QA: N/A

Intermodal and Highway Transportation of Low-level Radioactive Waste to the Nevada Test Site

Volume I

April 1999

DOE/NV-544-VOL I
United States Department of Energy
Nevada Operations Office
Las Vegas, Nevada

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Distribution

FINAL TECHNICAL REPORT: *INTERMODAL AND HIGHWAY TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE* (Volumes I and II)

The Department of Energy/Nevada Operations Office (DOE/NV) is pleased to issue the enclosed technical report of the comparative risks associated with intermodal transportation and alternate public highway routing of DOE low-level radioactive waste to the Nevada Test Site and DOE's responses to the numerous stakeholder comments on the pre-approval draft Environmental Assessment (EA).

On September 1, 1998, DOE/NV issued a pre-approval draft EA entitled, *Intermodal Transportation of Low-Level Radioactive Waste to the Nevada Test Site.* DOE/NV kept the public comment period open until February 1999. During the five months of review, DOE/NV responded to numerous requests to provide public informational briefings on the findings of the comparative risk analysis contained in the draft EA. Private citizens, tribal nations, municipal, county, state, and federal government agencies provided a total of 48 letters commenting on the draft EA. The final technical report on the subject of intermodal transportation and the DOE/NV response to comments is enclosed as Volumes I and II, respectively.

During the EA process, it became clear there is no decision to be made by DOE/NV that warrants a National Environmental Policy Act (NEPA) review. Therefore, there is no need for this office to issue a final NEPA document on intermodal transportation. Decisions regarding the transportation mode are made by the DOE generator site, and not by DOE/NV. The structure of the Department of Transportation regulations (49 C.F.R. 397.101-103) for hazardous materials, including radioactive materials, grants decisionmaking authority for highway route selection to the carrier. DOE generators have to satisfiy the requirements to protect public health and safety through appropriate packaging that meets structural standards and radiation limits. In place of a NEPA document, DOE/NV has prepared the enclosed technical report and comment response document.

DOE/NV appreciates the participation and contributions made by all stakeholders during the last 18 months we have spent addressing this important issue. We think the effort has resulted in an increased awareness of the sensitivities surrounding transportation mode and routing, and we continue to invite your interest on this subject.

Carl P. Gertz, Assistant Manager
for Environmental Management

WMD:KMS

Enclosure:
As stated

Intermodal and Highway Transportation of Low-level Radioactive Waste to the Nevada Test Site

Volume I

April 1999

DOE/NV-544-VOL I
United States Department of Energy
Nevada Operations Office
Las Vegas, Nevada

2.6.2 Options Choice

The option preferred by each generator depends on their local situation. The California generators are likely to continue to prefer truck transportation. Because their approach to the NTS is from I-15 from the southwest, they can simply choose to avoid the congestion, construction, and urban population densities in the Las Vegas Valley by taking CA 127 north from Baker. Intermodal transportation from California locations is likely to be significantly more costly for little gain in the reduction of radiological risk, particularly for the relatively low volumes of waste involved. Only 9.8 percent of the waste shipped to the NTS in FY 1997 arrived from the southwest.

The generators in the central and southern Rocky Mountain region have a more difficult decision. From this region, the cost difference between truck and intermodal are likely to be small for the truck route through the valley, but cost could vary significantly depending on the distance from the generator to an intermodal facility. If the facility is on the BNSF line and can accommodate trailers on flat cars, this mode would appear to be a good choice with a transfer back to the highway at Barstow. If intermodal facilities are not readily available, there would likely be a strong motivation to continue to use current truck routes through the valley, since avoiding the valley would add a significant percentage to the length and cost of the trip.

The availability of rail access would be important for Rocky Mountain region generators and the Pantex plant in Amarillo, Texas. For example, the Pantex plant has access to the BNSF Intermodal Facility in Amarillo. Rocky Flats has access to intermodal facilities of both the UP and BNSF in Denver and could choose either Caliente or Barstow, but Sandia National Laboratories in Albuquerque would be limited to the BNSF to Barstow. Los Alamos would need to truck waste over 161 km (100 mi) to reach the BNSF Intermodal Facilities in Albuquerque.

The generators in the east should have a clear motivation to use intermodal transportation. Both cost and radiological risk can be expected to be less than trucks. Even the small generators could use the trailer-on-flat-car mode from the most convenient intermodal facility or they could combine their waste with larger DOE generators. Since interline railroad transfers from eastern railroads to either the UP or the BNSF would need to be made, these generators could maintain a choice of rail carriers to control costs and use either the Barstow or Caliente intermodal options.

2.6.3 Conclusion

The choice of transportation mode and route is a decision that must be made jointly between the waste generator (the shipper) and the carriers with full knowledge of the characteristics of the available options. DOT regulations require carriers to "ensure that the motor vehicle is operated on routes that minimize radiological risk, considering available information on accident rates, transit time, population density and activities, and the time of day and the day of the week during which transportation will occur to determine the level of radiological risk." Intermodal transportation will incur less radiological risk than truck transportation alone. Both Barstow and Caliente intermodal options are workable. The preference for options by generators and carriers will depend on their individual situations.

INTERMODAL AND HIGHWAY TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE

– PREFACE –

A Preapproval Draft *Environmental Assessment (EA)* titled: *Intermodal Transportation of Low-level Radioactive Waste to the Nevada Test Site*, was released in September 1998 for public review. The review period closed 02/01/1999, after 5 months of public discussion, and formal comments were provided to the U.S. Department of Energy Nevada Operations Office (DOE/NV). This valuable feedback led DOE/NV to reconsider its approach for providing its approved waste generators, transportation contractors, and stakeholders with information about the environmental impacts and radiological risks associated with shipping radioactive waste to the Nevada Test Site (NTS) by commercial truck and rail. Although truck transportation has been used for many years, the preparation of a document conforming with *National Environmental Policy Act (NEPA)* regulations appeared to be appropriate for analyzing the impacts and risks associated with changing the mode of transportation and evaluating nontraditional routes. However, a number of reviewers pointed out that the proposed action, "to encourage DOE/NV generators and their transportation contractors to use transportation alternatives that would minimize radiological risk, enhance safety, and reduce cost," does not lead to a DOE/NV decision that requires NEPA documentation.

There are two factors that drove DOE/NV to define the proposed action as it did in the Preapproval Draft EA. The first factor is a potential decision by DOE generators to shift their transportation mode to include use of rail, based on an analysis of their individual operations. DOE/NV is not the decision maker for generator preferences of transportation mode. The second factor is the structure of the U.S. Department of Transportation (DOT) regulations governing transport of radioactive materials. The congressional intent and the implementing regulations (49 Code of Federal Regulations [CFR] 397.101-103) that govern interstate commerce is for all goods, including hazardous and radioactive materials, to move freely on the nation's highway and rail networks. Once generators have selected the mode of transportation and satisfied the requirements to protect public health and safety through appropriate packaging that meets structural standards and radiation limits, carriers have the responsibility for selecting a route that minimizes radiological risk. The routing selection process also permits carriers to modify a route to adjust to changing road and weather conditions during the course of a trip. DOE/NV does not make routing decisions and is not authorized to designate highway routes. This explains why DOE/NV made it clear in the Preapproval Draft EA that it would not identify a preferred alternative.

The Preapproval Draft EA provided environmental impact and radiation risk data to assist generators with mode selection and to assist carriers with highway routing. However, DOE/NV finds itself in a position where it will not be making decisions affecting the environment, selecting the mode of transportation nor determining a route. Therefore, continuing the preparation of a NEPA document is not appropriate. However, since the material developed for the EA is useful to approved generators, carriers, and stakeholders, DOE/NV has decided to incorporate responses to public comments on the EA, along with newly obtained information, and make this information available to them through the publication of this technical report.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

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ALARA	as low as reasonably achievable
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BN	Bechtel Nevada
BNSF	Burlington Northern Santa Fe
BOR	Bureau of Reclamation
CA [127]	California State Route [127]
CAR	Corrective Action Request
CDCA	California Desert Conservation Area
CEQA	California Environmental Quality Act
CES	Consulting Engineering Services
CFR	Code of Federal Regulations
Ci	Curie
cm	centimeters
CNEL	community noise equivalent level
CRMP	Community Radiation Monitoring Program
dB	decibels
dBA	A-weighted decibels
DLA	Defense Logistics Agency
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DOT	U.S. Department of Transportation
EMS	Emergency Management System
EO	Executive Order
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FSC	Fleet Support Center
ft	foot/feet
FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
HAZMAT	hazardous material
HLW	high-level radio active waste
I-[15]	Interstate [15]
ICBO	International Conference of Building Officials
ICRP	International Commission for Radiological Protection
IMEA	Intermodal Environmental Assessment
in	inch(es)
kg	kilograms
km	kilometer(s)
kmph	kilometers per hour
lb	pounds
L_{dn}	day/night noise levels
L_{eq}	hourly average noise level
LLW	low-level radioactive waste
$L_{max\text{-}fast}$	maximum instantaneous noise levels
LOS	level of service
m	meter(s)
MCLB	Marine Corps Logistics Base
MDAQMD	Mojave Desert Air Quality Management District
mgd	million gallons per day
mi	mile(s)
MP	milepost
mph	miles per hour
MWA	Mojave Water Agency
NB	northbound
NCL	North City Limit
NDOT	Nevada Department of Transportation
NEPA	National Environmental Policy Act
NNHP	Nevada Natural Heritage Program
NPS	National Park Service
NRAMP	Nevada Risk Assessment/Management Program
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS/EIS	Final Environmental Impact Statement for the Nevada Test Site and Off-site Locations in the State of Nevada
NV [375]	Nevada State Route [375]
OSHA	U.S. Occupational Safety and Health Administration
PIC	pressurized ionization chamber
PM	particulate matter
PVC	polyvinyl chloride
RCO	Regional Coordinating Offices
rem	Roentgen Equivalent in Man
RF	respirable fraction
ROD	Record of Decision
RWAP	Radioactive Waste Acceptance Program
RWMS	Radioactive Waste Management Site
SAIC	Science Applications International Corporation
SB	southbound
SCE	Southern California Edison
SCL	South City Limit
SCS	Soil Conservation Service
SEL	single event level
SoCal	Southern California
TEMP	Transportation Emergency Management Program
TLD	thermoluminescent dosimeter
TPWG	Transportation Protocol Working Group
TRU	transuranic waste
TTR	Tonopah Test Range
UNLV	University of Nevada Las Vegas
UP	Union Pacific
URF	unit risk factor
US [93]	U.S. Highway [93]
USFS	U.S. Forest Service
VRM	Visual Resource Management
WB	westbound
WCO	Waste Certification Official
WSA	Wilderness Study Area

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1.0 INTRODUCTION

The Nevada Test Site (NTS), a unique national resource managed by the U.S. Department of Energy, Nevada Operations Office (DOE/NV), is located about 105 kilometers (km) (65 miles [mi]) northwest of Las Vegas, Nevada. Historically, the primary mission of the NTS was to conduct nuclear weapons tests. Since the current moratorium on testing began in October 1992, this mission has changed to maintain a readiness to conduct tests, if so directed, in the future. The NTS, because of its favorable environment and infrastructure, has also supported the DOE Waste Management Program, as well as other national security-related research, development, and testing programs. As a result of the changing mission priorities, the DOE has focused on new national security, energy, and environmental issues challenging the nation and redefined the role for the NTS within the DOE Complex.

The NTS presently serves as a disposal site for low-level radioactive waste (LLW) for by DOE-approved generators. Managed radioactive waste disposal operations began at the NTS in the early 1960s, and low-level, transuranic (TRU), mixed, and classified LLW have been disposed of in selected pits, trenches, landfills, and boreholes on the NTS. The environmental effects resulting from the disposal of LLW at the NTS, for a 10-year period, are discussed in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (NTS/EIS) (DOE, 1996a).

During the formal NTS EIS scoping period, it became clear that transportation of LLW was an issue that required attention. The advantages of intermodal transportation were identified in 1992 by DOE's Office of the Inspector General (DOE, 1992). Their report on *Packaging, Transporting, and Burying Low-level Waste* recommended that DOE evaluate the feasibility of using rail and intermodal shipments to the NTS. In 1995, the Nevada Risk Assessment/Management Program (NRAMP) at the University of Nevada Las Vegas, in their comments on the *Waste Management Programmatic Impact Statement*, strongly endorsed the evaluation of rail transportation of LLW (University of Nevada Las Vegas [UNLV], 1995).

The Nevada Transportation Protocol Working Group (TPWG) was formed in 1995 to identify, prioritize, and understand local issues and concerns associated with the transportation of LLW to the NTS. The TPWG is comprised of representatives from the DOE, state and local governments, the NTS Community Advisory Board, and the private sector. The NTS EIS Record of Decision (ROD) (DOE, 1996b), signed by the Secretary of Energy in December 1996, stated that DOE would continue to meet with the TPWG regularly to discuss LLW transportation issues.

Presently, over 80 percent of the LLW shipments enter the state of Nevada on U.S. Highway 93 (US 93) at Hoover Dam in legal-weight trucks. They continue on US 93 through the communities of Boulder City, Henderson, and Las Vegas, and through the Snow Mountain Reservation of the Las Vegas Paiute Tribe. Most shipments pass through the interchange for US 93/US 95 and Interstate 15 (I-15). This interchange is very heavily used and the site of considerable traffic congestion.

In 1995, the TPWG suggested the DOE could reduce transportation costs and enhance public safety by using rail transportation. The DOE announced, in October 1996, that they would study the potential for intermodal transportation of LLW to the NTS.

The TPWG and DOE/NV prepared the *NTS Intermodal Transportation Facility Site and Routing Evaluation Study* (DOE, 1998a) to present basic data and analyses on alternative rail-to-truck transfer sites and related truck routes for LLW shipments to the NTS. Originally, the team identified eight potential sites for the intermodal transfer. Preliminary screening, based on the criteria necessary for an intermodal transfer point, eliminated the potential Hawthorne, Ely, and Crucero sites. The team evaluated the remaining potential intermodal transfer points at Caliente, Apex, Valley, Dunn, and Yermo. After the study was completed, potential sites at Arden and Moapa (both in southern Nevada) were also evaluated. The first three of these sites are in southern Nevada, while Dunn and Yermo are in southeastern California. Largely based on the conclusions of the *NTS Intermodal Transportation Facility Site and Routing Evaluation Study* of intermodal transportation, DOE/NV decided to prepare this report to provide additional information for DOE waste generators and carriers to assist them with transportation planning.

This report identifies the potential transportation risks and environmental factors of using new intermodal transfer sites and truck routes compared with continuing current operations to accomplish the objectives of minimizing radiological risk, enhancing safety, and reducing cost. Although DOE generators can select the mode of transportation, DOE does not have the legal authority to require the use of particular routes. U.S. Department of Transportation (DOT) regulation 49 Code of Federal Regulations (CFR) 397.101 gives the motor carrier transporting radioactive material discretion to choose the route that minimizes radiological risk. The analysis of radiological risk contained in this document will assist generators and carriers with these choices. The report evaluates the following options:

- **Option 1:** Use intermodal transportation.
  - **Option 1A:** Use existing intermodal facilities at Barstow, California.
  - **Option 1B:** Use a proposed intermodal facility at Caliente, Nevada, using existing rail facilities within the city limits.
  - **Option 1C:** Use a proposed intermodal facility at Caliente that is located 1.2 km (0.75 mi) south of the in-town location (Option 1B).
  - **Option 1D:** Use existing facilities at the Yermo Annex of the Marine Corps Logistics Base (MCLB) Barstow near Yermo, California.
- **Option 2:** Use All-truck routes.
  - **Option 2A:** Trucks from the east would use I-40 from Kingman, Arizona, to the connecting road with I-15 at Yermo, California, then continue on the route shown on Figure 2-1 (in Chapter 2 of this report) for the Yermo Option (Option 1D) to the NTS.

- **Option 2B:** Trucks from the northeast would travel southwest on I-15 then north on US 93 to Nevada State Route 375 (NV 375), then continue on the route shown on Figure 2-1 (in Chapter 2 of this report) for the Caliente options (Options 1B and 1C) to the NTS.

- **Option 3:** Current Routes. Generators would continue to use the current truck mode of transportation and current routes.

1.1 REGULATORY REQUIREMENTS

The following major laws, regulations, executive orders, and DOE orders may apply.

- *Atomic Energy Act of 1954.* This Act ensures proper management, production, possession, and use of radioactive materials. The Act also provides the DOE with authority for developing applicable standards for protecting the environment from radioactive materials.

- Hazardous and Radioactive Materials Transportation Regulations.

  - U.S. DOT regulations (49 CFR Parts 100 through 178) contain requirements for identification of a material as hazardous or radioactive. The DOT regulations govern the hazard communication (hazard labeling, vehicle placarding) and transport requirements (shipping papers or waste manifests).

  - U.S. DOT regulation 49 CFR 174.14(a) requires rail carriers to forward shipments of hazardous materials within 48 hours after acceptance at any yard, transfer station, or interchange point.

  - U.S. DOT regulation 49 CFR 397.101 provides guidance for route selection to the motor carriers. Paragraph (a)(1)(2) requires carriers to ensure that the motor vehicle is operated on routes that minimize radiological risk, considering available information on accident rates, transit times, population density and activities, and the time of day and the day of the week during which transportation will occur to determine the level of radiological risk. This regulation makes route selection the responsibility of the carrier, not the shipper.

- U.S. Nuclear Regulatory Commission (NRC) regulations applicable to radioactive materials transportation (10 CFR Part 71) detail packaging design requirements, including the testing required for package certification.

- *Clean Air Act of 1970.* The *Clean Air Act*, as amended, is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population."

- *Archeological Resources Protection Act of 1979.* This Act protects archeological resources located on U.S. public lands and American Indian lands, including sites under the DOE's control.

- *Endangered Species Act of 1973*. This Act, as amended, is intended to prevent the further decline of endangered and threatened species and to restore these species and their habitat.

- *Noise Control Act of 1972*. The *Noise Control Act*, as amended, directs all federal agencies to carry out, "to the fullest extent within their authority," programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.

- Executive Order (EO) 11988 *(Flood Plain Management)*. This order requires federal agencies to establish procedures to ensure that the potential effects of flood hazards and flood plain management are considered for actions undertaken in a flood plain.

- EO 12898 *(Environmental Justice)*. This order directs federal agencies to achieve Environmental Justice by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States.

- DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes*. This order provides DOE policy, sets forth requirements, and assigns responsibilities for the safe transport of hazardous materials, hazardous substances, hazardous wastes, and radioactive materials.

2.0 DESCRIPTION OF THE TRANSPORTATION OPTIONS

There is evidence that combining the use of rail and truck modes and using alternative routes could reduce radiological risk, enhance safety, and reduce costs for transporting LLW from generator sites to the NTS. LLW could be shipped via rail to intermodal facilities near the NTS where the cargo could be transferred to trucks for delivery to waste disposal sites at the NTS. Truck routing could also be changed to avoid the Las Vegas Valley and Hoover Dam. DOE/NV studied these concepts and evaluated their feasibility. This report addresses only transportation options; DOE/NV is not proposing to site, construct, or operate any new facilities.

Two options to current practices were considered for achieving these objectives. Option 1 would use intermodal transportation. This transportation mode would bring LLW by rail to a facility near the NTS where it would be transferred to trucks for delivery to disposal areas on the NTS. Option 1A would use existing intermodal facilities at Barstow, California. Option 1B would use a proposed intermodal facility at Caliente, Nevada, utilizing existing rail facilities in the populated area. Option 1C would use a proposed intermodal facility 1.2 km (0.75 mi) south of the in-town facility. Option 1D would use an existing intermodal facility at the Yermo Annex of the MCLB Barstow near Yermo, California. Option 2 would continue the use of trucks, but would use routes to reach the NTS that would avoid the Las Vegas Valley and Hoover Dam. The new intermodal routes to the NTS are shown on the maps in Figures 2-1 and 2-2. The new truck options are shown in Figure 2-3. Option 3 would continue to make all shipments from DOE/NV-approved LLW generators by truck using current routes over Hoover Dam and through the Las Vegas Valley. The current truck routes are shown on the map in Figure 2-4.

In Fiscal Year (FY) 1997, there were 754 shipments of LLW to the NTS from 12 of the 15 approved generators listed in Table 2-1. However, 231 were local shipments, from the Tonopah Test Range (TTR) to the NTS. The remaining 521 shipments were distributed as follows: 83.5 percent from the southeast (Kingman, Arizona), 9.8 percent from the southwest (Barstow, California), and 6.7 percent from the northeast (Mesquite, Nevada) (DOE, 1998b). The total number of shipments of LLW considered in this report are those used in the NTS EIS for the expanded use option. The NTS EIS assumed 25,084 truck shipments of LLW over a 10-year period (not including NTS LLW) (DOE, 1996a). For the intermodal options, the number of trains needed to accommodate these shipments was estimated using the ratio of train/truck shipments used in the *Waste Management Programmatic Environmental Impact Statement* (DOE, 1997b). This ratio is 96,880/257,270, resulting in a value of 0.377. This assumption equates to 9,457 train shipments over the 10-year period, with an average of 2.65 trucks per train. Each truck shipment is assumed equivalent to one 6-meter (m) (20-foot [ft]) container.

Using an average of 2.65 containers per train, it would require 2.59 trains per day, shipping 6.86 containers per calendar day to transport 2,508 equivalent truck shipments per year through an intermodal facility. These arrivals would require 7 trucks per day, or one truck every 1.14 hours during an 8-hour work day (assuming 365 working days per year) departing the intermodal facility. Traffic volume would be doubled by empty trucks returning to the intermodal facility.

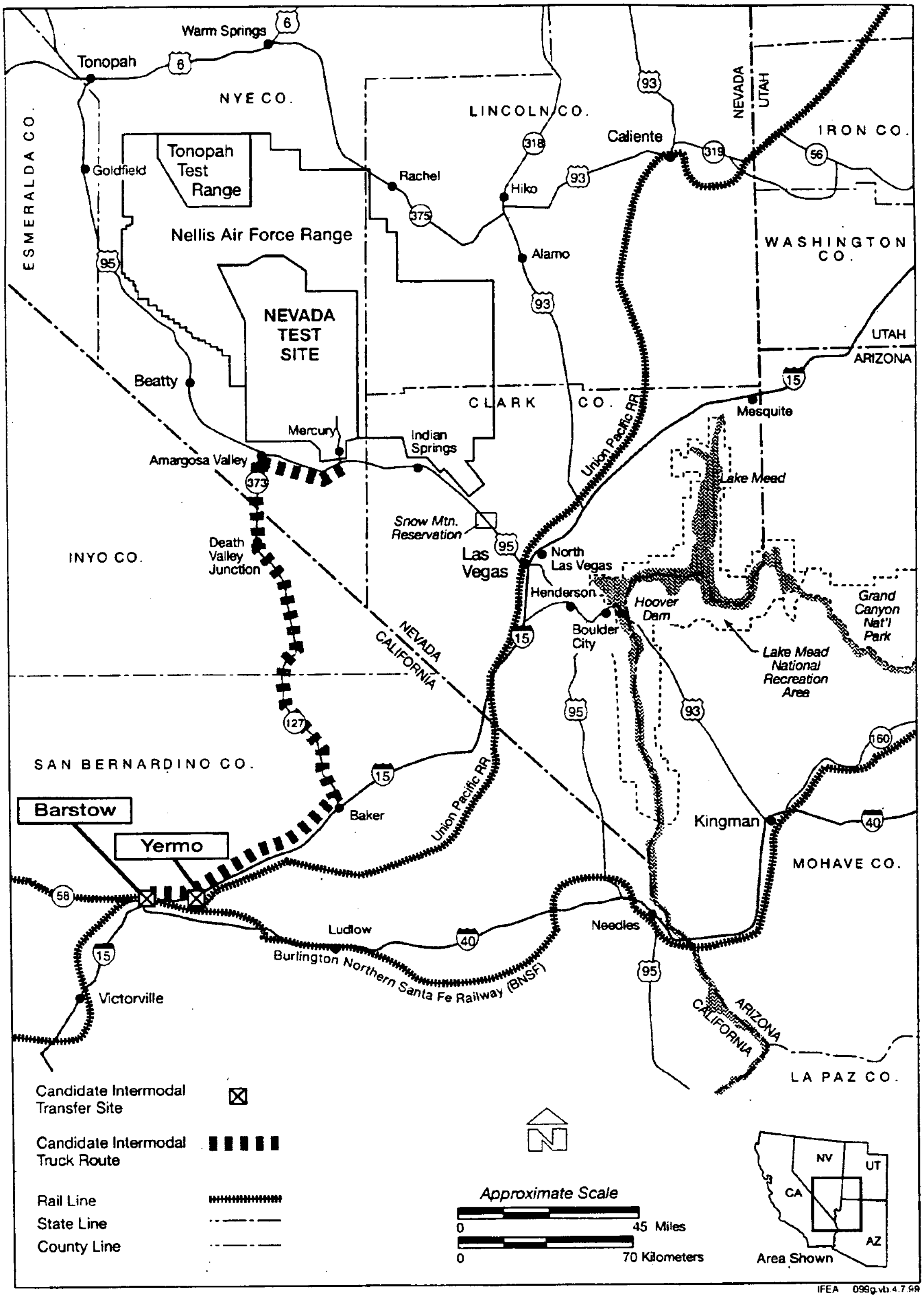

Figure 2-1. Barstow/Yermo Option.

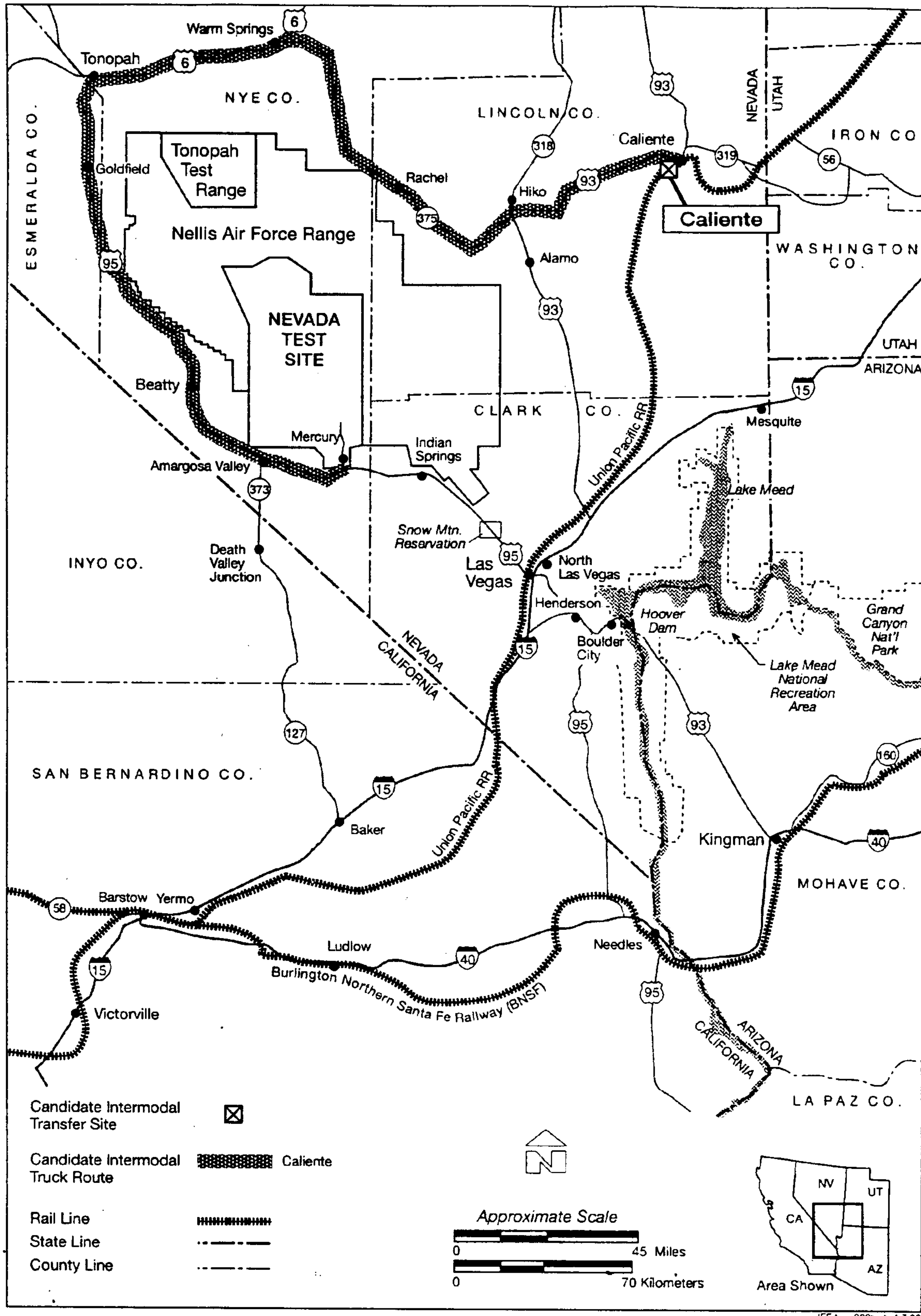

Figure 2-2. Caliente Option.

