below the allowed DAC.

To calculate the EDE at the LWTS, the maximum airborne concentration of 5×10^{-7} Ci/ml was divided by the DAC for tritiated water vapor (2×10^{-5} Ci/ml). This figure was then multiplied by the annual occupational dose limit, 5000 mrem, for an EDE of 125 mrem. The EDE for a worker at the Area 6 gas station was calculated by multiplying the DAC for tritiated water by the factor of 10^{-4} . Therefore, the EDE for a worker at the gas station is $10^{-4} \times 5000$ mrem or 0.5 mrem.

Any airborne particulates or noble gases (e.g., krypton-85) which may be released from the LWTS would be negligible. Residual solids (following 90 percent removal at the drill site) would be dewatered and solidified within the LWTS. All radionuclides other than tritium and noble gases would be contained within the residual solids and sludges left from evaporation. Based on calculations performed by RSN in the *Hazard Assessment Report--Liquid Waste Treatment System* [RSN, 1995], the controlling radionuclide in these residual solids would be cesium-137. A maximum quantity of 10 millicuries of cesium-137 would be present in the LWTS at any time. Assuming all of this activity was uniformly distributed within a single tank and neglecting any self-attenuation, the maximum exposure rate anywhere at the surface or top of the tank would be less than 1 milliroentgen per hour.

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