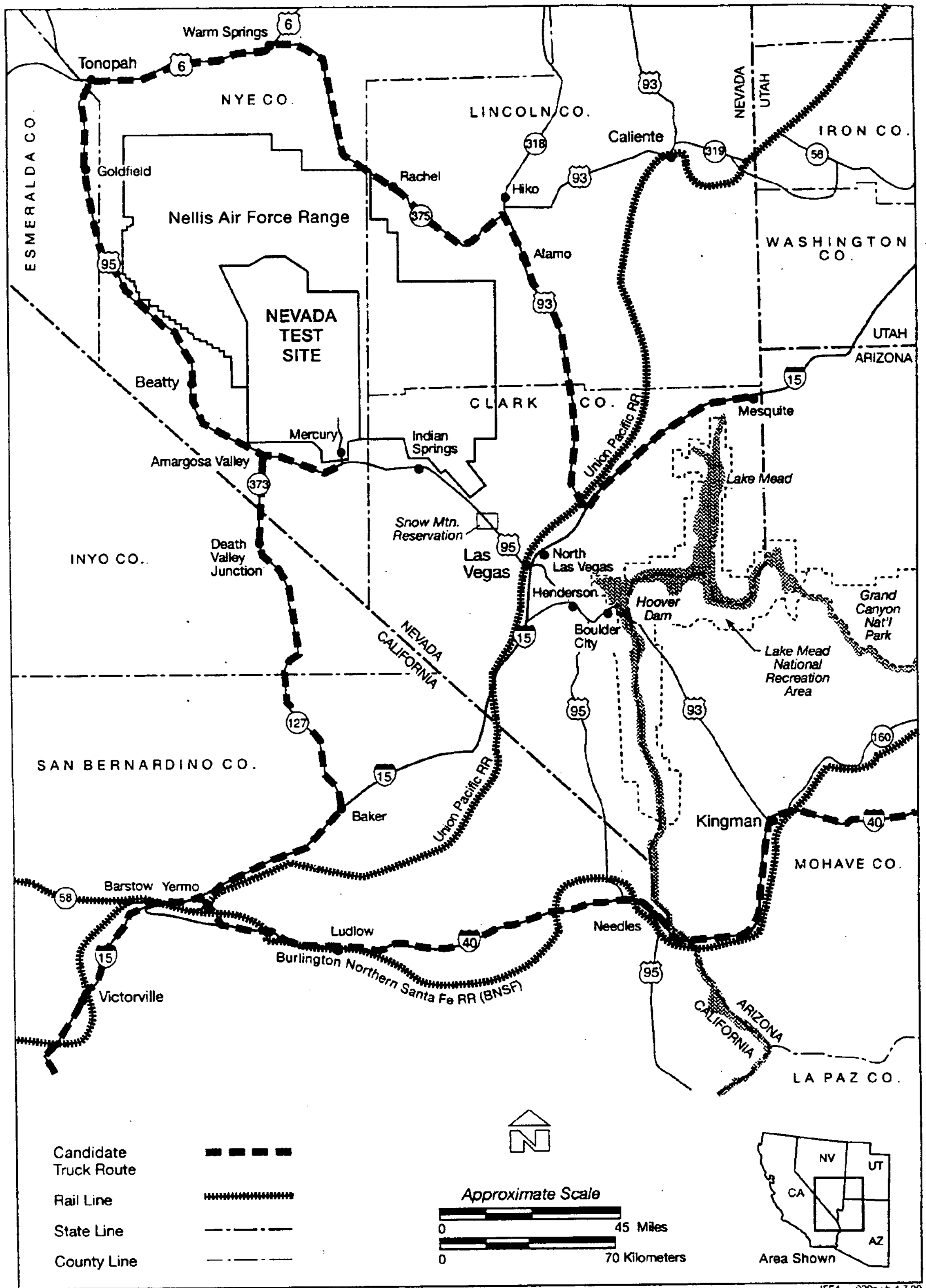

Figure 2-3. All-truck Option.

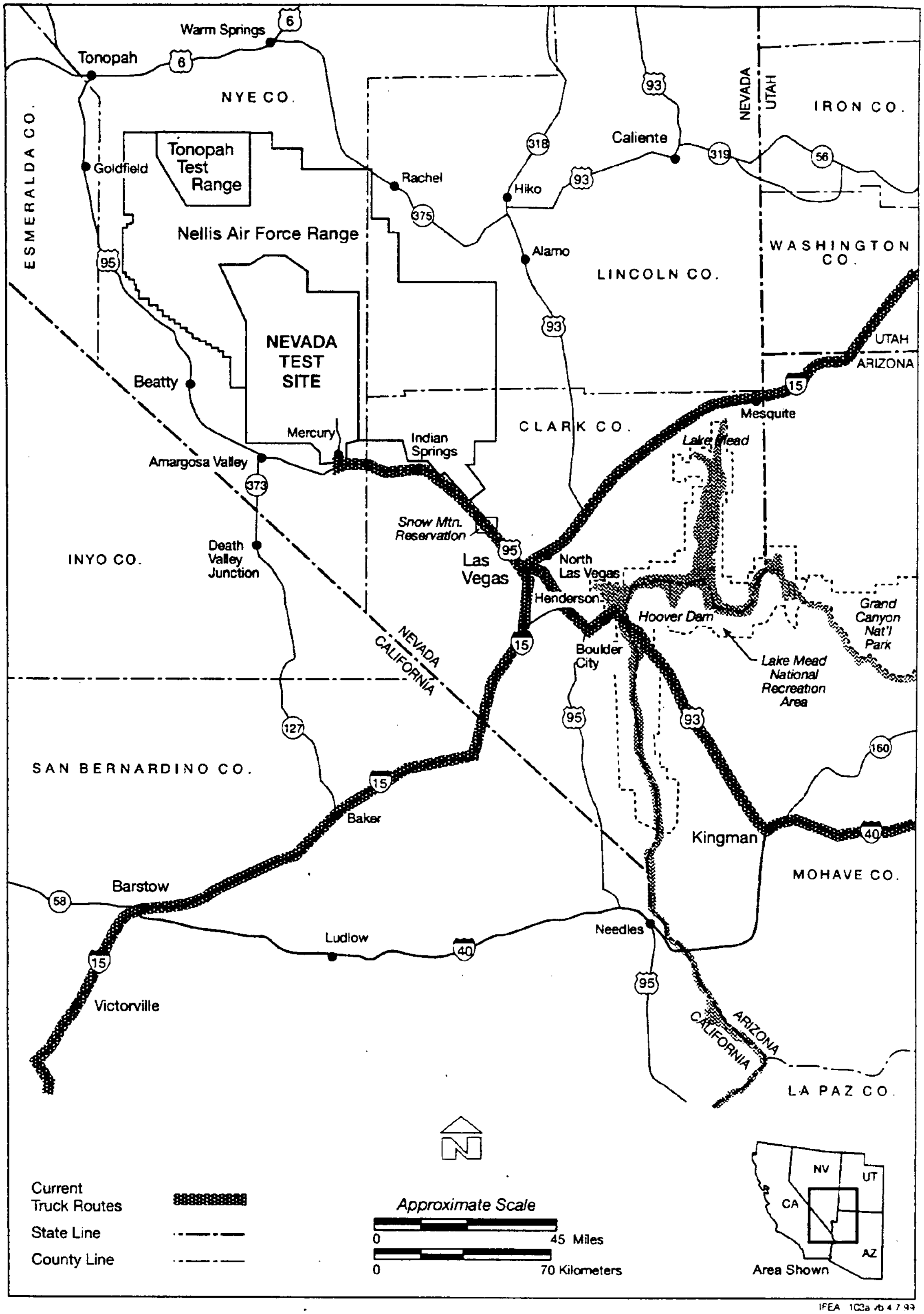

Figure 2-4. Current Routes.

Table 2-1. Approved Generators

Aberdeen Proving Ground, Aberdeen, Maryland	Allied Signal, Kansas City, Missouri
Bechtel Nevada, Nevada Test Site	Boeing North America-Rocketdyne, Canoga Park, California
Fernald Environmental Management Projects, Cincinnati, Ohio	General Atomics, San Diego, California
International Technology Corporation, Las Vegas, Nevada	Lawrence Livermore National Laboratory, Livermore, California
Lovelace Respiratory Research Institute, Albuquerque, New Mexico	Mound Plant, Miamisburg, Ohio
Pantex Plant, Amarillo, Texas	RMI Environmental Services, Ashtabula, Ohio
Rocky Flats Plant, Golden, Colorado	Sandia National Laboratories, Albuquerque, New Mexico
Sandia National Laboratories, Livermore, California	

The assumption of 365 working days per year was made to minimize container storage at the intermodal sites. The facility would require sufficient rail capacity for storage of rail cars that might arrive overnight and would not be unloaded until the following morning. Equipment would be needed to make the intermodal transfer of 6-m (20-ft) containers to truck chassis. Rail trackage would be needed to accommodate seven to ten rail cars on a siding or spur accessible to the transfer equipment to accommodate peaks in container arrivals. Storage would be provided at the NTS.

The All-truck routes assume that 83.5 percent of the shipments arrive from the southeast, 6.7 percent arrive from the northeast, and 9.8 percent arrive from the southwest (DOE, 1998b).

The NTS EIS also includes 14,000 shipments over 10 years from the NTS (TTR) to the waste disposal site. These shipments would continue to be moved by truck on US 6/95 from the TTR to the entrance of the NTS at Mercury. They would result in an average increase in traffic of 5.60 trucks departing the TTR per working day (assuming 250 working days per year), or one truck every 1.43 hours during an 8-hour work day. Traffic volume would be doubled by empty trucks returning via public roads.

During initial meetings with local officials, information on DOE emergency response procedures was requested. The DOE Emergency Management system described in Appendix D augments local emergency response capabilities referenced in the socioeconomics sections to this report.

2.1 OPTION 1 – INTERMODAL TRANSPORTATION

Option 1 would use intermodal transportation, which would bring LLW by rail to a facility near the NTS where it would be transferred to trucks for delivery to disposal areas on the NTS. LLW would be in containers on railcars or on truck chassis on flatcars when they arrive at the intermodal transfer site. Some of the LLW containers may already be on truck trailers. When the containers arrive, they are manually unlatched by personnel and then removed from the railcars by lifting equipment (crane or fork lift). The containers with trailers are off-loaded with their trailers. The containers without trailers are off-loaded and attached to individual trailer chassis.

Individual trailers (trailers and trailer chassis) are then connected to tractors and leave the facility for delivery to the NTS.

The following sites were considered for intermodal transfers. The truck routes to be used between the intermodal facilities and the NTS are described in Chapter 3.

2.1.1 Option 1A – Barstow, California

The Barstow Option would use a currently operating intermodal facility owned by the Burlington Northern Santa Fe (BNSF) Railway. Trucks servicing Barstow would use the route shown on Figure 2-1 for the trip to the NTS.

The existing facility currently transfers approximately 59,000 trailers per year to trucks for distribution throughout the region (Digiorno, 1998). The estimated maximum number of annual LLW shipments (2,508) would be approximately 4 percent of this activity. The facility is designed principally to transfer truck trailers on rail flat cars to truck tractors.

The facility is located in an isolated area at the southwestern edge of the urbanized area, with direct access to the interstate highway system at the intersection of I-15 and I-40 without passing through the city. Barstow is a major terminal for the BNSF. Transfer operations to the Union Pacific (UP) Railroad are conducted at the BNSF classification yard.

2.1.2 Option 1B – Caliente, Nevada, In-town Site

The City of Caliente has proposed to establish an intermodal facility to accommodate the transfer of both LLW and other freight to enhance the economic development of the city. The city has proposed two possible sites. One site is in a commercial area on the UP right-of-way (Caliente In-town). The location is shown on Figure 2-5.

Intermodal operations would be conducted from a new siding connected to the existing passing track at both ends on the existing UP right-of-way. A track layout plan is shown in Figure 2-6. Assuming the least efficient inbound loading situation, primarily due to the low volume originating from a multitude of different generating locations, as many as seven 89-ft flat cars could arrive per day. It is, therefore, prudent to plan for two tracks, each capable of accommodating between seven and ten 89-ft flat cars, 270 m (900 ft) per track. This additional trackage is necessary to accommodate the potential irregular operation of the inbound and outbound movement of rail cars.

A typical intermodal transfer would involve the following operations. The Las Vegas-bound road crew would stop the train at a point east of the switch for the Caliente intermodal track; uncouple the inbound cars for the LLW operation from the rest of the train; pull the inbound Caliente cars west of the switch to the Caliente intermodal lead; wait for the train dispatcher in Omaha, Nebraska, to align and lock the switch for the inbound intermodal lead; pull the inbound cars onto one of the two tracks for handling the LLW; secure the hand brakes on the inbound

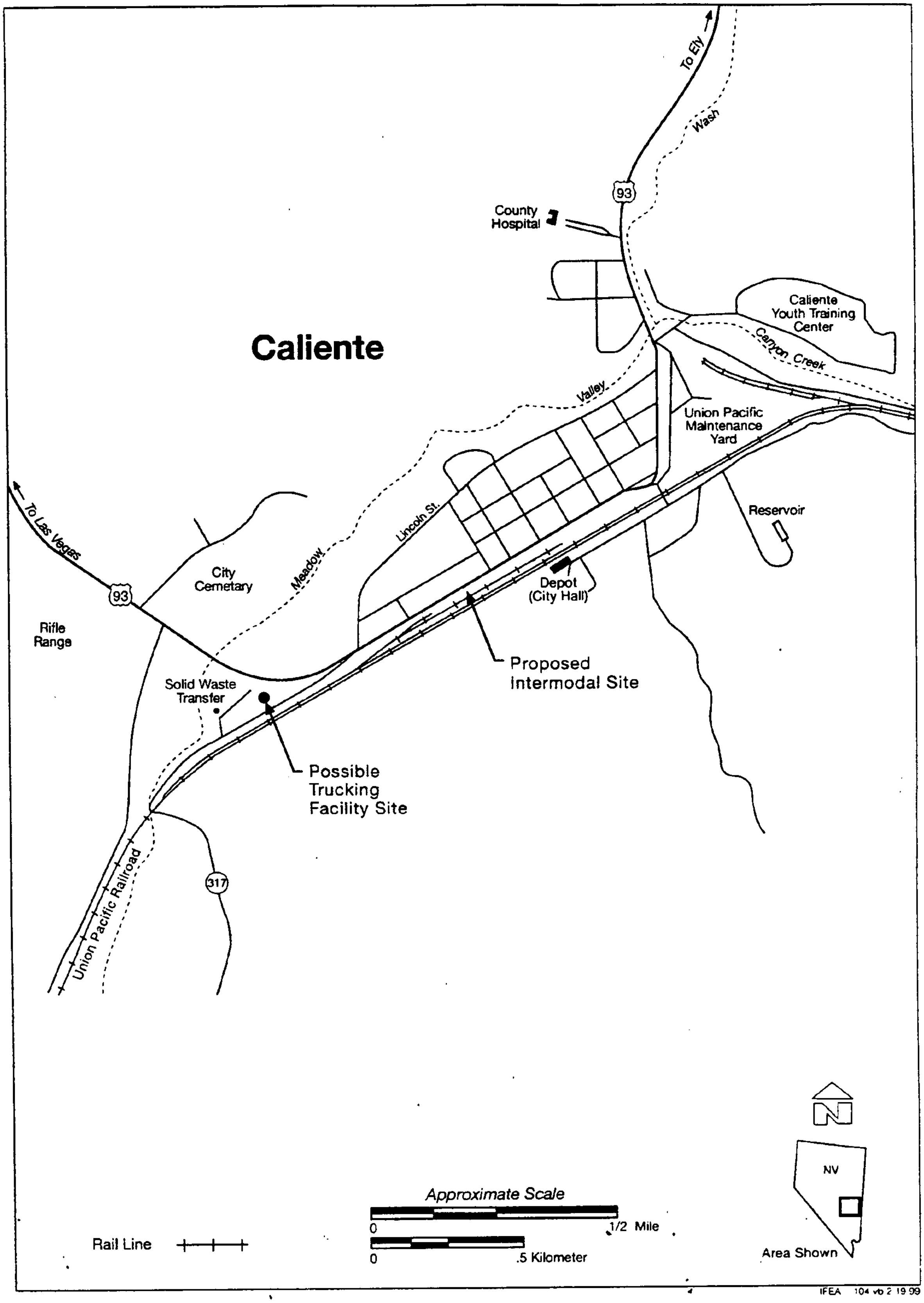

Figure 2-5. General Vicinity Map at the Proposed Caliente In-town Intermodal Site

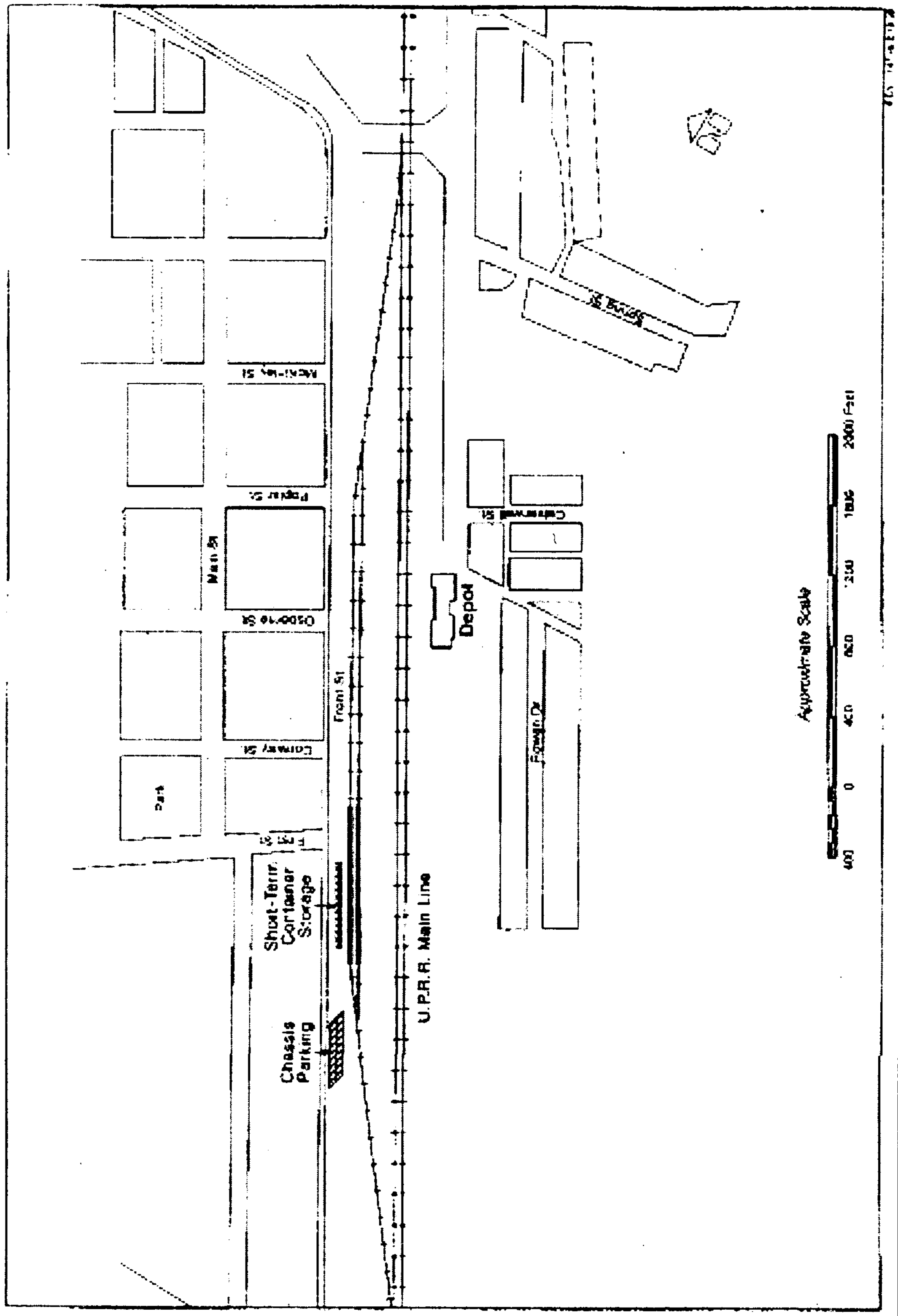

Figure 2-6. Track Layout Plan.

cars; cut the locomotive away from the inbound rail cars; pick-up any available and released empty rail cars (after visually inspecting them for mechanical defects); pull out onto the UP track west of the switch; have the dispatcher in Omaha align the switch to recouple with the balance of the train; restore the trainline pressure to release brakes on the remainder of the train; advise the train dispatcher in Omaha that the train is ready to depart from Caliente; and receive permission or signal to depart. Provided there is no delay in the required communications between the train crew and the dispatcher, this entire process should be accomplished in 30 minutes or less. It could occur at any time of the day or night (Gernon, 1998).

Intermodal transfer operations would occur only during daytime working hours. A large fork lift or crane would be used to transfer containers from the rail cars to truck chassis. Very limited short-term container storage at the site would be anticipated. Containers dropped off during the night would be transported to the NTS the following morning. A staff of three would be adequate to conduct these operations.

The UP right-of-way at the in-town site is currently graveled. An area approximately 270 by 30 m (900 by 100 ft) adjacent to the siding would need to be graded, fenced, and lighted. Intermodal operations could begin quickly at this site once a lease agreement had been reached with the railroad, site improvements had been made, and a portable crane had been obtained.

The Caliente route, illustrated on Figure 2-2, is designed to traverse rural areas and avoid the Las Vegas Valley. Truck access to the route could be obtained without driving through the populated area of the city. A rest area for truck drivers and emergency maintenance would be available at the entrance to the TTR. After unloading the containers at the NTS, being checked for radioactivity, and decontaminated as necessary, the empty trucks could return to the intermodal transfer facility through Las Vegas via US 95, I-15, and US 93.

2.1.3 Option 1C – Caliente, Nevada, South Site

The second site at Caliente is 1.2 km (0.75 mi) south of the populated area on city-owned land currently used for irrigation to dispose of water from sewage treatment ponds. A site layout plan is shown on Figure 2-7. It is currently pasture land with access by an unimproved road. Road improvements to accommodate legal-weight trucks would be needed, as well as construction of rail facilities for intermodal operations on a 5-acre site. The operations procedures and route to the NTS would be the same as those described in Option 1B. Figure 2-8 shows one method for unloading containers. Fork lifts and cranes could also be used.

Truck access to US 93 from the south site could also be obtained without driving through the populated area of the city. The city is currently planning to establish the in-town site first and move operations to the south site, in conjunction with other projects at this site described in Section 5.0, *Related Projects*.

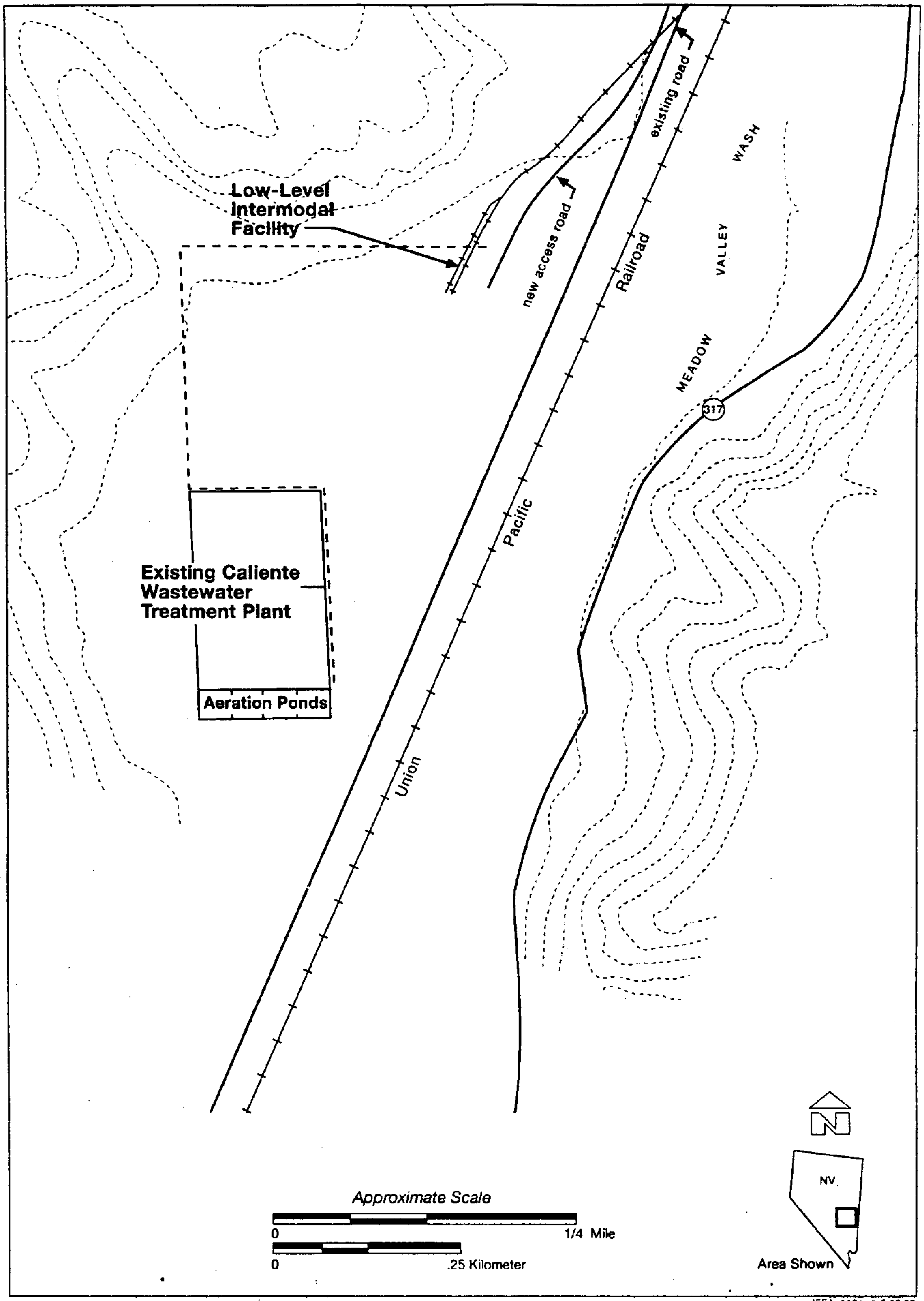

Figure 2-7. Layout Plan, Caliente South Site.

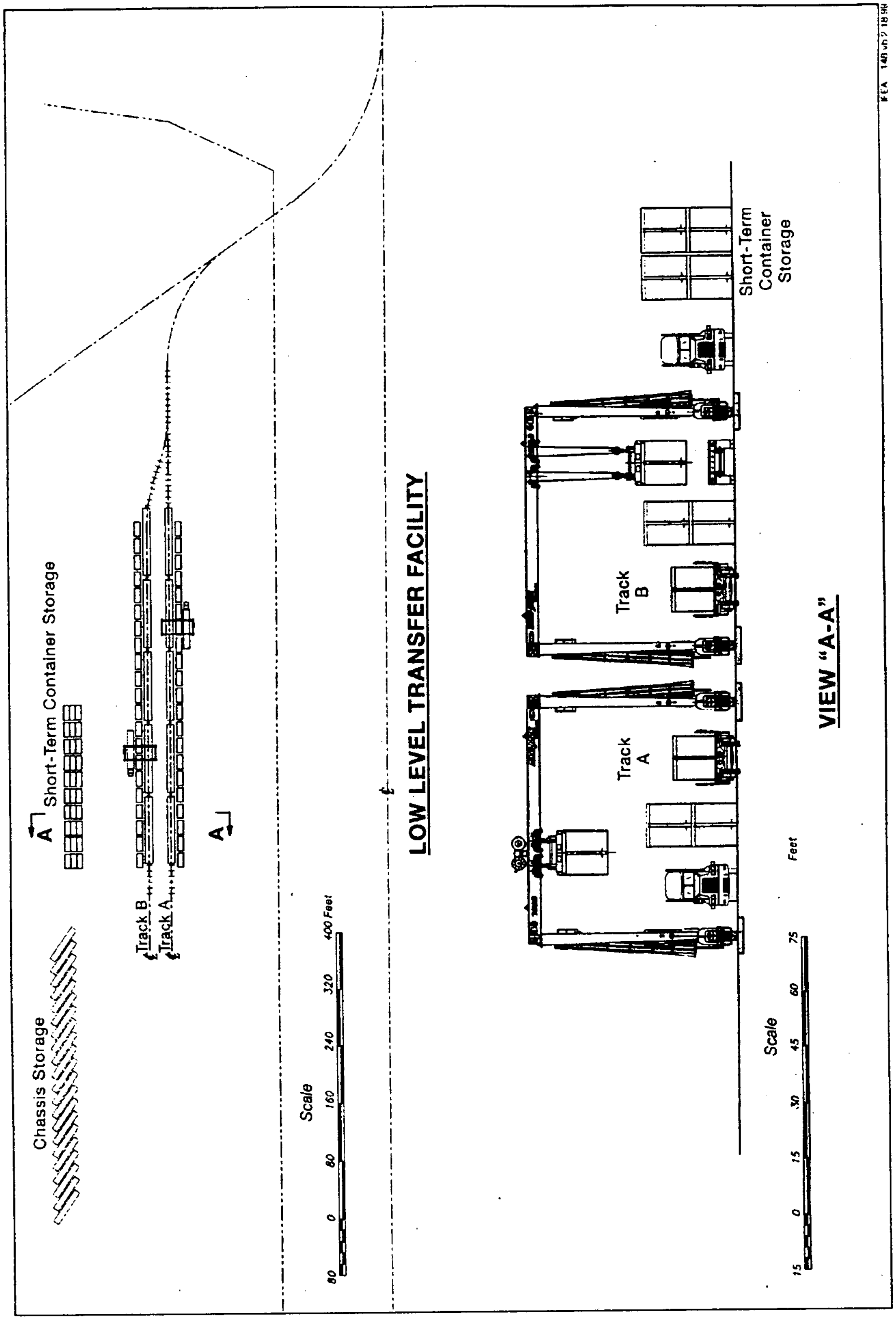

Figure 2-8. Intermodal Operations.

2.1.4 Option 1D – Yermo, California

The Yermo site would use the existing intermodal facilities at the rail terminal operated by the MCLB Barstow. Figure 2-9 indicates the location of the intermodal facility at the Yermo Annex. The facility has direct access to I-15. Relatively few intermodal operations are currently conducted. Although the rail facilities are extensive, they are used primarily to support military training exercises at nearby Fort Irwin. It also handles small quantities of radioactive materials and has limited emergency response capabilities (Gentry, 1998).

Trucks servicing this facility would use the route shown on Figure 2-1 for the round trip to the NTS. Since the base is served only by the UP, containers arriving on the BNSF would first be dropped off at the BNSF rail yard in Barstow, where they would typically remain for 16 to 24 hours. This dwell time could be as long as 48 hours over weekends (Littlefield, 1998). The rail cars are retrieved by the UP and moved 19.3 km (12 mi) to the UP yards at Yermo before being delivered 3.2 km (2 mi) to the base for pick-up by the Marine Corps for movement to the intermodal operations site (Crownover, 1998). Rail cars would be moved onto the Yermo Annex only during scheduled working hours when they would not interfere with military operations.

2.2 OPTION 2 – ALL-TRUCK

This option would continue to use federal and state highways to transport LLW to the NTS by truck without transiting the Las Vegas Valley or Hoover Dam. The routes are shown on Figure 2-3.

2.2.1 Option 2A – Kingman, Arizona, to Yermo Route

The All-truck route from the southeast would deviate at Kingman, Arizona, from its present route through Las Vegas, and continue on I-40 to the connecting road with I-15 at Yermo, California, and join the route to the NTS for the Yermo Option. The route from the west would continue to use I-15 and also join the route for the Yermo Option.

2.2.2 Option 2B – Mesquite, Nevada, via Tonopah

The All-truck route from the northeast would enter Nevada at Mesquite on I-15, and deviate from the route through the Las Vegas Valley at the intersection with US 93, and continue north to join the route from Caliente at the intersection with NV 375.

2.3 OPTION 3 – CURRENT ROUTES

All shipments would continue to use trucks with routes through the Las Vegas Valley and over Hoover Dam (shown in Figure 2-4). The level of analysis for all of the options is based on potential waste shipments identified in Option 3 (Expanded Use) from the NTS EIS

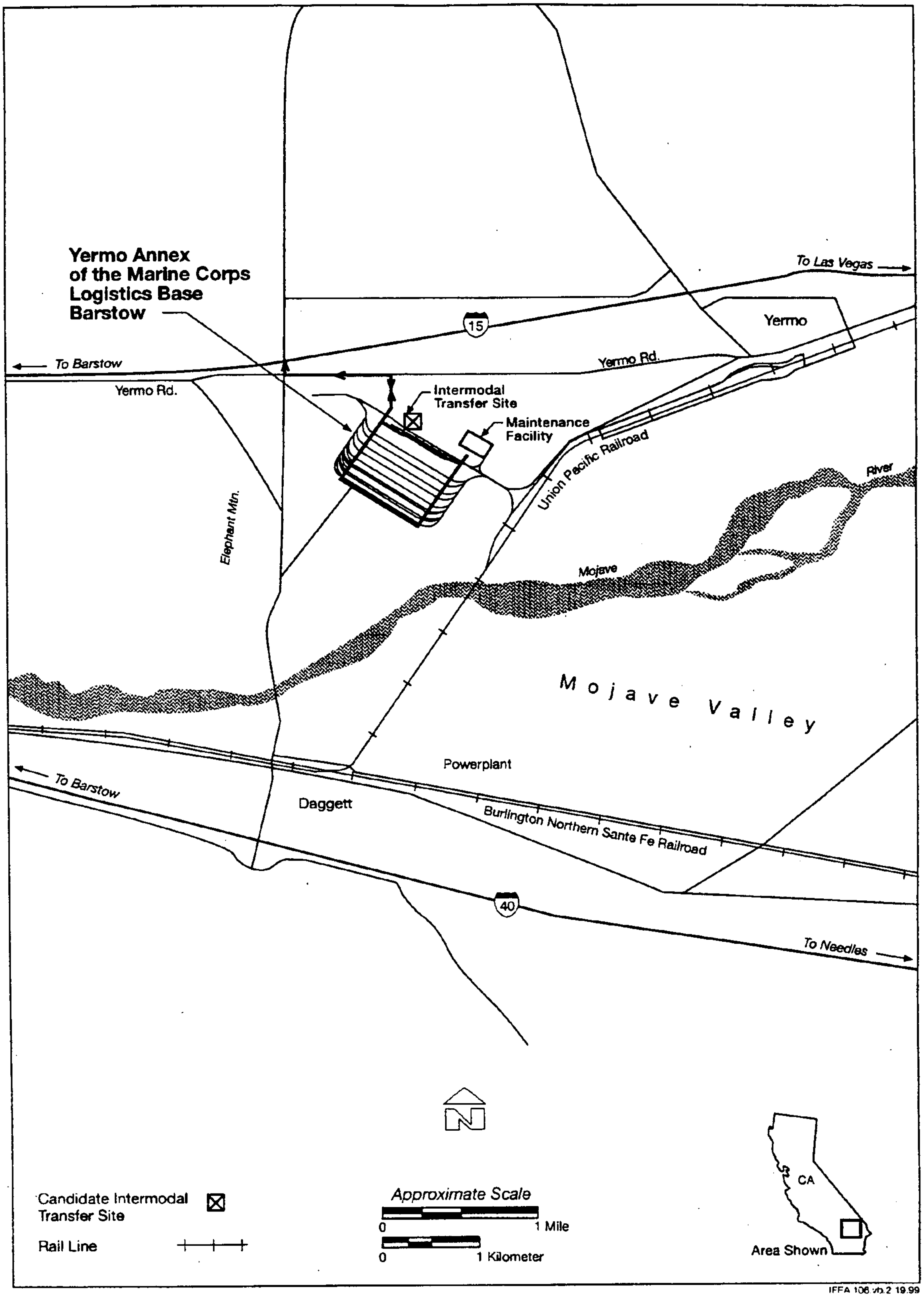

Figure 2-9. Transportation Systems at MCLB Barstow–Yermo Annex.

(DOE, 1996a). The objective is to provide an upper bound to the analysis to approximate the maximum number of shipments that could be experienced if the upcoming ROD for the *Waste Management Programmatic EIS* includes disposal at the NTS. The average annual number of shipments from the Expanded Use Option in the NTS EIS (2,508) are assumed to be distributed as they were in FY 1997 – 83.5 percent from the southeast (Kingman), 6.7 percent from the northeast (Mesquite), and 9.8 percent from the southwest (Barstow).

This option does not assume that expanded use will occur. It only permits consistent analysis of the differences in risk attributable to the modes of transportation and routes taken. If the *Waste Management Programmatic EIS* ROD does not change the present situation, LLW shipments would be limited to those from the 15 currently approved generators analyzed in Option 1 of the NTS EIS, and the number of shipments would be less than those analyzed in this report.

2.4 OPTIONS CONSIDERED AND ELIMINATED FROM FURTHER ANALYSIS

In January 1998, DOE/NV issued its *Nevada Test Site Intermodal Transportation Facility Site and Routing Evaluation Study* (DOE, 1998a). The planning phase of that 1997 study first eliminated three potential sites: (1) the Hawthorne Army Depot at Hawthorne, Nevada; (2) short-line facilities around Ely, Nevada; and (3) the UP Crucero siding in southeastern California.

The Hawthorne site in Mineral County, Nevada, is constrained by institutional issues concerning the Walker River Indian Reservation. The Ely site in White Pine County, Nevada, is constrained by track design and condition. The Crucero site in San Bernardino County, California, was eliminated from further evaluation because of its inaccessibility to trucks and its proximity to the Mojave National Preserve (1.4 million acres where the Mojave, Great Basin, and Sonoran deserts meet).

The results of the study eliminated three more potential transfer sites: (1) the UP Apex siding northeast of the Las Vegas Valley, (2) the Valley Intermodal Facility near North Las Vegas, and (3) the UP Dunn siding in southeastern California. Use of the Apex or Valley options would result in the transport of LLW in highly congested and populated areas of Clark County. The Dunn site does not have good truck access, and operations could conflict with bulk rail shipments from a private company.

After the study was completed, two additional sites, the UP Arden and Moapa sidings, were considered and eliminated from further analysis. The Arden site is near the junction of I-15 and NV 160 in Enterprise, an unincorporated area in Clark County. Since the State of Nevada and Clark County elected officials and others have made it clear that they oppose any intermodal transfer site located in Clark County, the Arden Option was considered to have no community support and was eliminated from further analysis. The Moapa site was also eliminated from further analysis for lack of community support. A formal vote by the Moapa Tribal Business Council opposed the project.

2.5 COMPARISON OF OPTIONS

Table 2-2 summarizes the results of the analysis and compares options according to their relative achievement of the objectives of minimizing radiological risk, enhancing safety, and reducing cost. The values for radiological risk are expressed as the chance of one cancer fatality from radiation exposure from 25,084 6-m (20-ft) container shipments over 10 years, in six situations. The first row shows the chance of a single cancer fatality for workers conducting normal operations at intermodal facilities. The dose received depends on the time spent in the vicinity of the container and the distance from the container. The second row shows the same information for a worker at a distance of 10 m (32.8 ft) from an accident involving a fire at an intermodal facility. The accident scenario includes damage to a shipping container that releases its contents and disperses radioactive material into the atmosphere. It includes both the probability and consequences of such an accident. These are the same for all options involving an intermodal transfer.

The third row in Table 2-2 shows the chance of a single cancer fatality from exposure to the external radiation field surrounding the shipping container during normal, incident-free transportation. The dose is a function of the number of people exposed, their proximity to the container, their length of exposure time, and the intensity of the radiation field surrounding the container. While none of the options pose a health risk, the Caliente Option that avoids the Las Vegas Valley indicates the minimum level of radiological risk. (Larger values indicate lower risk.) Although the distance from Caliente to the NTS is longer than other options, the route passes through areas with relatively small populations. The risk is reduced from the route from Caliente to the NTS through the Las Vegas Valley and from moving the same amount of waste on currently used routes. The All-truck Option poses the highest risk. However, differences between routes that go through the valley and those that avoid the valley are small when the entire route from eastern generators is considered. For example, the values from the Fernald site in Ohio are both one chance in 106 for the complete trip.

The fourth row shows the chance of a single cancer fatality from exposure to radiation from waste released during a transportation accident. Because it is not possible to predict where along a route accidents might occur, the accident risk analysis uses route-specific data on population densities to develop risk factors for three population density zones: rural, suburban, and urban. Radiation doses for these zones were weighted by accident probabilities to calculate dose risk. While none of the options pose a health risk, the Caliente Option that avoids the Las Vegas Valley, again indicates the minimum level of radiological risk. Although the distance from Caliente to the NTS is longer than other options, the route passes through areas with relatively small populations. The risk is reduced from the route from Caliente to the NTS through the Las Vegas Valley and from moving the same amount of waste on currently used routes.

The fifth row shows the chance of a single cancer fatality from exposure to radiation from waste released during a maximum reasonably foreseeable transportation accident, assuming the accident occurs. This scenario assumes that the accident would occur in the population density zone appropriate for each option. The suburban zone was indicated for the Caliente Option because it has no mileage classified as urban. All other options have urban mileage. While none

Table 2-2. Comparison of Options by Objectives[1,4]

	Option 1A Barstow		*Options 1 B/C Caliente*		*Option 1D Yermo*		*Option 2 All-truck*		*Option 3 Current Route*	
	Avoid[2]	*Through*[3]	*Avoid*[2]	*Through*[3]	*Avoid*[2]	*Through*[3]	*Avoid*[2]	*Through*[3]	*Avoid*[2]	*Through*[3]
Minimize Radiological Risk[4]										
1. Worker Cancer Fatality for Normal Operations at Intermodal Facility One chance in:	588		588		588		N/A		N/A	
2. Worker Cancer Fatality Risk for Radiological Accident at Intermodal Facility One chance in:	357 million		357 million		357 million		N/A		N/A	
3. Incident-free Cancer Fatality Risk One chance in:	227	145	263	204	152	111	101	116	116	
4. Accident Cancer Fatality Risk One chance in:	59 mil.	2.6 mil.	630 mil.	2.4 mil.	50 mil.	2.6 mil.	18 mil.	1.5 mil.	1.5 mil.	
5. Cancer Fatality from Maximum Reasonably Foreseeable Accident One chance in:	625	625	3,333	625	625	625	625	625	625	
6. A *Waste Management Programmatic EIS* analysis indicated that the ratio of latent cancer fatalities from radiation exposure from truck transportation to fatalities from rail was 7/1 for cross-country shipments of LLW (DOE, 1997b).										
Enhance Safety										
7. Accident Fatality Risk One chance in:	4.2	3.1	2.9	2.5	4.0	3.1	2.3	6.3	6.3	
8. A *Waste Management Programmatic EIS* analysis indicated that the ratio of fatalities from truck traffic accidents to fatalities from rail accidents was 76/1 for cross-country shipments of LLW (DOE, 1997b).										

Reduce Cost

	Option 2 – All-truck		Option 3 – Current Route
	Avoid[1]	Through[2]	Through[2]
9. Intermodal costs are typically less than trucking costs for generators located in the eastern U.S. Trucking costs are typically less than intermodal costs for generators located in the western U.S. FY 1997 shipments were 81.6 percent from the eastern U.S. and 18.4 percent from the west. (See Tables 3-3 and 4-12, in Chapters 3 and 4 respectively, for cost information).	Costs are increased by 2 percent for California generators, 20-28 percent for Missouri, Colorado, and Texas generators, and 10-15 percent for eastern generators		No change in current costs

[1] Risks were calculated for a 10-year LLW shipment period.
[2] "Avoid" uses the route from the point of origin of the option to the NTS that avoids the Las Vegas Valley.
[3] "Through" uses the route from the point of origin of the option that passes through the Las Vegas Valley.
[4] Larger values indicate less risk.

of the options pose a health risk, the Caliente Option that avoids the Las Vegas Valley indicates the lowest level of radiological risk. The risk is reduced from the routes from Caliente to the NTS through the Las Vegas Valley, as well as from all other options.

The sixth row of Table 2-2 shows that cross-country shipments by rail would reduce radiation hazards over shipments by truck, by a ratio of seven to one.

The seventh row compares the risk of traffic accident fatalities among the options. Accident fatality data were taken from state transportation department records for the past 3 years. The results are directly related to the relative mileage of each option. Since the current route within Nevada is the shortest, and the route from Yermo that avoids the Las Vegas Valley is about the same length, these options have the smallest risk of an accident fatality. However, both the Current Route and All-truck options could be expected to have higher accident risks than the intermodal options when the cross-country portions of their routes are added, due to the lower accident risk of rail compared with truck transportation. The truck route that avoids the valley is the longest and has the largest accident fatality risk.

The eighth row shows that cross-country shipments by rail would reduce traffic accident fatalities over shipments by truck, by a ratio of 76 to 1.

The ninth row shows that the cost of intermodal shipments from the eastern United States to the NTS could be expected to be less than current trucking costs. Over 80 percent of current shipments to the NTS are from this region. The additional mileage of the All-truck Option would result in cost increases over current routes of 2 percent for nearby generators, 20 to 28 percent for mid-range generators, and 10 to 15 percent for long-distance generators.

In summary, cross-country intermodal shipments of LLW offer significantly lower radiological risk than truck shipments. The Caliente intermodal options minimize radiological risk. They are followed, in order, by Barstow, Yermo, Current Route, and All-truck.

Although there are presently no intermodal facilities in Caliente, both of the sites evaluated would be suitable for the development of such a facility. The Yermo Option is constrained, operationally, by the transfers between rail lines and yards that would be required, and possible delays to avoid interference with operations at the MCLB Yermo Annex. The Barstow BNSF Railway intermodal facility normally handles trailers on flat cars, including placarded shipments containing radioactive materials. Special arrangements would need to be made to handle containers and other packaging methods. The All-truck Option poses the highest level of radiological risk.

The risk of accidents is much larger than radiological risk. The use of rail for cross-country transportation of LLW offers significantly lower accident fatality potential than truck shipments. When shipments arrive in the local region by rail, the highway accident potential is generally related to the distance from the intermodal facility to the NTS. The data indicate that Barstow would have the smallest accident fatality potential, followed by Yermo and Caliente. If intermodal transportation is not used, the accident potential of the current truck route option through Las Vegas would be smaller than the All-truck Option that avoids Las Vegas.

Intermodal operations offer lower costs than trucking for over 80 percent of shipments of LLW. The All-truck Option would increase costs for all shipments.

For comparison purposes, Table 2-3 provides a reference for the risk values by showing the chances of death from a variety of common events.

Table 2-3. Risk Comparisons

Cause of Death	*Lifetime Risk of Dying, One Chance In:*
Cancer, all causes	5
Automobile accident	87
Cancer, naturally occurring radiation	93
Fire	500
Poisoning	1000
Lightning	39,000
Cancer, fossil fuel emissions	55,000

Source: National Safety Council, 1993.

Potential environmental effects of the options were also analyzed. They are summarized in Table 2-4.

2.6 CHOOSING OPTIONS

There are numerous considerations that must be taken into account as waste generators evaluate intermodal transportation options. They include radiological risk, safety, cost, road conditions, the availability of intermodal facilities, the availability of competitive rail carriers, the availability and costs of packaging methods and containers, the compatibility of packaging and facilities, and environmental effects. Some waste generators have rail facilities located on their sites. Those without these facilities can identify the nearest intermodal facility and transport their waste to this facility by truck.

It is clear that the use of rail rather than truck for cross-country transportation is preferred from safety and radiological risk considerations alone. The choice of intermodal transfer points near the NTS is not so clear.

2.6.1 The Options

The Caliente Option provides the least radiological risk, principally due to the rural character of the highway route to the NTS. However, at 553.8 km (344 mi), it is the longest route of the three intermodal options considered and has the greatest accident potential. Although intermodal

Table 2-4. Comparison of Options by Resource and Potential Effects

Option 1A *Barstow*	*Option 1B* *Caliente In-town*	*Option 1C* *Caliente South*	*Option 1D* *Yermo*	*Option 2* *All-truck*	*Option 3* *Current Route*
			Transportation		
The increase of truck traffic would not affect the congestion levels on the roadways to a noticeable extent.	The low level of traffic increase would not have any effect on the capacity of the roadways used.	The low level of traffic increase would not have any effect on the capacity of the roadways used.	The increase of truck traffic would not affect the congestion levels on the roadways to a noticeable extent.	The low level of traffic increase would not affect the capacity or operation of the roadways.	Expanded use of the current routes would not affect traffic congestion levels.
			Land Use		
There would be no changes in land uses at the existing intermodal facility.	Intermodal operations on the existing railroad right-of-way would be consistent with current zoning.	A new land use would be consistent with rail operations adjacent to the site.	There would be no changes in land uses at the existing intermodal facility.	Land uses would not be affected by this option.	Land uses would not be affected by this option.
			Visual Resources		
Visual resources would not be affected.	Visual resources would not be affected.	Visual resources would not be affected.	Visual resources would not be affected.	Visual resources would not be affected.	Visual resources would not be affected.
			Utilities		
Utilities would not be affected at this operational intermodal facility.	Utilities with adequate capacity are readily available.	Utilities with adequate capacity are readily available.	Utilities would not be affected at this operational intermodal facility.	Utilities are not affected by this option.	Utilities are not affected by this option.
			Noise		
Noise levels would not be increased at this operational intermodal facility.	Intermodal operations would not cause a significant adverse effect on the noise environment in the area.	Intermodal operations would not cause a significant adverse effect on the noise environment in the area.	Noise levels would not be increased at this operational intermodal facility.	Redirection of trucks to alternative routes would cause no substantial increase in noise levels.	Expanded use would cause no substantial increase in noise levels along existing routes.
			Air Quality		
Air quality would not be affected at the existing intermodal site.	Air quality effects are negligible.	Air quality effects are negligible.	Air quality would not be affected at the existing intermodal site.	No significant adverse effects to air quality are expected.	No significant adverse effects to air quality are expected.

Table 2-4. Comparison of Options by Resource and Potential Effects (Continued)

Option 1A Barstow	*Option 1B Caliente In-town*	*Option 1C Caliente South*	*Option 1D Yermo*	*Option 2 All-truck*	*Option 3 Current Route*
		Water Resources			
Water resources would not be affected.	Water resources would not be affected.	Water resources would not be affected.	Water resources would not be affected.	Water resources would not be affected.	Water resources would not be affected.
		Radiation, Safety and Occupational Health			
No adverse health effects would be expected.	No adverse health effects would be expected.	No adverse health effects would be expected.	No adverse health effects would be expected.	No adverse health effects would be expected.	No adverse health effects would be expected.
		Biological Resources			
No effects are expected.	No effects are expected.	No effects are expected.	No effects are expected	No effects are expected.	No effects are expected.
		Cultural Resources			
Cultural resources would not be affected.	No direct or indirect effects to any known historic properties would result.	No direct effects to any known historic properties would be expected. However, a rock art site might be subjected to indirect effect to its visual setting.	Cultural resources would not be affected.	Cultural resources would not be affected.	Cultural resources would not be affected.
		Geology and Soils			
No effects would occur.	No effects would occur.	No effects would occur.	No effects would occur.	No effects would occur.	No effects would occur.
		Socioeconomics			
No effects would occur.	Beneficial effects are expected from the small number of jobs that would be created and the potential back-haul of products from the NTS.	Beneficial effects are expected from the small number of jobs that would be created and the potential back-haul of products from the NTS.	No effects would occur.	No effects would occur.	No effects would occur.
		Environmental Justice			
No effects would occur.	No effects would occur.	No effects would occur.	No effects would occur.	No effects would occur.	No effects would occur.

facilities are not currently available in Caliente, efforts are underway by a private company to offer the service. Facilities are being designed to accommodate containers, trailers on flat cars and innovative packaging. This site is served by only one railroad, the UP.

The Barstow and Yermo, California, options offer service by two railroads. The BNSF serves Barstow, and the UP serves the MCLB Annex at Yermo. Barstow has an active commercial intermodal facility. However, it is designed primarily for transferring trailers on flat cars to tractors. If generators choose this method, it should work well. However, special arrangements would need to be made with the railroad to handle containers. The equipment is available, but chassis to receive the containers would need to be supplied, and the availability of a tractor would need to be coordinated with the arrival of containers. The services of a broker would probably be needed to make the arrangements and track the shipments. Barstow is much closer to the NTS than Caliente, a distance of 320 km (199 mi). This route is also largely rural with only 1.1 km (0.7 mi) of urban highway and 0.3 km (0.2 mi) of suburban population density. This nonrural mileage results in a small increase in the radiological risk, compared with Caliente, even though the distance is 233 km (145 mi) shorter.

The Yermo Option would be attractive in that it has the shortest distance to the NTS and offers the security of a military base. However, it is not likely to be chosen by generators for the following reasons.

The requirement for interline transfer between the BNSF and the UP in Barstow increases the radiological risk to be the largest among the intermodal options. As in the Barstow example, the route is largely rural with only 1.1 km (0.7 mi) of urban highway and 0.3 km (0.2 mi) of suburban population density. The MCLB at Yermo is served by the UP. For UP rail cars to reach Yermo without transiting the Las Vegas Valley, they must first go to the BNSF classification yard in Barstow for transfer to the UP. The time that the cars remain in Barstow near populated areas while waiting to be retrieved by the UP increases the radiological risk above the other two intermodal options. Marine Corps Headquarters has also expressed concerns about interference with military operations and their emergency response capabilities. They have asked that the Yermo Option not be considered further.

The All-truck Option has the highest level of radiological risk because it has the longest highway mileage, 713 km (443 mi) from Kingman and 716 km (445 mi) from Mesquite. However, it does avoid delays and accident risks due to construction and congestion, particularly near Hoover Dam and in Las Vegas. When the total trip from long-distance generators is considered, the additional miles above the current truck routes result in no significance difference in radiological risk from a site such as Fernald in Ohio. However, the cost and radiological risk remain higher than intermodal transportation for long-distance generators, and costs would be significantly higher for generators in California and the Rocky Mountain region.

Environmental issues would have little influence on the choice of option, since no significant effects were identified. Although there are relatively small differences in calculated radiological risk among the intermodal options, the risk to human health is not significant for any of the options.

2.6.2 Options Choice

The option preferred by each generator depends on their local situation. The California generators are likely to continue to prefer truck transportation. Because their approach to the NTS is from I-15 from the southwest, they can simply choose to avoid the congestion, construction, and urban population densities in the Las Vegas Valley by taking CA 127 north from Baker. Intermodal transportation from California locations is likely to be significantly more costly for little gain in the reduction of radiological risk, particularly for the relatively low volumes of waste involved. Only 9.8 percent of the waste shipped to the NTS in FY 1997 arrived from the southwest.

The generators in the central and southern Rocky Mountain region have a more difficult decision. From this region, the cost difference between truck and intermodal are likely to be small for the truck route through the valley, but cost could vary significantly depending on the distance from the generator to an intermodal facility. If the facility is on the BNSF line and can accommodate trailers on flat cars, this mode would appear to be a good choice with a transfer back to the highway at Barstow. If intermodal facilities are not readily available, there would likely be a strong motivation to continue to use current truck routes through the valley, since avoiding the valley would add a significant percentage to the length and cost of the trip.

The availability of rail access would be important for Rocky Mountain region generators and the Pantex plant in Amarillo, Texas. For example, the Pantex plant has access to the BNSF Intermodal Facility in Amarillo. Rocky Flats has access to intermodal facilities of both the UP and BNSF in Denver and could choose either Caliente or Barstow, but Sandia National Laboratories in Albuquerque would be limited to the BNSF to Barstow. Los Alamos would need to truck waste over 161 km (100 mi) to reach the BNSF Intermodal Facilities in Albuquerque.

The generators in the east should have a clear motivation to use intermodal transportation. Both cost and radiological risk can be expected to be less than trucks. Even the small generators could use the trailer-on-flat-car mode from the most convenient intermodal facility or they could combine their waste with larger DOE generators. Since interline railroad transfers from eastern railroads to either the UP or the BNSF would need to be made, these generators could maintain a choice of rail carriers to control costs and use either the Barstow or Caliente intermodal options.

2.6.3 Conclusion

The choice of transportation mode and route is a decision that must be made jointly between the waste generator (the shipper) and the carriers with full knowledge of the characteristics of the available options. DOT regulations require carriers to "ensure that the motor vehicle is operated on routes that minimize radiological risk, considering available information on accident rates, transit time, population density and activities, and the time of day and the day of the week during which transportation will occur to determine the level of radiological risk." Intermodal transportation will incur less radiological risk than truck transportation alone. Both Barstow and Caliente intermodal options are workable. The preference for options by generators and carriers will depend on their individual situations.

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3.0 PRESENT CONDITIONS

The present conditions for the proposed intermodal facility sites and routes are presented in this section. The topics discussed in this chapter include transportation; land use; visual resources; utilities; noise; air quality; water resources; radiation, safety, and occupational health; biological resources; cultural resources; geology and soils; socioeconomics; and environmental justice.

3.1 TRANSPORTATION

The description of the affected transportation environment characterizes routes according to traffic volumes and roadway capacity. Level of Service (LOS) for road segments along the route options were computed by using the analysis procedures from the *1994 Highway Capacity Manual* (Transportation Research Board, 1994) for two-lane highways and freeway segments. Roadway segments with the highest traffic volumes were selected to give an indication of the worst case capacity conditions along the route. Roadway conditions obtained from videotaped field reviews of the entire routes are described in Appendix A. Additions to this section recommended by the American Indian Transportation Committee (AITC) are in Appendix E, Section E.3.1.

3.1.1 Current Route Environment

The majority of shipments along the current route enter Nevada on US 93 at Hoover Dam. This route goes through Boulder City, Henderson, Las Vegas, and the Las Vegas Paiute Tribe's Snow Mountain Reservation, located northwest on US 95. The most congested part of this route is in Las Vegas, Nevada, at the I-15 and US 95/US 93 interchange. Other routes currently used are I-15 from the northeast, and I-15 from the southwest. These routes converge in Las Vegas, and US 95 is used to reach the NTS from Las Vegas.

3.1.1.1 Traffic Volumes – Current Environment

Annual average daily traffic volumes on currently used routes are summarized in Table 3-1.

3.1.1.2 Roadway Capacity

General definitions for LOS for road segments are described in Table 3-2. The most congested part of the route is in Las Vegas, Nevada, at the US 93/US 95/I-515/I-15 interchanges, which are known locally as the "Spaghetti Bowl." The "Spaghetti Bowl" area is at LOS F during peak periods.

Traffic operations on the roadway segments used for existing truck operations can be summarized as follows (the LOS were computed based on the highest volumes on the segments noted):

Table 3-1. 1996 Average Daily Traffic Volumes Along Current Route Environment

Route Segment	*Annual Average Daily Traffic Volume (1996/1997)*	*Percent Trucks*	*Average Daily Trucks*
From the Southeast, US 93, Kingman, Arizona, to Las Vegas, Nevada			
US 93, Kingman to Hoover Dam	9,300	15.8	1,469
US 93/95, Railroad Pass Interchange	30,015	15.8	3,302
US 93/95, Railroad Pass to Wagonwheel	37,345	15.8	4,108
US 93/95, Wagonwheel to College Drive	33,075	15.8	3,638
US 93/95, College Drive to Horizon Drive	38,610	15.8	4,247
US 93/95, Horizon Drive to Lake Mead Drive	55,860	7.0	3,910
US 93/95, Lake Mead Drive to Sunset Road	73,840	7.0	5,169
US 93/95, Sunset Road to Russell Road	82,390	7.0	5,767
US 93/95, Russell Road to Tropicana Avenue	93,510	7.0	6,546
US 93/95, Tropicana Avenue to Flamingo Road	113,915	7.0	7,974
US 93/95, Flamingo Road to Boulder Highway	118,345	3.0	3,550
US 93/95, Boulder Highway to Charleston Boulevard	120,035	3.0	3,601
US 93/95, Charleston Boulevard to Eastern Avenue	126,740	3.0	3,802
US 93/95, Eastern Avenue to Las Vegas Boulevard	149,830	3.0	4,495
US 93/95, Las Vegas Boulevard to Casino Center	143,695	3.0	4,311
From the Northeast, I-15 at the Arizona/Nevada border to Las Vegas, Nevada			
West Mesquite to Riverside-Bunkerhill	12,555	22.0	2,762
Riverside-Bunkerhill to East Mesa	12,615	22.0	2,775
East Mesa to Carp-Elgin	12,540	22.0	2,759
Carp-Elgin to Logandale-Overton	12,550	22.0	2,761
Logandale to Glendale	14,285	22.0	3,143
Glendale to Moapa	12,570	22.0	2,765
Moapa to Hidden Valley	13,120	22.0	2,886
Hidden Valley to Byron	13,945	22.0	3,068
Bryon to Ute	13,955	22.0	3,070
Ute to Valley of Fire	13,950	22.0	3,069
Valley of Fire to US 93	14,290	22.0	3,144
US 93 to Apex	17,635	22.0	3,880
Apex to Lamb	17,160	16.0	2,746
Lamb to Craig	16,695	12.0	2,003
Craig to Cheyenne	47,845	7.0	3,349
Cheyenne to Lake Mead	70,200	7.0	4,914
Lake Mead to D Street and Washington	104,660	7.0	7,326
From the Southwest, I-15, Baker, California, to Las Vegas, Nevada			
I-15, Baker to Nipton Road	26,000	21.0	5,529
I-15, Nipton Road to Nevada State Line	30,000	20.0	5,850
I-15, Nevada State Line Interchange to Jean	33,220	16.0	5,315
I-15, Jean to Sloan Interchange	35,265	16.0	5,642
I-15, Sloan to Henderson	36,440	12.0	4,373
I-15, Henderson to Arden Interchange	36,000	12.0	4,320
I-15, Arden to Russell Road	107,010	7.0	7,591
I-15, Russell Road to Tropicana Avenue	112,885	7.0	7,902
I-15, Tropicana Avenue to Flamingo Road	143,830	7.0	10,068
I-15, Flamingo Road to Spring Mountain Avenue	159,905	7.0	11,193

Table 3-1. 1996 Average Daily Traffic Volumes Along Current Route Environment (Continued)

Route Segment	*Annual Average Daily Traffic Volume (1996/1997)*	*Percent Trucks*	*Average Daily Trucks*
I-15, Spring Mountain Avenue to Sahara Interchange	195,055	7.0	13,654
Las Vegas Area – I-15 at the Spaghetti Bowl			
I-15, South of US 93/95 (I-515), Charleston Boulevard Interchange to the Spaghetti Bowl	183,120	7.0	12,818
I-15, North of US 93/95 (I-515), from the Spaghetti Bowl to D Street/Washington Street Interchange	105,955	7.0	7,417
US 95 from the Spaghetti Bowl, North to Centennial Parkway			
US 93/95 (I-515) from Casino Center Boulevard to the Spaghetti Bowl	161,895	3.2	5,180
US 95 from the Spaghetti Bowl to Rancho Road	170,240	3.0	5,110
US 95 from Rancho Road to Decatur Boulevard	154,080	3.0	4,620
US 95 from Decatur Boulevard to Jones Boulevard	149,215	3.0	4,475
US 95 from Jones Boulevard to Rainbow Boulevard	138,640	3.0	4,160
US 95 from Rainbow Boulevard to Lake Mead Boulevard	96,880	4.6	4,440
US 95 from Lake Mead Boulevard to Cheyenne Boulevard	77,260	5.7	4,420
US 95 from Cheyenne Boulevard to Craig Road	55,640	7.4	4,145
US 95 from Craig Road to Rancho/Ann Road	35,470	10.9	3,870
US 95 from Rancho/Ann Road to Centennial Parkway	31,900	14.2	4,540

Table 3-2. Definition of Level of Service – Roadway Segments

LOS	*Definition*
A	Represents free-flow conditions.
B	Indicative of free-flow, although the presence of other vehicles begins to be noticeable. Average travel speeds are somewhat lower than LOS A.
C	Represents a range in which the influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream, and to select an operating speed is now clearly affected by the presence of other vehicles.
D	Speeds and ability to maneuver are severely restricted because of traffic congestion.
E	Represents operations at capacity and any disruptions, no matter how minor, will cause queues to form.
F	Represents forces or breakdown flow. Vehicles experience short spurts of movement followed by stoppages.

<u>From the Southeast, US 93, Kingman, Arizona, to Las Vegas, Nevada.</u>

US 93, Kingman, Arizona, to Hoover Dam: LOS D
US 93/95, Railroad Pass Interchange to Horizon Drive Interchange: LOS C
US 93/95, Horizon Drive Interchange to Casino Center Interchange: LOS F

From the Northeast, I-15 (Arizona/Nevada Border to Las Vegas, Nevada)

I-15, at the Arizona/Nevada border to Moapa, Nevada: LOS A
I-15, Moapa to Craig Interchange: LOS A
I-15, Craig Interchange to Washington Interchange: LOS E

From the Southwest, I-15 (Baker, California, to Las Vegas, Nevada)

I-15, from Baker, California, to Henderson Interchange: LOS C
I-15, from Henderson Interchange to Sahara Interchange: LOS F

Las Vegas Area – I-15

I-15, South of US 93/95, Charleston Boulevard. Interchange to D Street/Washington Street Interchange: LOS F

US 95, (Las Vegas Area to Centennial Parkway)

US 93/95 (I-515) from Casino Center Boulevard to US 95 Interchange with Lake Mead Boulevard: LOS F
US 95, Lake Mead Boulevard to Centennial Parkway: LOS E

3.1.1.3 Field Review of Roadway Conditions

A field review was conducted in May 1998 to review conditions of the current route environment for truck transport. Key observations from the field review are summarized in Appendix A, Table A-1. The routes can be characterized as follows:

From the Southeast, US 93, Kingman, Arizona, to Las Vegas, Nevada

In the Hoover Dam area, there are congested roadway conditions because of heavy tourist traffic from parking lots and overlooks, as well as heavy pedestrian traffic at the dam. Traffic is frequently stopped at the dam. Much of the roadway in this area has no shoulders. On US 93 from Boulder City to Lake Mead, the visitors' area at milepost (MP) 4.5 has a mix of local and tourist traffic.

Boulder City, Nevada, has many commercial areas with uncontrolled access to US 93, and there are residences near the roadway. Another area with cross traffic was noted near the Railroad Pass Casino. There was poor sight distance noted at this location.

From the Northeast, I-15, Arizona/Nevada Border to Las Vegas, Nevada

The community of Mesquite, Nevada, at approximately MP 20, is a tourist area, which generates exiting and entering traffic. Between MPs 117 and 110.5 there are several steep uphill sections. Between MPs 107 and 99 the roadway is elevated 1 to 2 m (3 to 6 ft) above ground level with few sections of guardrail. At MP 94.7 there is a steep downhill section to the exit NV 168.

From the Southwest, I-15, Baker, California, to Las Vegas, Nevada

On this route, which has generally two lanes per direction, there are a number of climbing lane sections, where there are three lanes northbound. At the Nevada border, there is a casino area with tourist activity, an overhead monorail, and tourist rail lines. At approximately MP 12.5 there is another casino area with tourist activity. Between MPs 25 and 28 is the Sloan community, which includes some scattered residences set back from I-15. Starting at MP 30 there are residences near or adjacent to I-15, and to the US 93 junction.

Las Vegas, Nevada, Area

There is heavy traffic in this area, with great differences in speed due to driver mix. There are residences and tourist areas closely adjacent to roadways. There is heavy congestion, especially in the area of the I-15/US 93/US 95 interchange. There are also many overpasses in this area. There were several areas of highway construction observed during the field review.

US 95, Las Vegas, Nevada, to Mercury, Nevada

There are few residences on this route past the Las Vegas area, with the exception of Indian Springs. The roadway is generally in excellent condition, with a paved right shoulder, and few drop-offs past the right shoulder. There appears to be some tourist traffic, but traffic was generally light past the Mount Charleston exit. There is cross traffic and pedestrians in the Indian Springs area.

3.1.1.4 Cost

The current costs for truck and intermodal shipments of LLW from current generators to the NTS are listed in Table 3-3.

3.1.2 Barstow Transportation Route

3.1.2.1 Traffic Volumes

This option involves the receipt of rail shipments at the BNSF Intermodal Facility in Barstow, California. These shipments would then be transported by truck to the NTS. There is easy vehicular access to I-58 and I-15 from this intermodal facility without passing through the populated area. The route is via I-15 to Baker, California, then north on California State Route 127 (CA 127) and NV 373 to Amargosa Valley, Nevada. Trucks would then take US 95 from Amargosa Valley, Nevada, to Mercury, Nevada.

The 1996 annual average daily traffic volumes along this route and the percent of trucks are shown in Table 3-4.

Table 3-3. Intermodal vs. Truck Transportation Costs to the NTS

Origin		*[1]Intermodal Cost ($)*		*Truck Cost ($)*	
		Barstow/Yermo	*Caliente*	*Industry Data*	*Generator Data*
Aberdeen, Maryland	D		4,200	5,084	
Canoga Park, California	T			1,210	
Fernald, Ohio	D		3,200	4,124	
Ashtabula, Ohio (RMI)	T		[2]4,200	4,414	3,150
Miamisburg, Ohio (Mound)	D		3,350	4,088	3,200
San Diego, California	T			1,104	
Kansas City, Missouri	T	2,850	2,800	2,838	
Livermore, California	T			1,601	
Amarillo, Texas	T	2,200		2,000	
Golden, Colorado	D	2,150	2,100	1,780	1,925
Albuquerque, New Mexico (Sandia)	T			1,710	

[1] Data from MHF Logistical Solutions (one-way, 20-ft containers).
[2] Includes cost of returning reusable container to RMI.
D = Direct rail service available at origin.
T = Container trucked to rail terminal near origin.
Source: Industry Source, 1998. Generator data from DOE/NV.

Table 3-4. 1996 Average Daily Traffic Volumes and Truck Data Along Barstow Route

Segment	*1996 Annual [1] Average Daily Traffic Volume*	*1996 Percent Trucks*	*1996 Average Daily Trucks*
I-15, East Yermo Interchange	30,000	N/A[2]	N/A
I-15, Minneola Road Interchange	29,500	18	5,339
I-15, Harvard Road Interchange	30,000	N/A	N/A
I-15, Field Road Interchange	25,000	N/A	N/A
I-15, Afton Road Interchange	25,000	N/A	N/A
I-15, Basin Road Interchange	25,000	N/A	N/A
I-15, Rasor Road Interchange	25,000	N/A	N/A
I-15, Zzyzx Road Interchange	25,000	N/A	N/A
I-15, West Baker Road Interchange	25,000	19	4,850
I-15, Junction, CA 127	26,000	18	4,680
CA 127, Baker at Junction Old State Highway	4,350	10	448
CA 127, School Road	1,500	N/A	N/A
CA 127, San Bernardino/Inyo County Line	560	13	73
CA 127, Shoshone at Junction with CA 178 East	1,300	13	169
CA 127, North Junction with CA 178 West	410	17	70
CA 127, Death Valley Junction, CA 190 West	340	22	75
CA 127, Nevada State Line	580	26	151
CA 373, California State Line to US 95	720	19	137

[1] Sources: Nevada Department of Transportation (NDOT). 1998; CalTrans, 1998.
[2] N/A = Not available.

3.1.2.2 Roadway Capacity

The traffic operating conditions on road segments along this route are summarized as follows:

- I-15, between Barstow, California, and CA 127: LOS C
- CA 127, between Baker, California, and the Nevada State line: LOS C
- NV 373, California State Line to US 95: LOS A
- US 95, Amargosa Valley to Mercury, Nevada: LOS B

The above results indicate that the roadway segments currently operate under generally uncongested conditions.

3.1.2.3 Field Review of Roadway Conditions

A field review of this route was conducted in January and May 1998 to determine potential concerns relating to truck travel along this route. An annotated log of the field review was compiled and is presented in Appendix A, Table A-2. The route can be characterized as follows:

- **BNSF Intermodal Facility**—The facility is located at West Main Street and "H" Avenue. The entrance road is a raised earthen roadbed without guardrails. The facility has one spur line and two cranes for off-loading containers.

- **I-15, Barstow to Baker**—There are populated areas near Barstow and Yermo. This part of the route is a freeway facility.

- **CA 127, Baker to Shoshone**—The area at the Baker exit to CA 127 has some development near the roadway. In general, this area is subject to extreme summer temperatures. There were a number of potential flood-prone areas in this segment of the route, which crosses numerous washes. The elevation change to reach the Ibex Pass Summit, which is 305 m (1,000 ft) in 12 km (7.5 mi) of road, may have the potential to cause vehicle overheating in the summer months. The community of Shoshone is built close to CA 127. It is a tourist area with residences, commercial areas, and a church.

- **CA 127, Shoshone to Junction NV 373, and NV 373 from Junction CA 127, to Junction US 95**—Similar to the previous segment, there are many wash crossings and this segment is subject to extreme summer temperatures. Traffic is light on this segment. At the community of Death Valley Junction, there is development close to the roadway. Entering into the community, there is restricted sight distance on a left-turn that is signed at 25 mi per hour (mph). Sight distance was observed to be poor at this location.

- **US 95, between Junction NV 373 and Mercury, Nevada**—Traffic volumes are light in this area.

In summary, this route uses a four-lane interstate facility, I-15, for part of the route. Travel through the Death Valley area will subject the trucks to the rigors of traveling in high temperatures during the summer months. There are a number of wash crossings that may have flood potential during rainy periods. There was one area on CA 127 through Death Valley Junction where a left-turn is required at 25 mph. The restricted sight distance in this area makes vehicles entering CA 127 from side driveways near the curve area difficult to see.

3.1.3 Caliente Transportation Route

3.1.3.1 Traffic Volumes

The Caliente route includes US 93, NV 375, and US 6/US 95 to Rachel, Tonopah, Goldfield, and Beatty, Nevada, then to the NTS, a route approximately 580 km (360 mi) in length. The 1996 annual average daily traffic volumes on this route, and truck volumes, are shown in Table 3-5. This route is characterized by low traffic volumes, particularly between Caliente and Tonopah, Nevada, a road segment which carries approximately 650 vehicles per day. On the segment of the route between Tonopah and the NTS, which uses US 95, volumes are somewhat higher, and range from 1,555 average vehicles per day to 4,800 vehicles per day. The 4,800 vehicles per day occurs within the city limits of Beatty, Nevada. This table also shows annual average daily traffic volumes on US 95, between the NTS and Las Vegas, Nevada. This is the route that unloaded, empty trucks would use. Average daily traffic volumes on this segment range from 3,900 vehicles per day near the NTS to 28,500 vehicles per day near Las Vegas.

3.1.3.2 Roadway Capacity

The highest volume road segments along this route occurred near Tonopah, Nevada, and Mercury, Nevada, where average daily traffic volumes were approximately 6,200 and 4,800 vehicles per day.

It should be emphasized that most of the roads on the route carry very low traffic volumes, and operate at LOS A, particularly between Caliente, Nevada, and east of Tonopah, Nevada, where the route carried between 185 and 650 vehicles per day.

The LOS for the road segments analyzed can be summarized as follows:

- US 6, (NV 376 to US 95): LOS A
- US 95, (US 6 to the South City Limit [SCL] of Tonopah, Nevada): LOS C
- US 95 (NV 160 to Mercury, Nevada): LOS B

3.1.3.3 Field Review of Roadway Conditions

A field review was conducted in January 1998 to determine potential concerns or restrictions relating to truck travel along the proposed route for the Caliente intermodal transfer facility. Key observations from the field review are summarized in Appendix A, Table A-3.

Table 3-5. 1996 Average Daily Traffic Volumes and Truck Data Along Caliente Route

Segment	*1996 Annual[1] Average Daily Traffic Volume*	*1996[2] Percent Trucks*	*1996 Average Daily Trucks*
Volumes on Loaded Truck Route			
US 93 from 0.8 km (0.5 mi) south to Caliente to NV 375	655	13	85
NV 375 from US 93 to US 6	185	22	40
US 6 from NV 375 to Sandia Road (TTR)	360	22	79
US 6 from Sandia Road to NV 376	635	22	140
US 6 from NV 376 to US 95	2,000	15	300
US 95 from 6 to South City Limit of Tonopah	6,200	9	558
US 95 from South City Limit to Tonopah to Goldfield	2,150	25	538
US 95 from Goldfield to NV 266	1,555	34	529
US 95 from NV 266 to NV 267	1,730	29	502
US 95 from NV 267 to NCL to Beatty	2,000	25	500
US 95 from NCL of Beatty to NV 374	3,600	14	504
US 95 from NV 374 to SCL of Beatty	4,800	11	528
US 95 from SCL of Beatty to NV 373	2,350	22	517
US 95 from NV 373 to NV 160	2,800	18	504
US 95 from NV 160 to the NTS	3,250	16	520
Volumes on Unloaded Truck Route			
US 95 from the NTS to Indian Springs	3,900	14	546
US 95 from Indian Springs to NV 156	4,100	13	533
US 95 from NV 156 to NV 157	5,700	9	513
US 95 from NV 157 to Ranch House Road	11,000	5	550
US 95 from Ranch House Road to Rancho Interchange	28,500	3	855

[1] Source: NDOT, 1998.
[2] Truck data include buses and recreational vehicles.
Note: NCL = North City Limits; SCL = South City Limits.

The Caliente route can be characterized as follows:

- **US 93, between Caliente and Junction NV 375**—This segment of road can be characterized by light traffic, with two mountain passes, and snow conditions in the winter. The road is in good condition.

- **NV 375, between US 93 and US 6**—This segment can also be characterized by light traffic, and is typically surrounded by open range. There are two mountain passes between Junction NV 375/US 93 and Rachel, Nevada. The road traverses some low areas, which were observed to have some possible flooding potential. In particular, at MP 15.3 in Nye County, the road passed through a playa (dry lake) that was full of water and ice for about 0.16 km (0.1 mi). The road is approximately 1.5 m (5 ft) above the water line, and this, coupled with a narrow shoulder, could pose a potential flooding problem during a rainy period.

- **US 6, between NV 375 and Tonopah, Nevada**—This segment is also characterized by light traffic, until entering the Tonopah area, where traffic increases, but not to a large degree. The road traverses three mountain passes through this area.

- **US 95, Tonopah, Nevada, to Mercury, Nevada**—Traffic volumes increase in this section. and range between 1,550 and 4,800 vehicles per day. The highest daily traffic volume occurs near Beatty, Nevada. This section of the route passes through Amargosa Valley and the towns of Goldfield, and Beatty, Nevada, and ends at Mercury, Nevada, at the NTS.

In summary, this route carries very low volumes and traverses relatively few populated areas. There are a number of mountainous upgrades and downgrades for vehicles to traverse, which are signed. Specific grades involved are not indicated on the signing. There are also some low-lying areas on NV 375, which may be flood prone.

3.1.4 Yermo Transportation Route

3.1.4.1 Traffic Volumes

The transfer site at Yermo, California, is proposed to transport rail shipments to trucks using I-15, CA 127 and NV 373, then US 95 to the NTS, a route of approximately 225 km (140 mi). Annual average daily traffic volumes on this route (the route for loaded vehicles), and percent trucks, are the same as shown in Table 3-3. Average daily traffic volume on I-15, a four-lane freeway, is approximately 25,000 vehicles per day. Volumes on CA 127, a two-lane state highway, are much lower, and range from 4,350 vehicles per day, near Baker, California, to 410 vehicles per day, near the junction of CA 127 with CA 178. NV 373, between CA 127 and US 95, carries approximately 700 vehicles per day. Truck volumes, as a percentage of total traffic, appear to be fairly high on this route, and truck percentages range from 10 to 26 percent.

3.1.4.2 Roadway Capacity

LOSs along the route for loaded vehicles on the Yermo intermodal transfer facility are the same as identified for the Barstow route.

3.1.4.3 Field Review of Roadway Conditions

The route is the same as Barstow which is characterized in Section 3.1.2.3. An annotated log of the field review is presented in Appendix A, Table A-4.

3.1.5 All-truck Routes

3.1.5.1 Traffic Volumes

There are two All-truck routes, one from the east and one from the northeast. Trucks coming from the east would use I-40 from Kingman, Arizona, to Barstow, California, then travel northeast on I-15 from Barstow, California, to Baker, California, then north on CA 127 and NV 373, from Baker, California, to Amargosa Valley, Nevada. Trucks would then use US 95 from Amargosa Valley, Nevada, to Mercury, Nevada.

Trucks from the northeast would exit I-15 at US 93 and continue north to intersect the Caliente route (described in Section 3.1.1) at NV 375. There is an option to use NV 168 at Moapa, Nevada, to exit to US 93, rather than exiting I-15 at exit 64, to US 93. This alternate route is further discussed in the field review section.

The 1996 annual average daily traffic volumes on this route and percent trucks are shown in Table 3-6.

3.1.5.2 Roadway Capacity

The traffic operations on the road segments analyzed can be summarized as follows:

From the East:

- I-40, between Kingman and the Arizona State Line: LOS C
- I-40, between the California State Line and Barstow, California: LOS C
- I-15, between Barstow, California, and CA 127: LOS C
- CA 127, between Baker, California, and the Nevada State: LOS C
- NV 373, California State Line to US 95: LOS A
- US 95, Amargosa Valley to Mercury, Nevada: LOS B

In general, the analysis indicates that the roadway segments are operating under uncongested conditions.

From the Northeast:

- US 93, between I-15 and US 93 East: LOS A
- NV 375, between Junction US 93 and US 6: LOS A
- US 6, between NV 375 and US 95 at Tonopah, Nevada: LOS A
- US 95, between Tonopah, Nevada, and NV 160: LOS C
- US 95, NV 160 to Mercury, Nevada: LOS B

3.1.5.3 Field Review of Roadway Conditions

The field review summary conducted of this route is presented in Appendix A, Tables A-5 and A-6.

Route from East Via I-40:

I-40, Kingman, Arizona, to Barstow, California. There is a populated area through the City of Kingman. Arizona. In Arizona, the I-40 speed limit is 75 mph. The speed limit on I-40 in California is 70 mph for automobiles, and 55 mph for trucks. Overpasses in Arizona have their clearances noted, while those in Nevada and California do not. Other populated areas along this route segment are in Needles, California, and in Barstow, California.

Table 3-6. 1996 Average Daily Traffic Volumes Along All-truck Routes

Segment	*1996 Annual Average Daily Traffic Volume*	*1996 Percent Trucks*	*1996 Average Daily Trucks*
From the East:			
I-40, Kingman to AZ State Line	14,000	35%	4,900
I-40, AZ State Line	10,500	31%	3,234
I-40, Jct. US 95 South	10,600	31%	3,254
I-40, Park Road	13,000	18%	2,291
I-40, Jct. US 95 North	14,000	18%	2,467
I-40, W. Newberry Road	11,000	34%	3,787
I-40, Airport Road	11,300	34%	3,890
I-40, A Street	13,200	21%	2,756
I-40, Jct. I-15	16,000	22%	3,460
I-15, at East Yermo Interchange	30,000	N/A[1]	N/A
I-15, Minneola Road Interchange	29,500	18	5,339
I-15, Harvard Road Interchange	30,000	N/A	N/A
I-15, Field Road Interchange	25,000	N/A	N/A
I-15, Afton Road Interchange	25,000	N/A	N/A
I-15, Basin Road Interchange	25,000	N/A	N/A
I-15, Rasor Road Interchange	25,000	N/A	N/A
I-15, Zzyzx Road Interchange	25,000	N/A	N/A
I-15, West Baker Road Interchange	25,000	19	4,850
I-15, Jct. CA 127	26,000	18	4,680
CA 127, Baker at Jct. Old State Highway	4,350	10	448
CA 127, School Road	1,500	N/A	N/A
CA 127, San Bernardino/Inyo County Line	560	13	73
CA 127, Shoshone at Jct. with CA 178 East	1,300	13	169
CA 127, North Jct. with CA 178 West	410	17	70
CA 127, Death Valley Jct., CA 190 West	340	22	75
CA 127, Nevada State Line	580	26	151
NV 373, California State Line to US 95	720	19	137
From the Northeast:			
US 93, I-15 to NV 375	1,600	N/A	N/A
NV 375 from US 93 to US 6	185	22	40
US 6 from NV 375 to Sandia Road (TTR)	360	22	79
US 6 from Sandia Road to NV 376	635	22	140
US 6 from NV 376 to US 95	2,000	15	300
US 95 from 6 to SCL of Tonopah	6,200	9	558
US 95 from SCL to Tonopah to Goldfield	2,150	25	538
US 95 from Goldfield to NV 266	1,555	34	529
US 95 from NV 266 to NV 267	1,730	29	502
US 95 from NV 267 to NCL to Beatty	2,000	25	500

Table 3-6. 1996 Average Daily Traffic Volumes Along All-truck Routes (Continued)

Segment	*1996 Annual Average Daily Traffic Volume*	*1996 Percent Trucks*	*1996 Average Daily Trucks*
From the East:			
US 95 from SCL of Beatty to NV 373	2,350	22	517
US 95 from NV 373 to NV 160	2,800	18	504
US 95 from NV 160 to the NTS	3,250	16	520
Volumes on Unloaded Truck Route:			
US 95 from the NTS to Indian Springs	3,900	14	546
US 95 from Indian Springs to NV 156	4,100	13	533
US 95 from NV 156 to NV 157	5,700	9	513
US 95 from NV 157 to Ranch House Road	11,000	5	550
US 95 from Ranch House Road to Rancho Interchange	28,500	3	855

[1] N/A = not available.

I-15, Barstow, California, to Baker, California. This part of the route is a freeway facility with LOS C.

CA 127, Baker, California, to Shoshone, California. The area at the Baker exit to CA 127 has some development near the roadway. In general, this area is subject to extreme summer temperatures. There were a number of potential flood-prone areas in this segment of the route, which crosses numerous washes. The elevation change to reach the Ibex Pass Summit, which is 305 m (1,000 ft) in 12 km (7.5 mi) of road, may cause vehicle overheating in the summer months. The community of Shoshone, California, is close to CA 127, a tourist area with residences, commercial areas, and a church.

CA 127, Shoshone, California, to California/Nevada Border, and NV 373 from the Border to Junction US 95 at Amargosa Valley, Nevada. Similar to the previous segment, there are many wash crossings, and this segment is subject to extreme summer temperatures. Traffic is light in this segment. At the community of Death Valley Junction there is development close to the roadway. Entering into the community, there is a left-turn with restricted sight distance, that is signed at 25 mph. The sight distance was observed to be poor at this location.

Route from Northeast using I-15:

I-15, Mesquite, Nevada, to US 93. The community of Mesquite, Nevada, at approximately MP 20, is a tourist area, which generates exiting and entering traffic. Between MP 117 and 110.5 there are several steep uphill sections. Between MP 107 and 99 the roadway is elevated 1 to 2 m (3 to 6 ft) above ground level with few sections of guardrail. At MP 94.7 there is a steep downhill section to the exit for NV 168.

US 93, between I-15 to NV 375. The roadway is in generally good condition and is currently used as a truck route. However, there are many locations on the roadway with drop-offs beyond the right shoulder area that are not guardrail protected. Also, there are several sections where the gravel shoulder is at a steep angle. While relatively lightly traveled, the roadway does get tourist traffic, especially on weekends and holidays. The Pahranagat Wildlife Refuge is adjacent to the roadway from MPs 23 to 33.

Option to use NV 168 to reach US 93 from I-15. NV 168 is a two-lane highway with lanes 3.4- to 3.7-m (11- to 12-ft) wide, and dirt shoulders that vary in width. The roadway passes through several washes and small hills that give the roadway an undulating feel for much of its length. There are many horizontal curves with restricted sight, but few driveways or crossroads. The roadway appeared to be suitable for truck traffic.

NV 375, between US 93 and US 6. This segment can also be characterized by light traffic, and is typically surrounded by open range. There are a number of high mountain passes between NV 375/US 93 and Rachel, Nevada. There are some low areas, which were observed to have some possible flooding potential. In particular, at MP 15.3 in Nye County, Nevada, the road passed through a playa that was full of water and ice for about 0.16 km (0.1 mi). The road is only approximately 1.5 m (5 ft) above the water line, and this, coupled with a narrow shoulder and no guardrail, could pose a potential flooding problem during a rainy period.

US 6, between NV 375 and Tonopah, Nevada. This segment is also characterized by light traffic, until entering the Tonopah area where traffic increases, but not to a large degree. There are also high mountain passes through this area.

US 95, between Tonopah, Nevada, and Mercury, Nevada. Traffic volumes increase in this section and range between 1,500 and 4,800 vehicles per day. The highest daily traffic volume occurs near Beatty, Nevada. This section of the route passes through the towns of Goldfield and Beatty, Nevada, and ends at Mercury, Nevada, near the NTS.

3.2 LAND USE

Land use identifies ownership and uses surrounding the intermodal sites and within the general region of the transportation routes associated with each site.

3.2.1 Current Route Environment

The current route enters Nevada through the western portion of the Lake Mead National Recreation Area before entering the populated areas of Boulder City, Henderson, and Las Vegas. Various commercial, industrial, and residential land uses currently exist along populated portions of this route. Within Las Vegas, this route encounters the "Spaghetti Bowl," a congested freeway interchange where I-15 and US 95 intersect. Land uses and ownership for that route segment between Las Vegas and the NTS entrance at Mercury, Nevada, include the Las Vegas Paiute Indian Reservation, Nellis Air Force Range, Desert National Wildlife Range, the town of Indian Springs, the Desert View Natural Environment Area, and public lands administered by the Bureau of Land Management (BLM).

3.2.2 Barstow

3.2.2.1 Intermodal Facility

The BNSF Intermodal Facility is located at the southwest edge of Barstow approximately 1.6 km (1 mi) north of I-15. This site is within an area zoned for general industrial and mixed use. Adjacent lands are currently vacant, however, future development in this area is expected to see commercial and industrial growth because of its proximity to the railroad.

3.2.2.2 Route to NTS

The general region of the Barstow-NTS route includes public lands managed by the BLM, state lands, and private holdings. A portion of San Bernardino County is designated as being within the California Desert Conservation Area (CDCA). CDCA lands administered by the BLM consist predominantly of wilderness areas while others allow for a wide variety of land uses and management practices. Livestock grazing has been and continues to be a significant use of renewable resources on public land in the California desert.

The land ownership pattern adjacent to this route incorporates many scattered parcels of federal, state, and private properties that include military lands, National Monuments lands, and UP lands. Recreational activities in this region include land sailing, rock hounding, sightseeing, camping, horseback riding, and off-road vehicle use. Except for Barstow, few other towns or populated settlements are located along this route. Land ownership and use along each of the route segments are as follows:

<u>I-15 Segment.</u> The route segment between Yermo and the CA 127 turnoff at Baker passes through lands administered by the BLM and U.S. Forest Service (USFS) as well as some privately owned lands. That portion between Yermo and Midway comprises private and BLM lands in the Barstow Resource Area while that portion between Midway and Baker passes adjacent to the Soda Mountains Wilderness Study Area (WSA) and the Mojave Wilderness Area in the National Park Service (NPS) Mojave National Preserve. The Afton Canyon and Cronese Lake Areas of Critical Environmental Concern (ACECs) are located near this portion of the route. There are approximately 40 single-family residences along this portion of the route. Physical land uses consist of dispersed recreation (camping, hunting, off-highway vehicle use), grazing, and conservation. This segment has the most intense recreational use of this route.

<u>CA 127 and NV 373.</u> This route segment goes through the Silurian Valley, and land ownership between Baker and Amargosa Valley (intersection with US 95) is primarily BLM-administered land. The Avawatz, South Avawatz Mountain, and Death Valley National Park WSAs lie west of this route segment that includes the southern entrance to Death Valley National Park; the Kingston Range WSA, Salt Creek ACEC, Hollow Hills Wilderness Area, Saddle Peak Hills Wilderness Area, and Ash Meadows National Wildlife Refuge lie to the east. There are very few residences along this route segment.

<u>US 95.</u> The route segment from Amargosa Valley to Mercury is coincidental with the Caliente transportation route described for the Caliente route in Section 3.2.3.3.

Towns and settlements along or near the Barstow route include Harvard, Midway, Baker, Tecopa, Shoshone, Death Valley Junction, and Amargosa Valley. Public and private airfields located along this route include Barstow-Daggett, Harvard (private), Baker, Shoshone, Amargosa (private), Imvite (private), and Jackass.

3.2.3 Caliente

3.2.3.1 In-town

Land uses within Caliente include residential, commercial (general and highway), park and recreation, and industrial. The site considered for an intermodal operation is a flat, gravel-surfaced area on a UP right-of-way between the railroad tracks and Front Street as shown in Figure 3-1. This area is zoned for industrial activities. Areas along Front Street across from this site are zoned for general commercial land uses. A Shell service station, church, vehicle compound, and other nonresidential activities are located along this street. This proposed intermodal site lies within the 500-year flood plain.

Intermodal operations have been conducted on this site when transferring oil from rail tanker cars to fuel trucks. A conditional land use permit is required from the City of Caliente to conduct this type of activity.

3.2.3.2 South

The Caliente South site consists of a 65-acre parcel of land that lies on the west side of the Rainbow Canyon section of the Meadow Valley Wash. This site is patented land owned by the City of Caliente. The city's wastewater treatment plant is located on this site. The Rainbow Canyon is a scenic area that is used for a variety of recreational purposes. Kershaw-Ryan State Park is located across the road from Meadows Valley Wash about 0.40 km (0.25 mi) east of the South site. There are no residences near this site. The proposed intermodal site lies within the 500-year flood plain illustrated in Figure 3-2.

3.2.3.3 Route to NTS

The transportation route for both the Caliente In-town and South sites is generally bordered by lands administered by the BLM and USFS for such activities as grazing, mining, and recreation. Recreational activities in this region consist primarily of hunting, fishing, camping, sightseeing, and off-road vehicle use. Except for the town of Tonopah, few other towns or populated settlements are located along this route. General land uses and designations along each of the route segments include the following:

<u>US 93 Segment.</u> The route segment between Caliente and Crystal Springs is part of the State Scenic Byway that stretches over mountains from Ash Springs through Caliente to Majors Place within the Humboldt National Forest (USFS). Points of interest along or near this route segment include Caliente Airfield (a charted private landing strip) and the Key Pittman Wildlife Management Area.

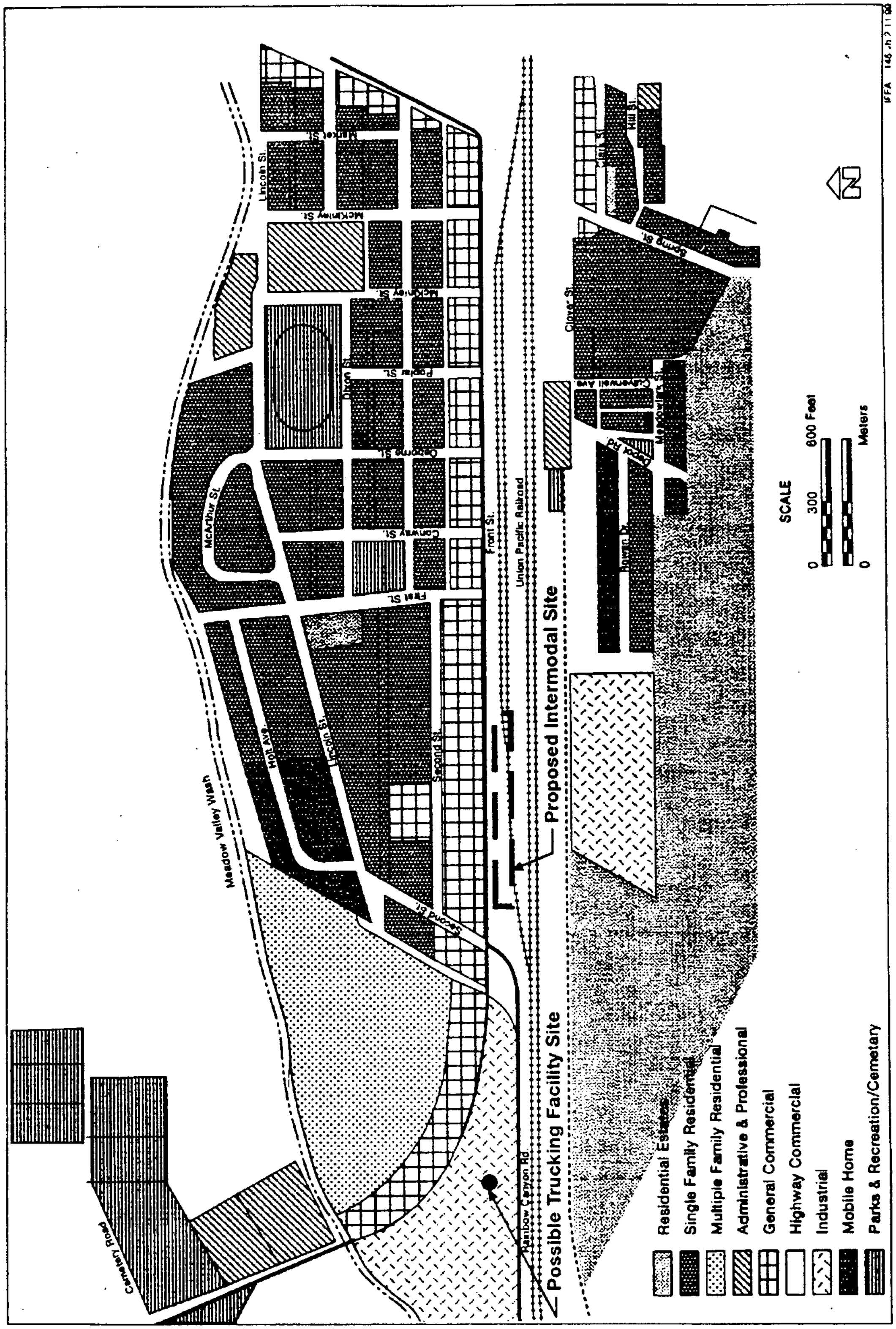

Figure 3-1. Caliente In-town Intermodal Site.

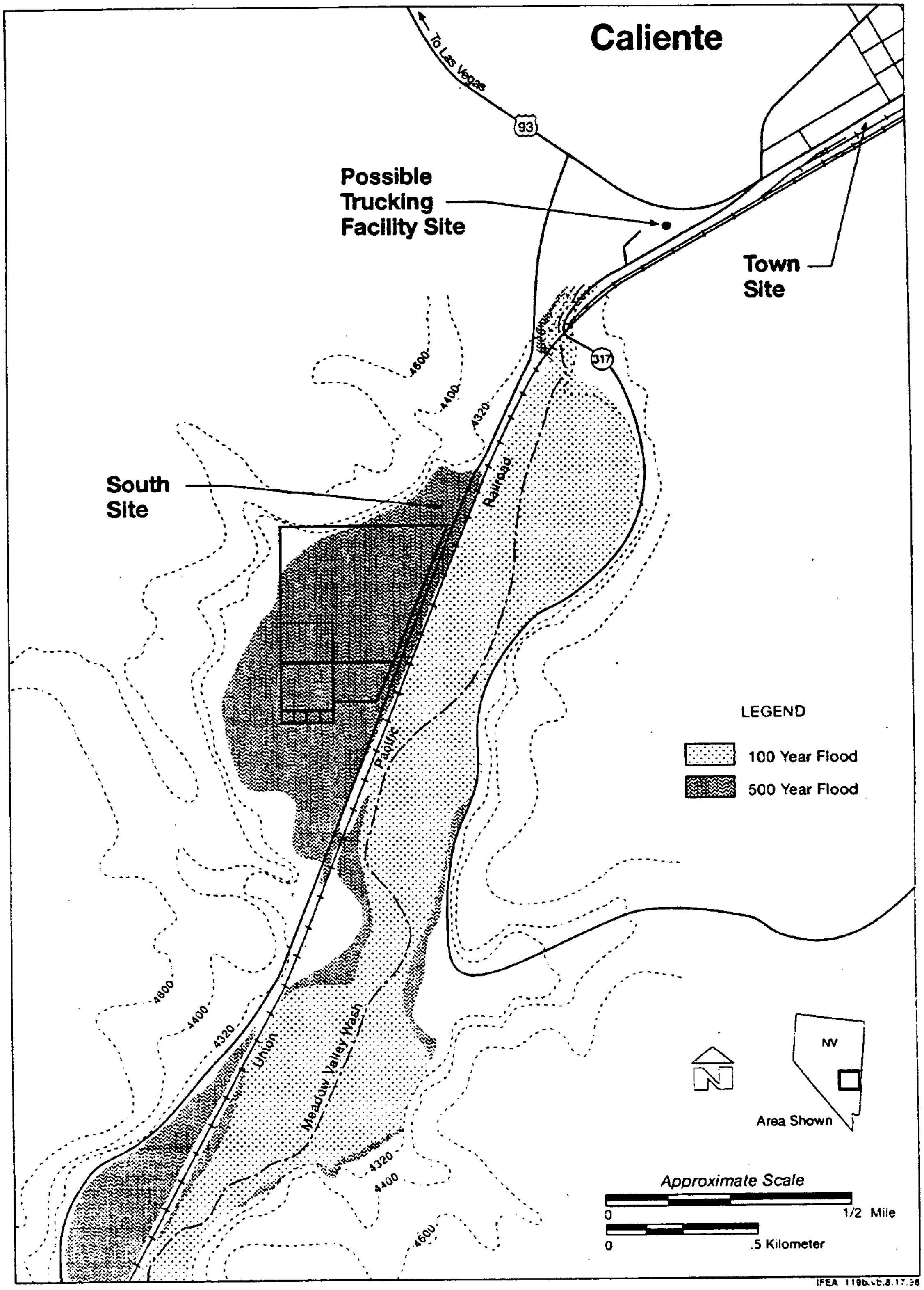

Figure 3-2. Flood Plain Map for Caliente-South Site.

NV 375 Segment. This segment connects Crystal Springs and Warm Springs and includes the town of Rachael, Fred's Well, and Twin Springs Ranch. Portions of the Palisades Mesa and Reveille WSAs are located near this route segment.

US 6 Segment. The segment between Warm Springs and Tonopah passes through the southern portion of the Monitor Range, which is part of the Toiyabe National Forest. The Tonopah Municipal Airport is located along this route segment.

US 95 from Tonopah to Mercury. This portion passes through or near the towns/settlements of Klondike, Alkali, Glenfield, West Spring, Florence Hill, Goldfield, Ralston, Scotty's Junction, Springdale, Pioneer, Rhyolite, Bullfrog, Beatty, Gold Center, Carrara, Ashton, and Amargosa Valley. Lands near the route include the Nellis Air Force Range withdrawn lands, Death Valley National Park, Rhyolite Historic Area, Toiyabe National Forest (USFS) and Ash Meadows National Wildlife Refuge (U.S. Fish and Wildlife Service [FWS]). Several small airfields (Goldfield, Lida Junction, Fran's Star Ranch, Beatty, and Jackass) and a National Aeronautics and Space Administration Tracking Station are located along the route.

The population density along the entire Caliente route is less than one person per 2.6 square km (1 square mi), except for the towns of Caliente, Rachel, and Tonopah. Each of these towns abuts the route for less than 1.6 km (1 mi). As of the 1990 Census, the population of Caliente was 1,111, Rachel was too small to register as a Census Designated Place (less than 1,000 people in a concentrated area), and Tonopah had 3,616 persons. State Demographer information indicated the population of Caliente has fallen to 1,081 as of July 1997.

3.2.4 Yermo

3.2.4.1 Yermo Annex Intermodal Facility

Land uses adjacent to the Yermo Annex include residences, businesses, and I-15 to the north; residences, a high school, and open space to the west; the Mojave River floodway, town of Daggett, and I-40 to the south; and the town of Yermo, the UP yard, and open space to the east. Development of the City of Barstow has been primarily toward the west and, as such, has had little effect on the MCLB which is located east of Barstow. Although Barstow, Daggett, and Yermo have had fairly stable development over the years, the threat of a potable water shortage has been a major constraint to development in this area.

Land uses within the Yermo Annex consist predominantly of warehousing and open storage facilities operated by the Defense Logistics Agency (DLA) and Fleet Support Center (FSC). A maintenance building is located approximately 660 km (2,200 ft) east of the site where intermodal operations are conducted, and several warehouses are located along rail spurs to the south. Another major use of this Annex is the Maintenance Center Barstow which operates the area and related laydown areas, sewage disposal, and military vehicle testing. Other land uses on the Annex include community support facilities, such as police and fire services, and recreation.

Flood hazard for the MCLB is relatively insignificant (U.S. Navy, 1988). The 100-year flood plain covers a small portion of the southern edge of the facility. The Yermo Annex is located north of this flood plain and is not as susceptible to surface water erosion and flash flooding.

3.2.4.2 Route to NTS

The Yermo-NTS route is the same as described above for the Barstow-NTS route.

3.2.5 All-truck Route Options

3.2.5.1 Kingman-Barstow Route to NTS

Lands bordering I-40 between Kingman, Arizona, and Barstow, California, are primarily public lands managed by the BLM. Upon entering California, this route passes near or parallels the Mojave National Preserve, Fort Mohave Indian Reservation, and Havasu National Wildlife Refuge. Few settlements are located along this portion of the route. This route intersects and coincides with a larger portion of the National Trials Highway that traverses the southern California desert.

3.2.5.2 Mesquite-Tonopah Route to NTS

I-15 between Mesquite and the US 93 exit passes through the Moapa River Indian Reservation, the towns of Glendale and Crystal, and BLM-administered lands. A portion of this route is designated as being part of the Old Spanish Trail. Land ownership, special designations, and uses along US 93 to Crystal Springs include the Desert National Wildlife Range, Pahranugat National Wildlife Refuge, Ash Springs Wildlife Area, and the towns of Alamo and Ash Springs. The remaining portion of this route to the NTS is described in Section 3.2.3.3.

3.3 VISUAL RESOURCES

The combined effects of the natural and man-made features of a particular environment create its visual qualities. These features form an overall impression that a viewer receives of an area. By identifying vegetation patterns, landforms, water features, and man-made structures, the overall landscape character can be assigned to the area, and the effects to that character can be assessed.

Intermodal terminal areas requiring new construction drive the analysis for visual resources. Therefore, the focus for visual resources consists of the visual environment for the Caliente In-town and South sites.

3.3.1 Barstow

Barstow is located at the junction of three major highways, I-15, I-40, and CA 58. Typical structures for this moderately populated area include commercial/industrial/residential structures, powerlines, and highway roads. The existing intermodal terminal for the BNSF is located in an isolated area at the southern edge of the populated area.

3.3.2 Caliente

3.3.2.1 In-town

Caliente is located in the Basin and Range physiographic province. The community is surrounded by small hills and volcanic rock formations and has very sparse vegetation. No water bodies are visible in this desert area.

The city consists of small urban structures typical of a small mountain valley community. Most structures are located along the main street with residential areas and buildings tucked behind. Typical structures include low commercial/industrial/residential structures, powerlines, and roads. The railroad bisects the community where the majority of development is located. The In-town site is located along the railroad right-of-way.

3.3.2.2 South

The South site lies within an area designated as BLM Visual Resource Management (VRM) Class III. The management objective of Class III is to partially retain the existing character of the landscape. However, this site is located on lands that are owned by the City of Caliente and is not under the jurisdiction of the BLM.

3.3.3 Yermo

The Yermo Annex of the MCLB Barstow is also located within the Basin and Range physiographic province. Located in the flat Mojave Valley, local landforms consist of small hills and volcanic rock formations. Vegetation is sparse, and low in profile. The Mojave River runs south of the installation. The intermodal site, located in the northwest portion of the Annex, consists of a series of railroad tracks, warehouse-type buildings, concrete parking/loading areas, and large motorized equipment such as rail cars, trucks, cranes, and military vehicles.

3.4 UTILITIES

The need for utilities is limited to the intermodal transfer sites. Therefore, the analysis for utilities consists of the proposed sites and areas immediately surrounding those sites.

3.4.1 Barstow

3.4.1.1 Electricity

Southern California Edison (SCE) supplies electricity to the Barstow area. Present SCE facilities are capable of supplying projected power needs for the near future. SCE has further indicated that existing substations have the capability of being expanded to serve long-range future demands. Electric service is supplied throughout the developed portions of the area and is available to the undeveloped area within and adjacent to developed lands (Barstow, 1997a).

3.4.1.2 Natural Gas

The Southwest Gas Corporation provides natural gas service to the Barstow area. Existing gas delivery lines serve the developed portions of the area, and lines can be extended to serve unimproved properties (Barstow, 1997a).

3.4.1.3 Water

Most of the Barstow area currently receives water from the Southern California (SoCal) Water Company, as well as from the Mojave Water Agency (MWA). The SoCal Water Company has the present on-line capacity to produce 32.69 million gallons per day (mgd) of water, with peak daily demands reaching 14.83 mgd during the summer months. The local water distribution system is in significant need of improvements due to old, deteriorating lines in the older parts of the area, and lines throughout the area that are undersized for meeting modern fire flow demands (Barstow, 1997a).

3.4.1.4 Wastewater

The existing wastewater collection system consists primarily of vitrified clay pipe and concrete pipe but includes truss, polyvinyl chloride (PVC), and cast iron pipe. The oldest portions of the collection system were constructed around 1939.

Barstow wastewater treatment facilities have a combined secondary treatment capacity of 7.5 mgd. The existing treatment facilities include aeration basins, secondary clarifiers, a chlorine contact chamber, and a chlorine contact lagoon. After treatment, effluent is discharged to the Mojave River adjacent to the treatment facilities (Barstow, 1997a).

3.4.1.5 Solid Waste

The area is served by the Barstow Sanitary Landfill, located 5 km (3 mi) southeast of the city, and the Lenwood/Hinkley Landfill, located 16 km (10 mi) west of Barstow. Both of these are Class III facilities, able to accept nonhazardous solid and inert waste originating from residential, commercial, agricultural, and construction sources. Through 1996, over 20 percent of the Barstow Landfill's 621,229-ton capacity has been used, while over 4 percent of the Lenwood/Hinkley Landfill's 1,451,656-ton capacity has been used. The life expectancy of the Barstow Landfill is 16 years, while that of the Lenwood/Hinkley Landfill is 240 years. The landfill operations at both facilities are in compliance with all applicable state and local regulations (Barstow, 1997a).

3.4.2 Caliente

The City of Caliente owns and manages systems for electric power, water, geothermal energy, and sewage treatment. The power operation, Caliente Public Utilities, has recently installed a new connection with the power grid and a new substation that provides adequate capacity for all anticipated demand.

The water utility is supported with storage capacity of 900,000 gallons. Water used for development and maintenance, dust control, fire protection, and any other use would be covered by existing permits. The city also owns two geothermal wells with aquifer temperature of 204 degrees Fahrenheit (°F). The energy is used for space heating in two buildings. Additional heating sources are propane, electricity, and wood. Natural gas is not available.

The sewage treatment plant was constructed in 1995 and was designed for a population of 2,500, approximately double the present population. Current infiltration problems are expected to be solved by a current project to reline the piping system (Van Roekel, 1998).

3.4.3 Yermo

The community of Yermo, California, is located 4.0 km (2.5 mi) east of the gate to the Yermo Annex of the MCLB Barstow. It has a population of 1,000. Electric power is provided by SCE. Water is supplied by the Yermo Water Company and private wells. Septic tanks are used for sewage disposal (Sandridge, 1998).

The community of Daggett, California, is located 4.0 km (2.5 mi) south of the proposed intermodal site at the Yermo Annex. It has a population of 500. Electric power is provided by SCE. Water is supplied by the Community Services District from wells. Septic tanks are used for sewage disposal (Bell, 1998).

3.5 NOISE

Noise can be generally defined as unwanted or unpleasant sound. Methodologies have been established for characterizing a noise environment so that the potential effects of noise level on a receptor can be determined. Appendix B provides background information on noise and its effects on hearing loss, sleep and speech interference, and annoyance.

Noise levels are regulated by various federal, state, and local regulations to minimize adverse effects on the general public. The following summarizes those regulations having applicability to this study:

Federal
The federal government regulates noise in the railroad industry in 40 CFR Section 201.1. The regulations establish noise limits for the noise of retarders, car coupling, locomotive load-cell test stands, and stationary locomotives.

State of Nevada
The State of Nevada has not adopted any noise regulations applicable to the proposed project.

State of California
The State of California has not adopted any noise regulations applicable to the proposed project. The *California Environmental Quality Act (CEQA)* has established guidelines to evaluate the significance of the effects of environmental noise attributable to a proposed project. Appendix G

of the CEQA Guidelines states that a project would normally have a significant effect on the environment if it would:

- conflict with adopted environmental plans and goals of the community where it is located (CEQA Guidelines, Appendix G, Item a);
- increase substantially the ambient noise levels for adjoining areas (CEQA Guidelines, Appendix G, Item p); or
- expose people to severe noise levels (CEQA Guidelines, Appendix I).

Local
City of Caliente—The Caliente Municipal Code Section 15.2530 Noisy Business/Where Prohibited is the City's Noise Ordinance. It states the following: "It shall be unlawful for any person, firm, association, or corporation to conduct any business in any zone except I-1, of the City of Caliente, of a noisy nature, or which would tend to disturb the peace and quietude, or health of these districts, and no permission shall be granted by the City Council or by any officer or officials of the City to conduct any such business in said districts." [Ordinance.9, Section.10]

The noise analysis includes the areas surrounding the proposed intermodal transportation facility sites and developed lands immediately adjacent to the roadway segments between the transportation facility sites and the NTS.

3.5.1 Barstow

3.5.1.1 Intermodal Facility

This site is an existing intermodal terminal for the BNSF located in an isolated area at the western edge of the populated area. No noise-sensitive receptors, which are land uses where noise could reasonably be expected to interfere with normal activity, are known to exist in the vicinity of the facility. The existing noise environment in this area is a result of current intermodal operations, through-rail operations, other industrial sources, and traffic. The major rail yard noise sources in Barstow include hump engines, concentrated switching, multiple and single lines of idling engines, multiple and single lines of parked mechanical refrigeration cars, and diesel load tests (at the existing diesel shop). These activities typically generate noise levels in the ranges of 80 to 90 A-weighted decibels (dBA). Car retarders generate the highest noise levels, 110 dBA measured at 30 m (100 ft). This is a 24-hour per day operation. In addition, there are seven eastbound and seven westbound UP trains, as well as 14 BNSF through trains (Barstow, 1997a).

3.5.1.2 Route to NTS

Based on the daily average traffic volumes and percent of truck traffic shown in Table 3-4 for the different Barstow route segments, noise levels along this route are estimated to range between 58 and 77 dBA within 30 m (100 ft) of the highway.

3.5.2 Caliente

3.5.2.1 In-town

Sensitive receptors in the area of the In-town site include a church, housing, and commercial buildings located across Front Street within about 60 m (200 ft) of the proposed site. The most significant source of noise affecting the area is current railroad traffic on the UP line. The Caliente City Manager estimates the frequency of train operations at approximately 24 trains per day over a 24-hour period. He cited historical records at between 18 and 30 trains per day. Switching operations are currently conducted both day and night (Rodkin, 1997). Trains travel through town at a speed of about 35 mph.

The noise of railroad train operations is comprised of the noise of the engine, rail cars, and train horn. Noise levels for existing train operations are estimated based on measurements of similar main line train operations in Central California (Illingworth and Rodkin, 1992). For the purposes of this analysis, it is assumed that 24 trains per day represent the annual average level of operations. It is assumed that the trains are evenly distributed over a typical 24-hour period, with 15 trains during the daytime (7 a.m. to 10 p.m.) and 9 trains during the nighttime (10 p.m. to 7 a.m.). Maximum noise levels generated by railroad train operations are typically between 85 and 95 dBA measured at a distance of 15 m (50 ft) from the tracks, resulting from the train engine and cars. Maximum noise levels of up to about 105 dBA can be generated at a distance of 15 m (50 ft) by the train warning horn, with an average single event level (SEL) of 106 decibels (dB) the calculated day/night noise levels (L_{dn}) is 77 dB, 15 m (50 ft) from the centerline of the tracks. In between railroad train passes, the noise environment would result primarily from local vehicular traffic.

3.5.2.2 South

This site is approximately 1.2 km (0.75 mi) south of the In-town site in an uninhabited area. The only significant source of noise affecting the environment in this area is rail operations and traffic described for the In-town site.

3.5.2.3 Route to NTS

The existing traffic mix on the roadway segments between Caliente and the NTS indicates light truck traffic volumes along all segments of the route, with truck percentages typically greater than 10 percent. Based on the daily average traffic volumes and percent of truck traffic shown in Table 3-5 for the different Caliente route segments, noise levels along this route are estimated to range between 56 and 74 dBA within 30 m (100 ft) of the highway.

3.5.3 Yermo

3.5.3.1 Yermo Annex Intermodal Facility

Rail operations are currently conducted on this site. It is assumed that this site is compatible with the surrounding land uses on the MCLB.

3.5.3.2 Route to NTS

The existing traffic mix indicates heavy truck traffic volumes along all the interstate highway segments of the route, with truck percentages typically greater than 18 percent. Estimated noise levels are the same as discussed for the Barstow route to the NTS.

3.5.4 Alternate Routes

Based on the daily average route volumes and percent of truck traffic shown in Table 3-6 for the all truck route segments, noise levels along these routes are estimated to range between 58 and 74 dBA within 30 m (100 ft) of the highway.

3.6 AIR QUALITY

3.6.1 Current Route Environment

The current truck route to the NTS includes vehicles traveling from the east across Hoover Dam into Nevada, through the Las Vegas metropolitan area, and out of Las Vegas to the northwest on US 95 to the NTS. The Las Vegas Valley is nonattainment for carbon monoxide and particulate matter as PM_{10}. The attainment status for the new particulate matter standard as $PM_{2.5}$ has not yet been established. Clark County is considering emissions controls for large trucks, particularly if emissions from such sources are shown to contribute to a potential nonattainment problem for $PM_{2.5}$.

Las Vegas is a major transportation hub for large trucks. I-15, and US 93, and US 95 continuously carry a significant number of large trucks.

3.6.2 Barstow

The BNSF intermodal transfer facility and associated highway routes to the NTS in California are in San Bernardino County. This area is in the Mojave Desert Air Quality Management District (MDAQMD), with headquarters in Victorville, California. Monitoring stations are located in Barstow and other communities in the MDAQMD. Barstow is in the high desert portion of the Mojave Desert Air Basin, which recently was created as a split of areas from the Southeast Desert Air Basin. All of San Bernardino County is classified as nonattainment for particulate matter as PM_{10}; the Barstow area is designated as moderate nonattainment. Portions of San Bernardino County are also nonattainment for ozone, carbon monoxide, and nitrogen dioxide. The Barstow area is included in the nonattainment area for ozone and is classified Severe-17 by the U.S. Environmental Protection Agency (EPA). This designation requires that the standard be attained by the year 2007.

Barstow is in a broad east- to west-oriented valley, with typically very good ventilation winds blowing through the area from the west. It is just these winds that appear to bring polluted air from the Los Angeles Basin to the west through the Barstow area; it is unlikely that this area would be a nonattainment area were it not for the proximity to the Los Angeles area. The area is attainment for the other criteria pollutants.

3.6.3 Caliente

Caliente is a small community in rural Nevada without any air quality monitoring stations for regulated pollutants. Part of the reason for an absence of nearby stations is the perceived lack of air quality problems. The State of Nevada describes most of rural Nevada as unclassifiable, assuming it to be in attainment status for the criteria pollutants.

Caliente is in a small valley topographic setting, oriented approximately east to west along the direction of the railroad passing through the community. The railroad also passes south of Caliente through a narrow canyon; the proposed intermodal facility location is in this canyon. The frequent sunny days typical of rural southeastern Nevada provide good neutral to unstable atmospheric mixing conditions in the daytime hours. The valley environment is conducive to surface-based temperature inversions occurring during nighttime hours. Temperature inversions are a stable atmospheric dispersion condition which limits the horizontal and vertical mixing of airborne air pollutants. However, the down-slope canyon opening to the south creates an air drainage pathway that provides nearly continuous ventilation of the area toward the south away from the city, rather than the stagnant conditions frequently associated with temperature inversions in flatland or closed-basin topographic settings. Thus, the area is not expected to experience a build-up of airborne pollutants, maintaining the good local air quality.

3.6.4 Yermo

The current air quality conditions in the Yermo Annex of the MCLB area are essentially the same as those described for Barstow. Both communities lie along I-15 and rail facilities in similar topographic settings, with similar local air quality influences. The MCLB routinely handles military vehicle and material transfers servicing a major desert training facility at Fort Irwin, north of Barstow and Yermo.

The MCLB Yermo Annex is subject to a complex EPA Title V permit, primarily due to volatile organic compounds used in vehicle maintenance activities at the facility. Locomotive operations at the MCLB are exempt from the Title V permit.

3.7 WATER RESOURCES

The transportation options do not involve the use of water resources.

Additions to this section recommended by the AITC are in Appendix E, Section E.3.2.

3.8 RADIATION, SAFETY, AND OCCUPATIONAL HEALTH

3.8.1 Current Route Environment

In FY 1997, there were 754 shipments of LLW to the NTS on the routes shown in Figure 2-4. There were no carrier vehicular accidents. There were, however, a few incidents. The descriptions below include a brief description of the incident, response action, notifications made, and corrective action(s) taken to prevent recurrence.

- On 03/24/1997, a shipment of LLW arrived at the NTS Area 5 Radioactive Waste Management Site (RWMS) with incorrect shipping papers. The driver was in possession of shipping papers for shipment WML97107 with a trailer containing shipment WML97109. The Fernald Waste Certification Official (WCO) was contacted. The correct certification papers were requested and received. Off-loading then occurred.

- On 05/21/1997, a shipment of LLW arrived at the NTS Area 5 RWMS with a breached package. Package #482403 leaked material onto the trailer floor. The trailer was decontaminated, and the package was accepted. Fluor Daniel Fernald issued a nonconformance report on 05/21/97 (NCR 97-0138) documenting certain planned corrective actions to prevent a recurrence of the problem. A Corrective Action Request (CAR) number Radioactive Waste Acceptance Program (RWAP)-C-97-02 was issued and subsequently closed with surveillance number RWAP-S-97-02.

- On 07/10/1997, a container received at the NTS was missing the certification sticker which fell off in transit. Bechtel Nevada (BN) Waste Management notified the WCO and requested a new certification sticker. Extra stickers are now included with the normal shipping papers, should it happen again (DOE, 1998b).

On 12/15/1997, the driver of a truck containing seven containers of LLW being shipped from Fernald, Ohio, to the NTS noticed that the trailer was leaking as he exited I-40 near Kingman, Arizona. Local and state authorities responded, as did the DOE Radiological Assistance Program Team and a support team from the Fernald Environmental Management Project. No radioactive contaminant was detected by the responders and they determined that the leaking liquid was not hazardous to the health and safety of the public, or damaging to the environment. The Investigation Board concluded that free liquid in the containers leaked onto the trailer floor and later out of the trailer when stress fractures in two shipping containers, caused by routine handling, were widened by the protracted vibration and wear during highway transport. As a result of this investigation, actions were identified to ensure the design integrity of the containers and eliminate the high moisture content of the waste.

On 10/01/1994, a tractor-trailer carrying LLW in a sea/land container on a flat-bed trailer was involved in a traffic accident west of Rolla, Missouri, on I-44. When passing a slower vehicle, the driver allowed a front tire to leave the pavement into a 10-inch (in) drop to the median, causing the truck to tip over. The container separated from the trailer and came to rest on its top in the median. The container was not breached. A hazardous materials team from Fort Leonardwood responded promptly, and the Phelps County Sheriff's Office secured the site until personnel from the Fernald Environmental Management Project arrived. After inspections were completed, the damaged container was returned to the Fernald facility in Ohio.

A 1993 report by the U.S. Bureau of Reclamation on hazardous material truck safety at Hoover Dam indicated that more than 10,000 vehicles per day use the highway approaches to the dam, including 1,200 trucks. Approximately 10 percent of these trucks contain hazardous materials. Seventy percent of these trucks contain gasoline and diesel fuel. Less than 3 percent contain radioactive materials (Bureau of Reclamation [BOR], 1993).

3.8.2 Barstow

3.8.2.1 Intermodal Facility

The BNSF Intermodal Facility at Barstow currently handles freight containing hazardous and radioactive materials. Safety and occupational health practices meet industry standards.

3.8.2.2 Route to NTS

See Section 3.8.1.

3.8.3 Caliente

Presently there are no intermodal operations in Caliente. LLW is not normally transported through Caliente.

3.8.3.1 In-town

An off-site radiation monitoring program has been conducted around the NTS since 1992 by the EPA Environmental Monitoring Systems Laboratory, Las Vegas, under an interagency agreement with the DOE. The objectives of the Off-Site Environmental Surveillance Program are "to ensure nearby residents of the safety of the air and water, and to provide a long-term environmental baseline to detect contamination from DOE activities." This program consists of extensive environmental sampling, and radiation detection and dosimetry networks in communities surrounding the NTS. This program is capable of collecting: air samples, noble gas and tritium samples, milk and other foodstuffs, measuring radiation levels, and conducting surface and groundwater sampling at designated locations.

An EPA Community Radiation Monitoring Program (CRMP) already exists in Caliente, which has a thermoluminescent dosimeter (TLD) for continuously recording radiation, and a pressurized ionization chamber (PIC) for continuous recording of gamma radiation. An air sampler, and noble gas and tritium samplers are in a stand-by mode for use as needed in an emergency.

3.8.3.2 South

No transportation operations are currently conducted at the South site.

3.8.3.3 Route to NTS

There were 231 shipments of LLW on the Tonopah to Mercury segment of this route in FY 1997.

3.8.4 Yermo

3.8.4.1 Yermo Annex Intermodal Facility

The intermodal facility operating at the MLCB, Yermo Annex handles military equipment and munitions being transported by rail and truck. Safety and occupational health practices meet government standards. The facility has the capability for handling small quantities of radioactive materials and responding to accidents (Gentry, 1998). An equipment maintenance facility is located 0.61 km (2,000 ft) from the intermodal area employing 937 people.

3.8.4.2 Route to NTS

See Section 3.8.1.

3.8.5 All-truck Route Options

3.8.5.1 Kingman to NTS

There are currently no shipments of LLW on the Kingman to Barstow segment of this route.

3.8.5.2 Mesquite, Nevada, to NTS

There were 231 shipments of LLW on the Tonopah to Mercury segment of this route in FY 1997.

3.9 BIOLOGICAL RESOURCES

The footprints of the proposed intermodal transfer facilities are the analysis areas for evaluation of effects on biological resources of construction and operation of those facilities. These restricted footprints were chosen because construction and operation activities (including accidental releases) are expected to remain within the footprint of the proposed facilities. In addition, with the exception of the Caliente South site, the areas surrounding the proposed sites are developed or highly modified and generally are devoid of natural vegetation, reducing the likelihood of animals moving into the proposed construction areas.

The analysis area for evaluating transportation effects on biological resources is the width of the highway and the associated disturbed shoulders when crossing terrestrial habitats because there will be no construction activities or other disturbances along highways, and because accidentally released materials will remain on or very close to the roads. The analysis area is expanded to within 400 m (1,312 ft) of highways where they cross perennial streams or other water bodies because spilled materials that reach water may spread more rapidly and contaminate areas beyond the highways (DOE, 1997b).

Additions to this section recommended by the AITC are in Appendix E, Section E.3.3.

3.9.1 Current Route Environment

This route is within the Mojave Desert from its origin to the NTS. Native vegetation associations along the route include Mojave mixed scrub, creosotebush scrub, and desert saltbush scrub (Utah State University, 1996). Vegetation along the Colorado River and other perennially moist waterways may include a combination of species of cattail, rushes, willows, cottonwoods, and saltcedar.

This route passes through habitat for the threatened desert tortoise from its origin to the NTS (Bury et al., 1994; BLM, 1992, 1994b). It does not cross areas identified as critical habitat for this species (FWS, 1994b). The route crosses Hoover Dam on the Colorado River, which contains three endangered fish, the Colorado Squawfish, the bonytail chub, and the razorback sucker.

3.9.2 Barstow

3.9.2.1 Intermodal Facility

This site is within an existing rail yard devoid of vegetation. No sensitive or protected plants or animals are known to occur on or near the proposed facility.

3.9.2.2 Route to NTS

This route is within the Mojave Desert for its length, crossing Mojave creosotebush scrub, salt desert scrub, and Mojave mixed scrub vegetation associations. Vegetation along wet river or creek bottoms in some of the valleys along the route includes species of rushes, cattail, desert willow, and/or saltcedar.

Two federally protected species are known to occur along the route and potentially could be found on the highway – the threatened desert tortoise and the endangered Amargosa vole. Desert tortoises are present in adjacent habitat along the length of this route. The route also borders an area classified as critical habitat for the desert tortoise from the route's beginning to about 45 km (28 mi) east of Yermo (FWS, 1994a). The Amargosa vole is found in the marshes associated with Tecopa Springs and portions of the Amargosa River (California, 1997). The route borders the northeast section of critical habitat for this species (50 CFR Ch. 1, 17.95, 1997; California, 1997). Desert tortoises are occasionally killed by passing vehicles. There is no record of Amargosa voles being found on highways.

3.9.3 Caliente

3.9.3.1 In-town Site

The proposed site for construction and operation of this facility is within the City of Caliente, Nevada. The town lies within Meadow Valley at an elevation of approximately 1,340 m (4,400 ft) at the north end of the Delamar and Clover mountains. The vegetation in undeveloped areas of the region are typical of the Great Basin Desert, and are predominantly sagebrush, salt desert scrub, and juniper (BLM, 1979).

The site proposed for construction of the facility is a graded and graveled area within the UP railroad right-of-way, with no vegetation. No surveys for animals have been conducted at this site. However, because of the lack of vegetation within the site, and because it is surrounded by developed areas, very few animals would be found within the proposed area. No state or federally protected species are known to be resident within or near the proposed location of the facility (Nevada Natural Heritage Program [NNHP], 1997).

3.9.3.2 South Site

The site for the new facility is an irrigated pasture north of the existing water treatment facility in the Meadow Valley Wash, south of Caliente. The pasture is separated from the perennial stream in Rainbow Canyon by the existing rail line. Jurisdictional wetlands have been delineated on the south and southwestern edges of the pasture. Small wetlands have formed in the borrow ditch adjacent to the existing rail line, and they may be jurisdictional. However, these areas have not been delineated.

No species listed under the *Endangered Species Act* or protected by the State of Nevada are expected to reside within the proposed construction area (NNHP, 1997; BLM, 1979). Two fish species, the Meadow Valley speckled dace (*Rhinichthys osculus* ssp.) and the Meadow Valley Wash desert sucker (*Catostomus clarki* ssp.), have been found in the Meadow Valley Wash above and below the route. Both species are considered sensitive by BLM and the Meadow Valley Wash desert sucker is classified as sensitive by the State of Nevada.

3.9.3.3 Route to NTS

From the beginning of the route in Caliente to near Beatty, the route is within the southern Great Basin Desert and passes through vegetation associations typical of that ecosystem, including salt desert scrub, hopsage, sagebrush, and juniper. Near Beatty, the route enters an area of transition between the Great Basin and Mojave deserts where vegetation types from both deserts are found, including salt desert scrub, blackbrush, creosotebush, sagebrush, and Mojave mixed scrub. Vegetation along wet river or creek bottoms in some of the valleys includes species of rushes, cattail, desert willow, cottonwoods, and/or saltcedar. The route crosses several mountain ranges and a perennial stream, the Amargosa River in Oasis Valley (BLM, 1979).

This route crosses habitat for only one species listed as threatened or endangered under the federal *Endangered Species Act* or by the State of Nevada (NNHP, 1997; BLM, 1979, 1994a). The desert tortoise (classified as threatened federally by the state) is found from near Beatty to the end of the route. The relative abundance of desert tortoises in this region is low (Karl, 1981; EG&G, 1991), and no critical habitat for this species has been identified in this region (FWS, 1994b).

Several sensitive species are found in perennial streams along the route. The Amargosa toad *(Bufo nelsoni)* and the Oasis Valley speckled dace *(Rhinichthys osculus ssp.)* have been found in the Amargosa River and nearby springs in the Oasis Valley (BLM 1994a; NNHP, 1997). Both species are considered sensitive by the BLM.

3.9.4 Yermo

3.9.4.1 Yermo Annex Intermodal Facility

The existing Yermo Annex Intermodal Transfer Facility is north of the playa in the Mojave River Valley, within the eastern Mojave Desert. Dominant vegetation in the region surrounding the facility is typical of the Mojave Desert and includes creosote bush *(Larrea tridentata)*, cheesebush *(Hymenoclea salsola)*, and white bursage *(Ambrosia dumosa)* (U.S. Navy, 1998).

No sensitive or protected plants or animals are known to occur on the facilities at the MCLB (California, 1997; U.S. Navy, 1998). The desert tortoise is known to occur in the region but is highly unlikely to be found within the intermodal facility.

3.9.4.2 Route to NTS

The biological environment for the Yermo-NTS route is the same as described above for the Barstow-NTS route.

3.9.5 All-truck Route Options

3.9.5.1 Kingman to Barstow to the NTS

This route is within the Mojave Desert for its length, crossing Mojave creosotebush scrub, desert saltbush scrub, and Mojave mixed scrub vegetation associations (BLM, 1980). Vegetation along the edges of the Colorado River and other wet river or creek bottoms crossed by the route includes species of rushes, cattail, desert willow, and/or saltcedar.

In addition to the protected or sensitive species described for this route from Barstow to Mercury (see Section 3.10.2.3), the route crosses the Colorado River, which contains three federally endangered fish, the Colorado squawfish, the bonytail chub, and the razorback sucker.

3.9.5.2 Mesquite, Nevada, to Tonopah, to the NTS

From the Colorado River to Alamo, and again from Beatty to the NTS, the northern portion of the All-truck Route passes through vegetation associations typical of the Mojave Desert. Between Alamo and Beatty, the vegetation is more typical of those found in the Great Basin Desert (BLM, 1994a; BLM, 1979).

This route passes through habitat for the federally and state-threatened desert tortoise from the Colorado River to Alamo, and again from Beatty to the NTS. This route is adjacent to an area designated as critical habitat for the threatened desert tortoise north of the route beginning at the Nevada-Utah border, extending southeast about 56 km (35 mi) (FWS, 1994b). An approximately 100-km (62-mi) section of US 93 from Maynard Lake to the junction with I-15 crosses an area designated as critical habitat for the desert tortoise (FWS, 1994b).

The route crosses the perennial outflows from Ash Springs Wildlife Management Area, the Key Pittman Wildlife Management Area, and the White River in the Pahranagat Valley. Two species of fish, the Pahranagat roundtail chub (classified as federally and state-endangered) and the White River springfish *(Crenichtys baileyi baileyi)* (federally endangered and state-protected), are found in these outflows (NNHP, 1997).

3.10 CULTURAL RESOURCES

Cultural resources include sites, buildings, structures, or objects with historical, architectural, archeological, cultural, or scientific importance. A variety of federal laws and regulations provide for the protection of such resources. Applicable laws include the *National Historic Preservation Act of 1966* as amended, the *National Environmental Policy act (NEPA) of 1969*, the *Archeological and Historic Preservation Act of 1974*, the *Archeological Resources Protection Act of 1979* as amended, the *American Indian Religious Freedom Act of 1978*, the *Native American Graves Protection and Repatriation Act of 1990*, DOE/NV Order 54Xd1A, Preservation of Antiquities, Archeological, and Historic Properties, 11/19/91, *EO 13007 - Indian Sacred Sites*, 5/24/96, and applicable State of Nevada and California statutes and regulations. Together, these statutes establish a comprehensive program and provide guidance for the identification, evaluation, and management of cultural resources. Any projects or actions involving publicly or tribally administered lands or federal funding require compliance with the above laws and regulations. Consultation is required with any tribe having a traditional, aboriginal, or historic tie to the area, as stipulated in the DOE American Indian Policy (1994).

Additions to this section recommended by the AITC are in Appendix E, Section E.3.4.

The AITC was formed in August 1996, during a study of American Indian issues related to the transportation of LLW to the NTS. The AITC has 9 members who were selected (with the approval of their respective governments) to represent the 29 tribes involved in the study. The AITC conducted a rapid cultural assessment of intermodal sites and highway routes from 01/11/1999 until 01/21/1999. The direct field observations are reported in Appendix E. The AITC also pointed out the need for further information so that Indian people can see a full range of their issues described in the assessment of this proposal. Their recommendations are reproduced below.

1. **Adequacy of Present Findings**. The AITC believes it has documented sufficient potential adverse impacts to American Indian cultural sites and cultural landscapes along all proposed Intermodal Environmental Assessment (IMEA) routes to warrant further study before a decision is made. The AITC does believe specific data collection steps are still needed before this report fully represents Indian opinion.

2. **Need for Elder Input**. The AITC has some ideas about the kinds expertise of tribal elders that are needed to more fully assess potential spiritual impacts at various critical cultural locations along all proposed IMEA routes. Foremost among these are potential impacts to (1) the Salt Song Trail and (2) the unburied spirits still at the Hiko, Nevada, massacre site.

3. **Need for Local Indian Input**. There are local Indian issues that could not be represented in this rapid cultural assessment. These include the potential impacts to the large multi-ethnic community in Barstow and the small Paiute community in Caliente. The presence of a multi-ethnic Indian Health Center at Tecopa Hot Spring, in California, needs to be better documented and potential impacts need to be better understood.

4. **Need to Assess Other Indian Economic Opportunities**. Some of the potential economic opportunity costs of the IM proposal remain unconsidered. For example, hot springs located within sight of US 93 north of Tonopah in the town of Mina are currently being used in an aquaculture business. Australia lobsters are being raised in warm water from the spring and, over the lobsters, tomatoes are being raised with hydroponics. The hot springs food products are selling at this time, mostly to local restaurants. Such economic ventures are within the interest and means of some of the tribes who have traditional cultural attachments to these hot springs. Whether or not such economic ventures would be considered in the future is unclear, but the presence of LLW trucks near the hot springs is seen by the AITC as a potential use conflict.

5. **Need to Assess Railroad Routes.** Two recent train derailments along the study area have caused he AITC to identify the need to study the potential physical and spiritual impacts of LLW haul on trains. On 12/24/1998, a UP train left the tracks 4 mi up stream on Clover Creek from Caliente. This accident took out a railroad bridge and placed many of the cars and their loads in the water of Clover Creek. The haul was coal, so it was scooped up and disposed of in big piles in the UP railroad yard in Caliente. Another accident occurred last year on the UP line that passes through the U.S. Desert Nature Preserve just south of CA 127 and on the way into Barstow, California. Both lines are being considered for LLW haul under the IMEA and both areas involved are well known spiritual places to Native Americans.

3.10.1 Barstow

Most of the archeologically significant resources in the Barstow area, such as Indian artifacts and petroglyphs, exist outside the city. However, undeveloped land throughout the city, particularly in the western portions, may hold unrecorded archeologically significant artifacts or fossils. Since the BNSF facility is established on developed lands, cultural resources are not a consideration for this site.

Additions for this section recommended by the AITC are in Appendix E, Section E.3.5.

3.10.2 Caliente

Additions for this section recommended by the AITC are in Appendix E, Section E.3.6.

3.10.2.1 In-town

Archeological, ethnographic, and historic research indicates that the Caliente/Meadow Valley Wash area has been occupied by various cultural groups from the terminal Pleistocene through historic times. Fowler et al., (1973), Fowler and Madsen (1986), and James and Zeier (1982) provide valuable summaries of the region's prehistory and offer a chronological framework for interpreting cultural developments in southeastern Nevada. Archeological site types reflecting prehistoric utilization of the area typically include residential bases, temporary campsites, rock art sites, and a variety of activity loci. These activity sites generally consist of artifact scatters, quarries, plant processing localities, hunting blinds, or rock alignments and represent resource procurement and/or processing behavior.

The research of Steward (1938) and Kelly and Fowler (1986) provides ethnohistoric information documenting the traditional lifeways of the region's Western Shoshone and Southern Paiute inhabitants. A wide variety of sites, geographic features and natural resources may hold special cultural meaning for native peoples. These include, but are not limited to, petroglyphs and pictographs, ceremonial sites, traditional settlements, and the habitat of certain animals and traditional medicinal plants.

The history of the Meadow Valley region is summarized by Roske and Planzo (n.d.) in their overview of Lincoln County. Historic occupation of the area began in the 1860s to 1870s with mineral discoveries in the mountains to the north and west. The Culverwell Ranch, established in the early 1870s, became the future townsite of Caliente. By 1905, Caliente had become a division point on the San Pedro, Los Angeles, and Salt Lake Railroad line. Historic resources in the region usually consist of the material remains of late 19th and early 20th century mining, ranching, transportation, or communication activities.

Because the Caliente project areas will require the construction of a new railroad siding and truck operations center, an existing data review was completed. Twenty-five archeological reconnaissance surveys have been conducted within a 3.2-km (2-mi) radius of the proposed Caliente facilities. To date, 19 cultural resources have been recorded as a result of these surveys. This total includes 12 prehistoric sites, 6 historic sites, and 1 multicomponent prehistoric/historic site. Prehistoric site types consist of artifact scatters, rockshelters, temporary camps, and several rock art sites. Historic sites include trash scatters, a series of stone and masonry structures (Kershaw-Ryan State Park facilities), a railroad berm, and a railroad depot. The multicomponent site consists of a lithic scatter, a historic trash scatter and a wooden corral. Currently, six of these cultural properties have been determined noneligible through consultations with the Nevada State Historic Preservation Office, while six are considered eligible for listing on the National Register of Historic Places (NRHP). One site, the Caliente Railroad Depot, is listed on the NRHP. The remaining seven sites have not been evaluated for NRHP eligibility.

No formal ethnographic studies of cultural resources important to American Indians have been conducted at or near the two locations proposed for the intermodal facility.

3.10.2.2 South

Cultural resource information is the same as discussed above for the In-town site.

3.10.3 Yermo

The proposed Yermo intermodal facility is located within a previously developed portion of the MCLB Barstow, Yermo Annex.

Additions to this section recommended by the AITC are in Appendix E, Section E.3.7.

3.11 GEOLOGY AND SOILS

3.11.1 Barstow

The Barstow intermodal facility is located in the Mojave Desert province. Characteristic landforms in the Mojave Desert include broad alluvial fans, old dissected terraces, and playas. Also included are the Mojave River and its flood plain, and scattered mountains that dominate the landscape.

Barstow is located in a tectonic region described as having a series of closely spaced northwest-trending faults. Barstow is located in Seismic Zone 4, which is characterized by areas likely to sustain major damage from earthquakes, and corresponds to intensities of VII or higher on the modified Mercalli Scale. Active faults in the vicinity of Barstow include the San Andreas Fault, the Garlock Fault, and the Manix Fault.

Barstow is located on alluvial deposits dissected by many small intermittent streams. The primary hydrologic feature in the area is the Mojave River, which runs to the north of the Barstow site. The river flows from the San Bernardino Mountains northeasterly to Soda Lake. The Barstow intermodal facility is located in an area of undetermined flood potential (City of Barstow, 1997b).

The soils at the Barstow site are classified as Cajon sand (Soil Conservation Service [SCS], 1978). The Cajon sand consists of very deep, somewhat excessively drained soils on alluvial fans. It formed in alluvium derived dominantly from granitic material. Slopes are broad, long, smooth, and nearly level (0 to 2 percent). The upper 63.5 centimeters (cm) (25 in) of soil is typically very pale brown sand. The next 50.8 cm (20 in) of the underlying soil is very pale brown gravelly sand, and the lower part to a depth of 152.4 cm (60 in) or more is very pale brown sand (SCS, 1978).

Permeability of this Cajon sand is rapid. Runoff is slow, and the hazard of water erosion is slight. However, the hazard of wind erosion is high. The soil is not subject to flooding. The Cajon sand has a low shrink-swell potential. Corrosivity of the soils to untreated steel is moderate. Corrosivity to concrete is low (SCS, 1978).

3.11.2 Caliente

3.11.2.1 In-town

Caliente is located in the eastern part of the Great Basin section of the Basin and Range physiographic province. Mountain ranges in the vicinity trend north-south and are narrow compared to the valleys in the area (BLM, 1979). The Chief Range is to the north of Caliente and the Clover Range is to the south. Volcanic rocks (lava flows and tuffs), nonintrusive rocks (sedimentary and volcanic), and alluvium make up the geologic environment in the Caliente area. Caliente is located in Seismic Zone 2B, as defined in the Building Code (International Conference of Building Officials, [ICBO], 1994). Zone 2B is defined as an area of moderate damage potential.

The City of Caliente is located on the flood plains of the Meadow Valley Wash, which runs to the north of the city. The elevation at Caliente is 1,340 m (4,400 ft). The soils at Caliente are classified as Geer fine sandy loam, gravel substratum (SCS and BLM, 1976). A representative soil profile of the Geer series consists of about 22.9 cm (9 in) of yellowish-brown and light-gray silt loam that is underlain by pale-brown, very pale brown, and light gray, stratified loamy sand, very fine sandy loam, silt loam, and loam that extends to a depth of 152.4 cm (60 in) or more (SCS and BLM, 1976).

The Geer fine sandy loam, gravel substratum in the Caliente area is level to nearly level. It has a profile similar to that described as representative of the series, but the surface layer is different in texture and, below a depth of 50.8 cm (20 in), the soil material is 5 to 30 percent gravel. Runoff is slow, and the hazard of erosion is moderate. The soil is subject to occasional flooding. The Geer fine sandy loam, gravel substratum has a low shrink-swell potential and a high frost-action potential. Corrosivity of the soils to untreated steel or concrete is high (SCS and BLM, 1976).

3.11.2.2 South

The geology and soil types for this site are the same as those described for the In-town site. As shown on Figure 3-2 the South site is located in a 500-year flood plain (Consulting Engineering Services [CES], 1991).

3.11.3 Yermo

The geology and soils in the vicinity of the existing Yermo intermodal facility are similar to those described for the Barstow site. The exception is that the southeast corner of the Yermo Annex is in the 100-year flood plain of the Mojave River, but it does not include the intermodal site (U.S. Navy, 1998).

3.12 SOCIOECONOMICS

Additions to this section recommended by the AITC are in Appendix E, Section E.3.8.

3.12.1 Current Route Environment

The current route environment includes the Nevada cities listed in Table 3-7.

Table 3-7. Nevada Cities on Current Route

City	*Population (July 1, 1997)*
Boulder City	14,493
Henderson	147,870
Las Vegas	425,270
Mesquite	9,270
North Las Vegas	93,010
Clark County Total	*1,192,000*
Average Daily Visitors, Las Vegas, 1998	*83,850*

Source: Nevada State Demographer, 1998; Las Vegas Perspective, 1999.

The communities affected by the transportation mode and route options are described in the following sections.

3.12.2 Barstow

The population of Barstow as of 01/01/1998, was estimated by the California Department of Finance as 22,641. The most important factor limiting growth is the availability of water. The groundwater basin, upon which Barstow has always relied for water, is in overdraft, and other sources for water are needed.

3.12.2.1 Fire Protection

Fire protection, including fire prevention, fire safety and paramedic services to the Barstow Area is provided by the Barstow Fire Protection District. The district encompasses 142.5 square km (55 square mi) and includes all of the City of Barstow. The district operates four fire stations, five engine companies, one truck company, and a paramedic/reserve squad. Full-time employees operate one engine company and the paramedic unit; volunteers provide personnel for the additional apparatus.

Within the populated portions of the Barstow area, response times vary from 3 to 10 minutes depending on the location of the emergency and the station that responds. These times generally fall within recommended standards of 5 minutes throughout the district because of the strategic station locations.

In total, 26 full-time firefighters, 37 on paid-call, and 7 volunteer firefighters provide fire protection for the City of Barstow. The number of firefighters on duty depends on the time of day. Those members of the Fire District who are on paid-call, or are volunteers, respond to calls from their residence or place of employment—not from any particular station. The San Bernardino County Hazardous Materials Division provides primary response to incidents involving hazardous materials. In the event of an incident involving hazardous materials, initial response would come from the Barstow Fire Protection District, supported by the San Bernardino County hazardous material (HAZMAT) team, composed of technicians and specialists based with other fire departments throughout the county. The Barstow Fire Protection District has four trained specialists on its staff, one of whom would respond to the first alarm, with fire suppression personnel. Approximate response time, if the team is in the station and available, is up to 30 minutes, depending on the location of the emergency. Capabilities are limited to use of geiger counters for purposes of isolating zones of contamination. In addition, the county has a Hazardous Response Van stationed with the Barstow Fire District because of the city's relative remoteness. The van is authorized to respond to incidents located throughout the county. Written mutual aid agreements exist with the Marine Base, Daggett, Newberry Springs, and Fort Irwin fire departments. Other mutual aid under the California Master Mutual Aid Agreement is available from throughout the state, but response times for the closest units are estimated at 1 hour (Barstow, 1997a).

3.12.2.2 Law Enforcement

Local police protection services are provided by the Barstow Police Department.

The Barstow Police Department's jurisdiction lies within the city limits. The department is currently staffed by 37 sworn officers. Emergency response times for the populated portions of the Barstow area average approximately 5 minutes, while nonemergency response times average 10 minutes. The department maintains 13 marked patrol cars, in addition to support vehicles. The Police Department has indicated that its current staff is adequate in providing police protection to the city (Barstow, 1997a).

3.12.2.3 Elementary and High Schools

Barstow is served by the Barstow Unified School District. The School District's boundaries include the City of Barstow as well as the Lenwood, Hodge, and Hinkley communities. During FY 1995 to 1996, the district maintained eight elementary schools, one independent study program, two middle schools, one senior high school, one continuation high school, and one adult school. Six of the elementary schools and two of the middle schools are located within the city limits. The only senior high school, Barstow High School, is also located within the city. There is also a continuation high school called Central High School.

From 1985, the total school enrollment in the Barstow Unified School District grew rapidly from 6,413 students to a peak of 7,435 in 1991. Between 1985 and 1991, the enrollment grew 15.9 percent. Since 1991, the annual total enrollment gradually declined 5.2 percent over a period of 4 years to 7,050 students in 1995 to 1996. This trend is expected to continue for the next few years (Barstow, 1997a).

3.12.3 Caliente

Table 3-8 indicates that the population of Caliente has remained stable over the 1990 to 1995 period with 1997 estimates remaining at 1,160. The population in Caliente has remained at approximately 28 percent of the Lincoln County population.

Table 3-8. Population of Caliente, Nevada, in Relation to Lincoln County, Nevada

	Population						
	1980	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Lincoln County	3,732	3,810	3,870	4,080	4,130	4,340	4,110
Caliente	1,097	1,120	1,140	1,140	1,160	1,160	1,160
Caliente Percentage of County Population	*29%*	*29%*	*29%*	*28%*	*28%*	*27%*	*28%*

Source: Nevada State Demographer, 1998.

Table 3-9 shows that nonfarm employment in the county experienced a decline in the 1990 to 1995 period of 3.22 percent. Employment in 1995 was concentrated in the private and government employment sectors. Table 3-10 indicates that earnings have also followed this pattern with nonfarm earnings declining by 3.08 percent over the same period.

Police protection is provided by three deputy sheriffs. The volunteer fire department has 25 well-trained members with one 1,000-gallon pumper and two 500-gallon pumpers. They have air packs and foam equipment for responding to railroad accidents, and members have received hazardous materials training from the UP (Van Roekel, 1998).

Health care facilities include the Grover C. Dils Medical Center and the Lincoln County Clinic. The medical center's hospital has 4 acute-care beds and 16 long-term beds with a 24-hour emergency room, and ambulance service from six locations in the county. Surgical services are not available locally. Transport services are available via both fixed-wing and helicopter to medical centers in Las Vegas, Nevada, and St. George and Cedar City, Utah (Elkins, 1998).

A Joint City-County Impact Alleviation Committee was established in 1984 to provide information to the public on nuclear risks. The committee has four members each from the city and county supported by grant funds. Funding for the current federal fiscal year is $540,000. The committee has conducted numerous studies regarding the effect of nuclear activities on the county and has toured nuclear power stations to develop an understanding of how fuel rods are produced, maintained, and retired. These activities have resulted in a community that is exceptionally well-informed about nuclear energy and the disposal of radioactive wastes (Van Roekel, 1998).

3.12.4 Yermo

Yermo is an unincorporated village located 4 km (2.5 mi) east of the entrance to the Yermo Annex of the MCLB Barstow with a population of approximately 1,000. It is designated as a Community Services District in San Bernardino County. Fire protection is provided by 15

Table 3-9. Employment in Lincoln County, Nevada

Employment	*1980*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*Average Annual Percent Rate of Change*		*Absolute Change in Number of Jobs*		*Sector Employment as Percent of Total*	
								1980-1990	1990-1995	1980-1990	1990-1995	1990	1995
Total full- and part-time employment	1,810	2,403	2,338	2,210	2,216	2,204	2,038	2.87	-3.24	593	-365	100.00	100.00
Farm employment	164	178	160	162	157	159	149	0.82	-3.49	14	-29	7.41	7.31
Nonfarm employment	1,646	2,225	2,178	2,048	2,059	2,045	1,889	3.06	-3.22	579	-336	92.59	92.69
Private employment	1,251	1,688	1,630	1,475	1,481	1,449	1,285	3.04	-5.31	437	-403	70.25	63.05
Ag. serv., forestry, fishing, and other	(L)	(D)	20	19	(L)	(L)	(L)	NA	NA	NA	NA	NA	NA
Mining	308	30	23	17	17	15	18	-20.78	-9.71	-278	-12	1.25	0.88
Construction	75	47	52	30	28	27	36	-4.57	-5.19	-28	-11	1.96	1.77
Manufacturing	12	10	(D)	(L)	(D)	(D)	(L)	-1.81	NA	-2	NA	0.42	NA
Transportation and public utilities	96	88	88	69	62	70	59	-0.87	-7.68	-8	-29	3.66	2.89
Wholesale trade	12	(L)	(D)	(D)	(D)	(D)	(D)	NA	NA	NA	NA	NA	NA
Retail trade	310	250	228	248	247	253	(D)	-2.13	NA	-60	NA	10.40	NA
Finance, insurance, and real estate	52	50	60	61	50	53	59	-0.39	3.37	-2	9	2.08	2.89
Services	382	(D)	(D)	(D)	(D)	(D)	(D)	NA	NA	NA	NA	NA	NA
Government and government enterprises	395	537	548	573	578	596	604	3.12	2.38	142	67	22.35	29.64
Federal, civilian	25	45	42	39	40	40	40	6.05	-2.33	20	-5	1.87	1.96
Military	12	12	11	11	10	(L)	(L)	0.00	NA	0	NA	0.50	NA
State and local	358	480	495	523	528	547	556	2.98	2.98	122	76	19.98	27.28
State	73	150	161	171	162	168	169	7.47	2.41	77	19	6.24	8.29
Local	285	330	334	352	366	379	387	1.48	3.24	45	57	13.73	18.99

N/A = Not available.
L = Less than 10 jobs.
D= Number not disclosed.
Source: Nevada State Demographer, 1988.

Table 3-10. Total Earnings and Average Earnings per Job, Lincoln County, Nevada

Total Earnings ($000)	*1980*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Earnings by place of work	$27,221	$65,704	$64,808	$55,219	$56,508	$57,776	$54,356
Farm earnings	$1,450	$1,916	$1,055	$424	$2,140	$1,849	$1,866
Nonfarm earnings	$25,771	$63,788	$63,753	$54,795	$54,368	$55,927	$52,490
Private earnings	$21,133	$50,656	$49,672	$39,338	$38,337	$39,213	$35,225
Ag. serv., forestry, fishing, and other	(L)	(D)	$116	$103	$68	$74	$78
Mining	$7,669	$519	$403	$304	$252	$257	$248
Construction	$2,194	$1,061	$703	$305	$329	$382	$556
Manufacturing	$108	$109	(D)	$118	(D)	(D)	$55
Transportation and public utilities	$1,796	$2,079	$2,489	$2,570	$2,533	$2,603	$2,324
Wholesale trade	$101	(L)	(D)	(D)	(D)	(D)	(D)
Retail trade	$2,218	$2,144	$2,321	$2,471	$2,489	$2,753	(D)
Finance, insurance, and real estate	$325	$311	$475	$569	$502	$538	$650
Services	$6,685	(D)	(D)	(D)	(D)	(D)	(D)
Government and government enterprises	$4,638	$13,132	$14,081	$15,457	$16,031	$16,714	$17,265
Federal, civilian	$390	$1,211	$1,184	$1,215	$1,374	$1,427	$1,429
Military	(L)	$73	$69	$76	$70	$72	$64
State and local	$4,216	$11,848	$12,828	$14,166	$14,587	$15,215	$15,772
State	$1,204	$4,478	$4,980	$5,705	$5,523	$5,763	$6,003
Local	$3,012	$7,370	$7,848	$8,461	$9,064	$9,452	$9,769
Per capita personal income (dollars)	$8,093	$18,254	$19,121	$19,360	$18,865	$18,556	$18,635
Earnings per Job ($)	*1980*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Earnings by place of work	$15,039	$27,342	$27,719	$24,986	$25,500	$26,214	$26,671
Farm earnings	$8,841	$10,764	$6,594	$2,617	$13,631	$11,629	$12,523
Nonfarm earnings	$15,657	$28,669	$29,271	$26,755	$26,405	$27,348	$27,787
Private earnings	$16,893	$30,009	$30,474	$26,670	$25,886	$27,062	$27,412
Ag. serv., forestry, fishing, and other	NA	NA	$5,800	$5,421	NA	NA	NA
Mining	$24,899	$17,300	$17,522	$17,882	$14,824	$17,133	$13,778
Construction	$29,253	$22,574	$13,519	$10,167	$11,750	$14,148	$15,444
Manufacturing	$9,000	$10,900	NA	NA	NA	NA	NA
Transportation and public utilities	$18,708	$23,625	$28,284	$37,246	$40,855	$37,186	$39,390
Wholesale trade	$8,417	NA	NA	NA	NA	NA	NA
Retail trade	$7,155	$8,576	$10,180	$9,964	$10,077	$10,881	NA
Finance, insurance, and real estate	$6,250	$6,220	$7,917	$9,328	$10,040	$10,151	$11,017
Services	$17,500	NA	NA	NA	NA	NA	NA

Table 3-10. Total Earnings and Average Earnings per Job, Lincoln County, Nevada (Continued)

Earnings per Job ($)	*1980*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Government and government enterprises	$11,742	$24,454	$25,695	$26,976	$27,735	$28,044	$28,584
Federal, civilian	$15,600	$26,911	$28,190	$31,154	$34,350	$35,675	$35,725
Military	NA	$6,083	$6,273	$6,909	$7,000	NA	NA
State and local	$11,777	$24,683	$25,915	$27,086	$27,627	$27,815	$28,367
State	$16,493	$29,853	$30,932	$33,363	$34,093	$34,304	$35,521
Local	$10,568	$22,333	$23,497	$24,037	$24,765	$24,939	$25,243
Per capita personal income	$11,079	$19,552	$19,828	$20,946	$21,898	$22,811	$23,812

NA - Not Applicable.
(L) - Less than 10 jobs.
(D) - Number not Disclosed.
Source: Nevada State Demographer, 1998.

volunteers. Police protection is provided by the San Bernardino County Sheriff. An elementary school provides Kindergarten through 5th grade education for several small communities in the area (Sandridge, 1998).

Daggett is an unincorporated village located 4 km (2.5 mi) south of the proposed intermodal facility at the Yermo Annex of the MCLB Barstow, with a population of approximately 450. It is designated as a Community Services District in San Bernardino County. Fire protection is provided by 20 volunteers. Police protection is provided by the San Bernardino County Sheriff. A middle school provides grade 6 to 8 education for several small communities in the area. The high school is located between Daggett and Yermo and also serves several communities (Bell, 1998).

3.13 ENVIRONMENTAL JUSTICE

Presidential EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, provides that each federal agency makes achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Native American Tribes. This section presents statistical information on the presence of these populations within the area that could be affected by the project.

Region of Comparison
Environmental justice has a "potentially affected area" and a "region of comparison." The potentially affected area includes the 1-mile wide corridor containing the transportation routes and the transfer sites. The region of comparison consists of the political jurisdiction(s) that encompass the affected areas. The percentage of minority and low-income persons in the area affected by each option is analyzed relative to the general population in the region of comparison to determine if the populations of concern are measurably higher in the affected areas. The region of comparison for this project is the seven counties that contain the highway transportation routes and the intermodal transfer sites. The counties include Clark, Lincoln, Nye, and Esmeralda counties in Nevada; Inyo and San Bernardino counties in California, and Mohave County in Arizona. Data pertaining to sub-county areas referred to as census block groups, which are located along the alternate highway routes, were also analyzed, as well as data for the communities of Barstow, Caliente, Yermo, and Indian reservations in the region.

Minority Populations and Low-income Populations
For the purposes of this analysis, minority populations and low-income populations are defined as follows:

Minority populations—Hispanics of any race, plus non-Hispanics who are either Black/African American; Asian and Pacific Islanders; American Indians, Eskimos and Aleuts; or Other (nonwhite) Races.

Low-income populations—Persons living below the poverty level, defined as $12,674 for a family of four in 1989, as reported in the 1990 census, and adjusted depending upon household size.

Estimates of these two population categories were developed using data from the 1990 Census of Population and Housing. The census does not report the minority population of an area, but it does report population by race, and separately for ethnicity, including Hispanic origin by race, which were used to derive the minority populations for this analysis.

For enumeration purposes, the Bureau of Census defines small geographic units for which data are aggregated below the county level. Census block groups, which are clusters of blocks within the same census tract, have been identified for the seven counties and separately for those areas within 0.8 km (0.5 mi) of the highway routes (i.e., the subset of block groups in the seven counties that intersect the 1.6 km [1 mi] corridor). Census block groups do not cross county or census tract boundaries and generally contain between 250 and 550 housing units.

Within each census block group for each county, percentages were calculated of minority and low-income communities. Two approaches were used. The first approach gives more weight to block groups with larger populations, whereas the second approach weights two block groups equally, providing they have the same percentage of minorities or low-income persons, regardless of the total population in the block group.

The first approach calculates the minority population percentage of a block group, and separately, the low-income population of a block group, using the total 1990 population in the seven-county region (2,294,517 persons) as the denominator. To determine whether a block group percentage is meaningfully larger than other block group percentages, thresholds (the absolute deviation from the mean) for low-income populations, and separate thresholds for minority populations, were determined. Following this step, the calculated percentages for the block groups located along the highway transportation routes were compared to the threshold percentages (0.02004 percent "minority threshold" and 0.00702 percent "low-income threshold").

The second approach calculates a set of percentages by figuring the number of minority persons, and separately, the number of low-income persons, in each block group as a percentage of the total population in that block group. This approach calculates the minority (or low-income) population of a block group using the total population in that block group as the denominator. This percentage is then compared to the total percentage of minorities and low-income persons in the region. Of the total population in the seven counties, which is 2,294,517 persons, approximately 749,004 persons are minority or 32.6 percent, and 269,182 persons are living below the poverty level or 11.7 percent. For this analysis, individual block groups located along the highway routes have been identified that contain the following conditions: (1) the minority population percentage in the census block group exceeds the minority population percentage in the region of comparison of 32.6 percent; (2) the minority population percentage of the census block group exceeds 50.0 percent; and (3) the low-income population percentage of the census block group exceeds the low-income population percentage in the region of comparison of 11.6

percent. The paragraphs below describe the results of this analysis for each option, noting those cases where thresholds would be exceeded.

Additions to this section recommended by the AITC are in Appendix E, Section E.3.9.

3.13.1 Current Route Environment

The current highway corridor passes through 147 census block groups. Of this number, 23 block groups exceed the minority threshold and 26 exceed the poverty threshold, all of which are located in Clark County, Nevada.

The minority population percentage exceeds the seven-county average of 32.6 percent in 42 of the 147 block groups. Minorities comprise more than 50 percent of the total population in 27 block groups. The percentage of the population living below the poverty level exceeds the threshold of 11.7 percent in 56 of the block groups.

Because the Las Vegas area population in the vicinity of the current route is large relative to populations in the vicinity of the other routes, the first (i.e. population-weighted) approach identifies very few census block groups that exceed the minority or poverty thresholds other than those associated with the current route. However, because block groups with lower population levels can nevertheless contain high percentages of minority or low-income persons relative to their total population, the second approach identifies many more block groups that exceed the thresholds.

3.13.2 Barstow

The City of Barstow contained a population of 21,472 persons in 1990, of whom 45.5 percent were minorities and 14.4 percent were living below the poverty level. These two percentages are measurably higher than the region of comparison.

The highway corridor for the Barstow option passes through 12 census block groups, of which one exceeds the minority threshold; this is located in San Bernardino County.

The minority population exceeds the seven-county average of 32.6 percent in 2 of the 12 census block groups but does not comprise more than 50 percent of the population in any block groups. The percentage of the population living below the poverty level exceeds the region of comparison (11.7 percent) in the census block groups.

3.13.3 Caliente

The City of Caliente, located in Lincoln County, Nevada, contains the In-town site and is 1.2 km (0.75 mi) north of a second site for the proposed transfer facility that would be built for the Caliente Option. Caliente contained 1,111 persons in 1990, of whom 92 persons or 8.2 percent of the population are minority and 16.3 percent are living below the poverty level. The latter percentage exceeds the region of comparison.

The 1.6-km (1-mi) wide highway corridor passes through 18 block groups, none of which exceed either the minority or poverty thresholds.

The minority population percentage does not exceed the seven-county average of 32.6 percent in any of the 18 block groups and minorities do not comprise more than 50 percent of the total population in any of the block groups that intersect the 1.6-km (1-mi) wide highway corridor. The percentage of the population living below the poverty level exceeds the region of comparison (11.7 percent) in 9 of the block groups.

3.13.4 Yermo

Yermo, an unincorporated community located in San Bernardino County, California, contains the existing transfer facility that would be used for the Yermo Option. Although the U. S. Census does not report Yermo as a separate entity, the census block group that contains the community of Yermo had a population of 1,198 persons in 1990, of whom 301 persons or 25.1 percent of the population are minority and 11.2 percent are living below the poverty level. Neither of these percentages exceeds the averages for the region of comparison.

The highway corridor passes through 12 block groups, one of which exceeds the minority threshold.

The minority population percentage exceeds the seven-county average of 32.6 percent in 2 of the 12 census block groups, which are both located in San Bernardino County. Minorities do not comprise more than 50 percent of the total population in any block groups. The percentage of the population living below the poverty level exceeds the region of comparison in 6 of the census block groups.

3.13.5 All-truck Routes

The highway corridor passes through 72 census block groups, of which 3 exceed the minority threshold (located in San Bernardino County) and 2 exceed the poverty threshold (one in San Bernardino County and one in Mohave County).

The minority population percentage exceeds the seven-county average of 32.6 percent in 18 of the 72 block groups, primarily in San Bernardino County, and 2 block groups exceed 50 percent minority population. The percentage of the population living below the poverty level exceeds the region of comparison (11.7 percent) in 44 of the block groups. The Fort Mojave Reservation, located near I-40 at the Arizona/California border, is in the vicinity of this option. This reservation is described further under the following discussion of American Indian reservations.

American Indian Reservations/Native American Tribes

The region of comparison contains 14 Indian reservations, including 4 in Nevada, 7 in California, 2 in Arizona, and 1 located in all three states. The reservations are described below, including their location, population, and poverty status. One reservation is in the immediate vicinity of the All-truck Option, the Fort Mojave Reservation, 8 km (5 mi) north at I-40 at the Arizona/California border. Two reservations are in Clark County on the Current Route Option

Route, the Las Vegas Paiute Colony and the Moapa Reservation. The Timbisha Shoshone is a federally recognized tribe without a reservation located in the vicinity of CA 127.

Indian reservations located in the Nevada portion of the region include the Las Vegas Paiute Colony, Moapa River Indian Reservation, Duckwater Indian Reservation, Yomba Indian Reservation, and Fort Mojave Indian Reservation, which has boundaries in Nevada, California, and Arizona. The Las Vegas Paiute Colony is located in Clark County. It contains a population of 86 persons, of which 37.2 percent are living below the poverty level. The Moapa River Indian Reservation is located in Clark County. It contains a population of 377 persons, of which 50.7 percent are living below the poverty level. The Duckwater Indian Reservation is located in Nye County. It contains a population of 151 persons, of which 24.5 percent are living below the poverty level. The Yomba Indian Reservation is located in Nye County. It contains a population of 106 persons, of which 34.9 percent are living below the poverty level. The Fort Mojave Indian Reservation is located in Clark County, with portions in San Bernardino County, California, and Mohave County, Arizona. It contains a population of 692 persons, of which 41.8 percent are living below the poverty level.

Reservations located in San Bernardino County and Inyo County, California, include the Chemehuevi Reservation, Fort Independence Reservation, Colorado River Indian Tribes, Big Pine Reservation, Bishop Reservation, and Lone Pine Reservation. The Chemeheuvi Reservation is located in San Bernardino County. It contains a population of 325 persons, of which 24.9 percent are living below the poverty level. The Fort Independence Reservation is located in Inyo County. It contains a population of 58 persons, of which 22.4 percent are living below the poverty level. The Colorado River Indian Tribes are located in San Bernardino County. They contain a population of 7,944 persons, of which 27.1 percent are living below the poverty level. The Big Pine Reservation is located in Inyo County. It contains a population of 455 persons, of which 23.3 percent are living below the poverty level. The Bishop Reservation is located in Inyo County. It contains a population of 1,477 persons, of which 25.1 percent are living below the poverty level. The Lone Pine Reservation is located in Inyo County. It contains a population of 235 persons, of which 27.2 percent are living below the poverty level.

Reservations located in Mohave County, Arizona, include the Hualapi Reservation and Trust Lands, and the Kaibab Reservation, both of which also extend east into Cococino County. The Hualapi Reservation and Trust Lands contain a population of 883 persons, of which 54.7 percent are living below the poverty level. The Kaibab Reservation contains a population of 120 persons, of which 27.5 percent are living below the poverty level. Population data are based on the 1990 census.

3.14 AMERICAN INDIANS

This section, recommended by the AITC, is in Appendix E, Section E.3.10.

3.14.1 Current Route Environment

This section, recommended by the AITC, is in Appendix E, Section E.3.11.

3.14.2 Barstow

This section, recommended by the AITC, is in Appendix E, Section E.3.12.

3.14.2.1 Intermodal Facility

This section, recommended by the AITC, is in Appendix E, Section E.3.13.

3.14.2.2 Route to NTS

This section, recommended by the AITC, is in Appendix E, Section E.3.14.

3.14.3 Caliente

This section, recommended by the AITC, is in Appendix E, Section E.3.15.

3.14.3.1 In-town

This section, recommended by the AITC, is in Appendix E, Section E.3.16.

3.14.3.2 South

This section, recommended by the AITC, is in Appendix E, Section E.3.17.

3.14.3.3 Caliente Route to NTS

This section, recommended by the AITC, is in Appendix E, Section E.3.18.

3.14.4 Yermo

This section, recommended by the AITC, is in Appendix E, Section E.3.19.

3.14.5 All-truck Routes

This section, recommended by the AITC, is in Appendix E, Section E.3.20.

3.14.5.1 Kingman to Barstow to the NTS

This section, recommended by the AITC, is in Appendix E, Section E.3.21.

3.14.5.2 Mesquite, Nevada, to Tonopah, to the NTS

This section, recommended by the AITC, is in Appendix E, Section E.3.22.

3.14.5.2.1 Mesquite, Nevada, to US 93

This section, recommended by the AITC, is in Appendix E, Section E.3.23.

3.14.5.2.2 US 93 to Hiko

This section, recommended by the AITC, is in Appendix E, Section E.3.24.

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4.0 ENVIRONMENTAL, SAFETY, AND HEALTH EFFECTS

This chapter identifies environmental effects of implementing the options described in Chapter 2 relative to the environmental setting described for each resource in Chapter 3.

Additions to this section recommended by the AITC are in Appendix E, Sections E.3.25 through E.3.30.

4.1 OPTION 1 – INTERMODAL OPERATIONS

This option includes the use of intermodal facility capabilities for transporting LLW to the NTS using modes and routes that would minimize radiological risk, enhance safety, and reduce cost compared with current practices. This option addresses three potential intermodal facility locations. Each option is examined under the different resource areas relative to the current conditions for the intermodal sites, as described in Chapter 3.

4.1.1 Option 1A – Barstow Intermodal Facility

LLW shipments would be integrated with ongoing operations at the BNSF Intermodal Facility. Estimated maximum shipments of 2,500 per year would represent 4 percent of the 59,000 shipments handled per year by the facility.

4.1.1.1 Transportation

The Barstow Option assumed that there would be 25,084 truck shipments of LLW over a 10-year period. This means that the level of truck shipments would be typically seven vehicles per day. This level of truck traffic increase would not significantly affect the congestion levels on the roadways. Accidents could result in temporary road closures.

4.1.1.2 Land Use

Land ownership and uses on or adjacent to the existing Barstow BNSF Intermodal Facility would not be affected by the addition of LLW operations at this site.

4.1.1.3 Visual Resources

Visual resources in the Barstow area and vicinity of this existing Intermodal Facility would be unaffected.

4.1.1.4 Utilities

Utilities are adequate at the existing facility to accommodate the increased number of shipments.

4.1.1.5 Noise

This site is an existing intermodal terminal for the BNSF located in an isolated area at the western edge of the urbanized area. It is an industrial area with existing freight and intermodal operations. The additional intermodal operations that would result from this option would not cause a noticeable or measurable change in the noise levels generated from this facility. No noise-sensitive receptors are known to adjoin the facility.

4.1.1.6 Air Quality

The anticipated air quality effects that would result from a 4 percent increase in operations are negligible.

4.1.1.7 Water Resources

Water resources would not be affected.

4.1.1.8 Radiation, Safety, and Occupational Health

Intermodal Facility. The radiation dose received by workers at intermodal facilities is a function of the time spent in the vicinity of and the distance from the shipping container. The dose rate for exposed individuals can be determined from the radiation dose rate near the container surface. The radionuclide content of the material and the characteristics of the container determine the dose rate.

The following are considered tasks involving occupational exposure:

- unlatching the shipping container,
- operating the lifting equipment,
- latching the shipping container to the trailer chassis,
- connecting the trailer chassis to the yard tractor,
- driving the yard tractor, and
- disconnecting the trailer chassis from the yard tractor.

A dose per shipping container at the various occupational exposure distances of concern was calculated for use in estimating occupational exposure, as shown in Table 4-1. Health effects were estimated using risk factors recommended by the International Commission on Radiological Protection (ICRP, 1991).

The total collective dose from handling 25,084 containers over the entire 10-year intermodal shipment campaign is estimated to be about 4.21 person-rem (Roentgen Equivalent in Man). No adverse health effects would be expected in the worker population as a result of this exposure. The likelihood of a single cancer fatality in the entire worker population as a result of these doses is estimated to be 1.7×10^{-3}, or a likelihood of about 1 in 600, that a single fatal cancer would occur in the worker population as a result of this exposure.

Table 4-1. Occupational Dose per Shipping Container Transferred

Task	*Distance (m)*	*Exposure Duration (hr/container)*	*Dose Rate (rem/hr)*	*Dose/Container (rem/container)*
Lift Equipment Operator	3	0.1	1.8e-04	1.8e-05
Yard Tractor Driver	3	0.14	1.8e-04	2.52e-5
Yard Worker	1	0.25	5.0e-04	1.25e-04
Dose per Container Occupational Dose Summary			*Person-Rem/Container*	*1.68e-04*

For comparison, Table 4-2 lists the chances of death from several activities encountered in daily life.

Table 4-2. Risk Comparisons

Cause of Death	*Lifetime Risk of Dying One Chance In:*
Cancer, all causes	5
Automobile Accident	87
Cancer, naturally occurring radiation	93
Fire	500
Poisoning	1,000
Lightning	39,000
Cancer, fossil fuel emissions	55,000

Source: National Safety Council, 1993.

A fire near a shipping container could possibly be ignited by a fuel leak in a vehicle used in the transfer operation. Based on safety data for waste management operations at the NTS, the likelihood of such a fire would be estimated at once every 25,000 years. The risk of a collective radiation dose to the population in the Barstow region from a fire causing a rupture of a shipping container and release of its contents to the atmosphere would be one chance in 6,000. A discussion of the methodology used in this analysis is in Appendix C.

The potential for activities at the intermodal facility to affect health and safety is minimized by a combination of the control of public access to the site and a comprehensive program for implementing safety and occupational health requirements for site workers.

Route to NTS. The transportation risks were analyzed for two routes from the intermodal facility, one is the proposed route that avoids the Las Vegas Valley. The second is the route from the intermodal facility passing through the valley. This analysis permits a comparison of the relative radiological risk of the two routes. Table 4-3 summarizes this analysis for the Barstow Option. A larger value indicates less risk. A more detailed description is in Appendix C.

Table 4-3. Incident-free Transportation – Barstow

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	227	(57)
Through Las Vegas Valley	145	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table 4-4 indicates the results of the risk analysis for transportation accidents. Fatalities for both vehicle-related accidents and radiation exposure to the general public are shown. Vehicle-related accidents typically result in higher risks for the route that avoids the valley because the mileage is longer. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller populations than urban routes through the valley.

Table 4-4. Transportation Accident Risks – Barstow

Routes	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes **	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	4.2	(35)	59 million	(2,169)
Through Las Vegas Valley	3.1		2.6 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

The risk values presented in the previous tables take into account the likelihood that accidents would occur. Table 4-5 shows the cancer fatality risk assuming that the accident would occur.

Table 4-5. Maximum Reasonable Foreseeable Accidents – Barstow

Route	*Risk of Cancer Fatality One Chance in:*	*Years Between Accidents*
Avoids Las Vegas Valley	625	166,000
Through Las Vegas Valley	625	50,000

4.1.1.9 Biological Resources

Intermodal Facility. All construction and operation activities for this option would be within an existing rail yard which is devoid of biological resources. For this reason, no effects to biological resources are expected.

Route to NTS. The probability of effects on biological resources along this route from any waste release in transportation accidents is negligible. The possibility of an accidental release occurring during transport of waste is extremely low, and if a release does occur, contaminants will be contained within the highway and adjacent areas, and cleaned up quickly. Although contaminants may travel farther from roads if accidents occur where the route crosses perennial streams, the likelihood of this occurring is negligible given that these areas are less than 1 percent of the entire route.

4.1.1.10 Cultural Resources

The Barstow BNSF facility is an established site on developed lands, therefore, cultural resources would not be affected by this option.

4.1.1.11 Geology and Soils

The Barstow BNSF facility is an established site on developed lands, therefore, geology and soils would not be affected by this option.

4.1.1.12 Socioeconomics

This option does not involve socioeconomic effects.

4.1.1.13 Environmental Justice

The existing intermodal terminal for the BNSF in Barstow is located in an isolated area at the western edge of the urbanized area. Since no significant environmental effects were identified for resource areas for this option, there would be no disproportionately high and adverse effects on minority or low-income populations.

4.1.2 Option 1B – Caliente In-town Site

The proposed In-town Caliente Intermodal Facility site is currently graveled. An area approximately 270 by 30 m (900 by 100 ft) adjacent to the siting would need to be graded, fenced, and lighted. Intermodal operations would be conducted on the existing UP right-of-way from a new siding connected to the existing passing track at both ends. An estimated 2,500 shipments per year of LLW would be handled at the site.

4.1.2.1 Transportation

Option 1B assumes that there would be 25,084 truck shipments of LLW over a 10-year period. Transfers from rail cars to trucks would be made during normal working hours, 7 days per week. These truck shipments are destined for a waste facility at the NTS. All storage would be at the NTS. It is estimated that typically seven truck shipments per day would be using the road network.

This low small increase in traffic over current levels would have minimal effect on the capacity of the roadways used on the routes from an intermodal facility at Caliente to the NTS. Accidents could result in temporary road closures.

The existing peak hour LOSs on the routes are:

- US 6, (NV 376 to US 95): LOS A
- US 95, (US 6 to the SCL of Tonopah): LOS C
- US 95 (NV 160 to Mercury, Nevada): LOS B

Definitions for LOSs are provided in Section 3.1.1.2.

4.1.2.2 Land Use

Establishing intermodal operations on the UP right-of-way at the Caliente In-town site would not affect land ownership and uses of the surrounding properties. Such operations would be consistent with current zoning of this property and adjacent lands for industrial and commercial activities, and the occasional intermodal operations that have been conducted on this site. Caliente ordinances may require that a conditional land-use permit be obtained for these operations.

4.1.2.3 Visual Resources

Establishing an intermodal facility at the In-town site would not affect visual resources in the area. This type of rail and trucking operation would be consistent with existing activities in the locale.

4.1.2.4 Utilities

Existing utility capacities would be adequate to accommodate the small increase in demand.

4.1.2.5 Noise

To determine whether noise from the proposed intermodal facility would have a significant effect on the noise environment at sensitive receptors in the area, significance criteria are used to evaluate what would constitute a substantial increase in noise. The increase in noise would be considered to be substantial and the effect significant upon existing residents or other sensitive receptors if:

- Noise resulting from the project would increase average noise levels (L_{dn}) by more than 3 dBA, and the absolute noise level resulting from the project generated noise would be 65 L_{dn} or greater at a sensitive receptor location; or,

- Maximum instantaneous noise levels ($L_{max\text{-}fast}$) would exceed maximum noise levels resulting from existing rail operations or other ambient noise sources by 5 dBA or more.

Lesser noise level increases are not considered substantial and would not result in a significant adverse effect.

There would be approximately three switching operations per day distributed over a 24-hour period. Noise sources associated with the switching operation include the sound of the cars and locomotive when they decelerate, stop, uncouple, re-couple, and accelerate away, and the sound of the horn, which must be sounded whenever the train locomotive starts moving. Noise levels resulting from these activities were monitored in Northern California in 1996.[1] At a distance of 60 m (200 ft), the maximum noise level resulting from the engine is 79 to 80 dBA. Train cars typically generate noise levels of 65 to 70 dBA. The sound of the slack action or "crunch" associated with the cars starting and stopping is 70 to 80 dBA. The train horn is about 90 dBA. The sound of the train locomotive idling generates a maximum noise level of about 55 to 60 dBA. The hourly average noise level (L_{eq}) resulting from a switching operation is about 55 dBA. The resulting L_{dn} from three switching operations (assuming one at night) would be 50 to 55 dBA at a distance of 60 m (200 ft).

Maximum noise levels resulting from the switching operation would be less than maximum noise levels associated with through trains. Hourly average noise levels and day/night average noise levels would not increase measurably (less than 1 dBA) as a result of the additional switching operations. These activities would not cause a significant adverse effect on the noise environment in the area.

Intermodal operations would occur during the daytime. These would include the arrival, loading, and departure of trucks at the facility. The crane or large forklift would generate a maximum noise level of 75 to 80 dBA at a distance of approximately 60 m (200 ft). The noise level would be similar to existing ambient noise levels resulting from truck traffic on the highway and existing train operations. The truck loading operation would not generate a significant daily average noise level due to the short time required for this equipment to operate to complete its work. There would be approximately seven truck trips per day in and out of Caliente. These would occur during the daytime. The addition of seven trucks per day would cause less than a 0.5 dBA change to L_{dn} noise levels along US 93. Noise from intermodal facility activities and trucking would not cause a significant adverse noise effect in Caliente. The combined noise of the switching activities and other intermodal activities together would not cause a substantial increase in noise levels, a substantial change to the character of the noise, or, therefore, any significant adverse environmental effect.

4.1.2.6 Air Quality

The anticipated air quality effects from operation of the proposed intermodal facility in Caliente and associated highway movements are negligible. The number of trucks per day is quite small (seven), resulting in low emissions. Currently, there is an average of one train per hour traveling through Caliente, and there is light highway traffic (see Section 3.1.1). Furthermore, the intermodal operations are anticipated to occur during the day when dispersion conditions are good, further minimizing effects.

4.1.2.7 Water Resources

Water resources would not be affected.

[1] Noise level data from files of Illingworth & Rodkin, Inc., 1996.

4.1.2.8 Radiation, Safety, and Occupational Health

Intermodal Facility. The effects for the Caliente facility would be the same as discussed for the Barstow facility in Section 4.1.1.8

Route to NTS. The transportation risks were analyzed for two routes from the intermodal facility, one is the proposed route that avoids the Las Vegas Valley. The second is the route passing through the valley from the facility. This analysis permits a comparison of the relative radiological risk of the two routes. Table 4-6 summarizes this analysis for the Caliente Option. A more detailed description is in Appendix C.

Table 4-6. Incident-free Transportation – Caliente

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	263	(22)
Through Las Vegas Valley	204	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table 4-7 indicates the results of the risk analysis for transportation accidents. Fatalities for both vehicle-related accidents and radiation exposure to the general public are shown. Vehicle-related accidents typically result in higher risks for the route that avoids the valley because the mileage is longer. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller population than urban routes through the valley.

Table 4-7. Transportation Accident Risks – Caliente

Routes	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes **	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	2.9	(16)	630 million	(21,624)
Through Las Vegas Valley	2.5		2.9 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

The risk values presented in the previous tables take into account the likelihood that accidents would occur. Table 4-8 shows the cancer fatality risk assuming that the accident would occur.

Table 4-8. Maximum Reasonably Foreseeable Accidents – Caliente

Route	*Risk of Cancer Fatality One Chance in:*	*Years Between Accidents*
Avoids Las Vegas Valley	3,333	135,000
Through Las Vegas Valley (and the All-truck Option)	625	24,000

4.1.2.9 Biological Resources

Intermodal Facility. The Caliente In-town site would be located within a previously developed area, therefore, there would be no effects from facility construction on biological resources. Because the facility is surrounded by developed land, and because accidental releases will be contained on the site, operation of these facilities would not affect biological resources.

Route to NTS. The probability of effects on biological resources along this route from any waste release in transportation accidents is negligible. The possibility of an accidental release occurring during transport of waste is extremely low, and if a release does occur, contaminants will be contained within the highway and adjacent areas, and cleaned up quickly. Although contaminants may travel farther from roads if accidents occur where the route crosses perennial streams, the likelihood of this occurring is negligible given that these areas are less than 1 percent of the entire route.

4.1.2.10 Cultural Resources

The proposed Caliente In-town transfer facility and truck operations center is situated near the juncture of US 93 and the UP rail line. This area was previously surveyed for cultural resources during a NDOT highway project (NDOT, 1986) and a more recent street extension project (Stearns, 1992). No significant historical properties were identified within the proposed project area. The Caliente Railroad Depot (26LN1508), a NRHP-listed property, is situated approximately 700 m (2,300 ft) to the northeast. The proposed intermodal facility will not visually alter the depot's historical setting because of the distance between the two locations. Therefore, no direct or indirect effects to any known historic properties will result from this option.

4.1.2.11 Geology and Soils

Regional effects on geology and soils would not be significant. Local effects on soils at the Caliente intermodal facility site would result from construction activities such as grading and excavation. Local soils in Caliente are moderately susceptible to wind and water erosion. Grading activities would increase the potential for erosion by wind and water. Therefore, preventive measures would be necessary to minimize erosion.

4.1.2.12 Socioeconomics

A small beneficial effect would result from the three additional jobs that would be created. Indirect benefits include the potential for the use of trucks returning to the Caliente Intermodal Facility for transporting products from commercial activities proposed for location at the NTS.

4.1.2.13 Environmental Justice

No significant adverse environmental or health effects have been identified for this option, and no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur.

4.1.3 Option 1C – Caliente South Site

Selection of this option would require construction of a new facility to accommodate intermodal shipments. Road improvements to accommodate legal-weight trucks would be needed, as well as construction of rail facilities for intermodal operations on a 5-acre site.

4.1.3.1 Transportation

The South site would use the same route as the In-town site discussed in Section 4.1.2.1. The increased traffic would have no effect on roadway capacities. Accidents could result in temporary road closures.

4.1.3.2 Land Use

Use of the South site for establishing an intermodal operation would add a new land use at this location that would be consistent with rail operations in this area. Approximately 5 acres of land would be disturbed for both the construction of the rail spur and intermodal pad. This activity is not anticipated to require any changes in land ownership for the involved properties and would not have any effect on the ownership and uses of other adjacent lands.

4.1.3.3 Visual Resources

The area proposed for the intermodal operation and the adjacent Rainbow Canyon Area has been classified by BLM as a VRM Class III (BLM, 1978). The management objective of Class III is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape (BLM, 1984a). The intermodal facility would not significantly alter the landscape from existing passing trains and sewage treatment operations, and public exposure would be limited due to obstruction by natural vegetation. Therefore, visual effects as a result of the activity would not be significant.

4.1.3.4 Utilities

New electric power service would be needed for lighting the 5-acre site. Power lines are available near the site, and capacity is adequate. Electric power, water supply, and sewage disposal facilities are currently provided to the sewage treatment facility on the site. Therefore, utility effects would not be significant.

4.1.3.5 Noise

This site is approximately 1.2 km (0.75 mi) south of the In-town site in an uninhabited area. No noise-sensitive receptors adjoin the site. Noise effects from intermodal activities at this site would be less than noise from intermodal activities at the In-town site.

4.1.3.6 Air Quality

The anticipated air quality effects from operation of the proposed intermodal facility south of Caliente and associated highway movements are negligible. The number of trucks per day (seven) is small, resulting in low emissions. Currently, there is an average of one train per hour traveling through Caliente, and there is light highway traffic (see Section 3.1.1). Furthermore, the operations are anticipated to occur during the day when dispersion conditions are good in the area, further minimizing effects.

4.1.3.7 Water Resources

No water resources would be needed.

4.1.3.8 Radiation, Safety, and Occupational Health

Effects for the Caliente South site are the same as the In-town site, discussed in Section 4.1.2.8.

4.1.3.9 Biological Resources

Approximately 5 acres of irrigated pasture would be disturbed during construction of this facility. Additional effects for the Caliente South site are the same as the In-town site discussed in Section 4.1.2.9.

4.1.3.10 Cultural Resources

The South site is situated in the northern portion of the city's wastewater treatment compound. A nonsystematic cultural resource survey of this portion of Meadow Valley Wash was conducted by Fowler in 1967 (Fowler et al., 1973). Fowler identified a number of rock art sites in the canyons and along the cliff faces above the wash. The area was later resurveyed by Mariah Associates, Inc. (Kautz and Oothoudt, 1992) prior to the construction of the City of Caliente's Wastewater Treatment Plant. Two of the archeological sites (26LN105 and 26LN106) located during these inventories are within 250 m (820 ft) of the proposed intermodal facility. Site 26LN106 has been determined eligible to the NRHP. Although the 26LN105 petroglyph site has not been evaluated for eligibility to the NRHP, it may be eligible based on its complex composition and good condition. Neither site falls within the proposed intermodal transfer facility project area.

There will be no direct effects to any known cultural properties from the proposed action. However, site 26LN105 might be subjected to indirect effect to its visual setting given its location on the cliff face above the proposed intermodal facility.

4.1.3.11 Geology and Soils

Regional effects on geology and soils would not be significant. Local effects on soils at the Caliente South site would result from construction activities such as grading and excavation. Local soils in Caliente are moderately susceptible to wind and water erosion. Grading activities would increase the potential for erosion by wind and water. Therefore, preventive measures would be necessary to minimize erosion.

4.1.3.12 Socioeconomics

A small beneficial socioeconomic effect would result from three additional jobs. Indirect benefits include the potential for the use of trucks returning to the Caliente Intermodal Facility for transporting products from commercial activities proposed for location at the NTS.

4.1.3.13 Environmental Justice

No significant adverse environmental or health effects have been identified for this option, and no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur.

4.1.4 Option 1D – Yermo Annex Intermodal Facility and Route to NTS

In Option 1D, it is assumed that there would be 25,084 truck shipments of LLW over a 10-year period. Transfers from rail cars to trucks would be made during normal working hours for the MCLB. It is estimated that a maximum of seven truck shipments per day would be using the road network.

4.1.4.1 Transportation

This low level of traffic increase would not have any effect on the capacity of the roadways used on the routes from the Yermo Annex to the NTS. Accidents could result in temporary road closures.

Currently, peak hour LOSs for the routes are (typically the highest volume on the route segment was used to compute the LOS):

- I-15, (Yermo to CA 127): LOS C
- CA 127, (Baker, California, to the Nevada State Line): LOS C
- NV 373, (California State Line to US 95): LOS A.

4.1.4.2 Land Use

The addition of LLW intermodal operations with current activities at the Yermo Annex would have no effect on federal land ownership and uses within the MCLB or on the ownership and uses of adjacent properties. This site is currently used for intermodal shipments of military equipment and hazardous materials. Therefore, LLW intermodal activities should be consistent with current operations. Other activities on this site, such as the maintenance facility, are located at least 660 m (2,200 ft) from the intermodal site.

4.1.4.3 Visual Resources

Visual resources at the Yermo Annex would be unaffected by the additional intermodal operations at this site.

4.1.4.4 Utilities

No additional utilities would be needed.

4.1.4.5 Noise

This site is located within the MCLB at the Yermo Annex. It is an industrial area with existing freight and intermodal operations. The additional intermodal operations required for the proposed project would not cause a substantial change in the noise levels generated from the facility. No noise-sensitive receptors are known to adjoin the facility. Truck traffic to and from the facility would be along existing truck routes. The incremental increase in truck traffic would not cause a substantial increase in noise along the truck routes. There would be no adverse noise effects upon sensitive receptors resulting from intermodal operations at the Yermo facility.

4.1.4.6 Air Quality

The anticipated air quality effects from operation of an existing intermodal facility for the number of additional shipments being considered are negligible. The maximum number of shipments would be less than 4 percent of current operations.

4.1.4.7 Water Resources

Water resources would not be affected.

4.1.4.8 Radiation, Safety, and Occupational Health

Intermodal Facility. Effects under this option would be the same as those described in Section 4.1.1.8 for the Barstow Option.

Route to NTS. The transportation risks were analyzed for two routes from the intermodal facility, one is the proposed route that avoids the Las Vegas Valley. The second is the route passing through the valley from the facility. This analysis permits a comparison of the relative radiological risk of the two routes. Table 4-9 summarizes this analysis for the Yermo Option. A more detailed description is in Appendix C.

Table 4-9. Incident-free Transportation – Yermo

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	152	(37)
Through Las Vegas Valley	111	

* Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table 4-10 indicates the results of the risk analysis for transportation accidents. Fatalities for both vehicle-related accidents and radiation exposure to the general public are shown. Vehicle-related accidents typically result in higher risks for the route that avoids the valley because the mileage is longer. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller population than urban routes through the valley.

Table 4-10. Transportation Accident Risks – Yermo

Routes	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes **	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	4.0	(29)	50 million	(1,823)
Through Las Vegas Valley	3.1		2.6 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

The risk values presented in the previous tables take into account the likelihood that accidents would occur. Table 4-11 shows the cancer fatality risk assuming that the accident would occur.

Table 4-11. Maximum Reasonable Foreseeable Accidents – Yermo

Route	*Risk of Cancer Fatality One Chance in:*	*Years Between Accidents*
Avoids Las Vegas Valley	625	166,000
Through Las Vegas Valley	625	50,000

4.1.4.9 Biological Resources

Intermodal Facility. No construction activities would be necessary for the Yermo facility, therefore, there would be no construction effects associated with that facility. Because the facility is within a large developed complex with no biological resources in the vicinity, no effects are anticipated.

Route to NTS. The probability of effects on biological resources along this route from any waste release in transportation accidents is negligible. The possibility of an accidental release occurring during transport of waste is extremely low, and if a release does occur, contaminants will be contained within the highway and adjacent areas, and cleaned up quickly. Although contaminants may travel farther from roads if accidents occur where the route crosses perennial streams, the likelihood of this occurring is negligible given that these areas are less than 1 percent of the entire route.

4.1.4.10 Cultural Resources

The proposed Yermo intermodal transfer node will use existing facilities. No ground disturbing activities will take place. Therefore, there will be no effects on cultural resources.

4.1.4.11 Geology and Soils

No construction activities will be necessary for the Yermo facility, therefore there will be no effects on geology and soils.

4.1.4.12 Socioeconomics

There would be no socioeconomic effects. Intermodal operations would be conducted with the current staff.

4.1.4.13 Environmental Justice

The Yermo Option would utilize the existing Yermo transfer facility. Since no significant adverse environmental or health effects have been identified for this option, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur.

Waste shipments would have no effect on land uses adjacent to the transportation routes. Transportation effects from transporting waste shipments would be minimal and the low level of increases in traffic volume would not affect the capacity of the highway routes or the associated LOSs. The public would be exposed to slightly increased potential for personal injury due to transportation accidents from increased traffic and would receive slightly increased exposure to noise and fugitive dust emissions from rail and truck traffic. These effects would be minimized through use of normal traffic/transportation controls. Radiation consequences of the slightly increased risk of an accident involving transport or handling of LLW are not expected to have a significant effect on the general public. There is a slight potential for exposing the general public to low levels of radiation during transport, however this exposure would be minimal and would result in no adverse health effects. These effects would result in no disproportionately high and adverse effects on minority and low-income populations.

4.2 OPTION 2 – ALL-TRUCK HIGHWAY ROUTES

This option includes the use of two All-truck routes that could avoid the Las Vegas Valley and Hoover Dam. Each route is examined under the different resource areas relative to current conditions along these routes, as described in Chapter 3.

Current peak hour LOSs for routes on the All-truck Option are (typically the highest volumes on the route segments were used to compute the LOS):

From the Northeast:

- US 93, between I-15 and US 93 East: LOS A
- NV 375, between Junction US 93 and US 6: LOS A
- US 6, between NV 375 and US 95 at Tonopah, Nevada: LOS A
- US 95, between Tonopah and NV 160: LOS C
- US 95, NV 160 to Mercury, Nevada: LOS B

From the East or West:

- I-40, Kingman to Arizona State Line: LOS C
- I-40, California State Line to Barstow, CA: LOS C
- I-15, Barstow to CA 127: LOS C
- CA 127, Baker, California to Nevada Line: LOS A
- CA 373, California State Line to US 95: LOS A
- US 95, Amargosa Valley to Mercury, Nevada: LOS B

Cost. The additional costs for the All-truck route for shipments of LLW from current generators to the NTS are listed in Table 4-12.

Table 4-12. All-truck Option Transportation Costs to the NTS

Origin	*Mi*	*Current Cost ($)*	*Additional Mi*	*New Cost*	*Percent Increase*
Aberdeen, Maryland	2,542	5,084	294	5,672	11.6
Canoga Park, California	383	1,210	10	1,242	2.6
Fernald, Ohio	2,012	4,124	294	4,727	14.6
Ashtabula, Ohio (RMI)	2,207	4,414	294	5,002	13.3
Miamisburg, Ohio (Mound)	2,044	4,088	294	4,676	14.4
San Diego, California	400	1,104	10	1,132	2.5
Kansas City, Missouri	1,419	2,838	294	3,426	20.7
Livermore, California	593	1,601	10	1,624	1.4
Amarillo, Texas (Pantex)	930	2,000	234	2,386	19.4
Golden, Colorado (Rocky Flats)	809	1,780	294	2,261	28.1
Albuquerque, New Mexico (Sandia)	645	1,710	234	2,224	30.0

Source: Industry Source, 1998.

4.2.1 Option 2A – Kingman to Barstow to the NTS

In the All-truck Option, it is assumed that there would be a maximum of 25,084 truck shipments of LLW over a 10-year period, or approximately seven truck shipments per day, divided between the two route segments. This low level of increase in truck traffic will not affect the capacity or operation of the roadway. Accidents could result in temporary road closures.

4.2.1.1 Transportation

The increased traffic would have no effect on roadway capacities.

4.2.1.2 Land Use

Land uses and ownership or special designations along this route would be unaffected by this option.

4.2.1.3 Visual Resources

Visual resources along this route would be unaffected by this option.

4.2.1.4 Utilities

Utility use is not involved.

4.2.1.5 Noise

No intermodal operations would be conducted in the All-truck Option. Alternate truck routes also carry substantial truck traffic. The redirection of trucks from existing truck routes to new truck routes would cause no substantial increase in noise levels along these routes.

4.2.1.6 Air Quality

The anticipated air quality effects for transportation of the number of shipments being considered relative to current usage of the highways are negligible.

4.2.1.7 Water Resources

Water resources would not be affected.

4.2.1.8 Radiation, Safety, and Occupational Health

The transportation risks were analyzed for two routes, one is the proposed route that avoids the Las Vegas Valley and Hoover Dam. The second is the route passing through the valley. This analysis permits a comparison of the relative radiological risk of the two routes. Table 4-13 summarizes this analysis for the All-truck Option. Radiation risks are typically lower for valley avoidance routes because they are in rural areas with smaller populations than urban routes through the valley. However, the All-truck Option is an exception, due to the much longer length of the valley avoidance route. A more detailed description is in Appendix C.

Table 4-14 indicates the results of the risk analysis for transportation accidents. Fatalities for both vehicle-related accidents and radiation exposure to the general public are shown. Vehicle-related accidents typically result in higher risks for the route that avoids the valley because the

Table 4-13. Incident-free Transportation – All-truck

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	101	13
Through Las Vegas Valley	116	

* Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table 4-14. Transportation Accident Risks – All-truck

Routes	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes **	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes **
Avoids Las Vegas Valley	2.3	64	18 million	(1,100)
Through Las Vegas Valley	6.3		1.5 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

mileage is longer. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller population than urban routes through the valley.

Use of this option would increase the rate of vehicle-related accidents due to the increased mileage. There would be a decrease in the radiation risks to the general public due to the decreased potential population exposure. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller populations than urban routes through the valley.

4.2.1.9 Biological Resources

The probability of effects along this route on biological resources from waste release in transportation accidents is negligible. The possibility of an accidental release occurring during transport of waste is extremely low, and if a release does occur, contaminants will be contained within the highway and adjacent disturbed areas, and cleaned up quickly. Although contaminants may travel farther from roads if accidents occur where the route crosses perennial streams, the likelihood of this occurring is negligible given that these areas are less than 1 percent of the entire route.

4.2.1.10 Cultural Resources

Cultural resources would not be affected by this option.

4.2.1.11 Geology and Soils

Geology and soils would not be affected by this option.

4.2.1.12 Socioeconomics

Socioeconomic resources would not be affected by this option.

4.2.1.13 Environmental Justice

This route passes in close proximity to the Fort Mojave Indian Reservation along I-40 near the California/Arizona border. No significant environmental effects are identified in resource areas and, therefore, there would be no disproportionately high and adverse effects on minority or low-income populations. However, Native American tribal members may perceive that this option has disproportionate effects due to the avoidance of close proximity to Indian Reservation lands by the other options.

4.2.2 Option 2B – Mesquite, Nevada to Tonopah to the NTS Route

4.2.2.1 Transportation

The increased traffic would have no effect on roadway capacities. Accidents could result in temporary road closures.

4.2.2.2 Land Use

The ownership, special designation, and use of lands along this route would be unaffected by this option.

4.2.2.3 Visual Resources

Visual resources would be unaffected by this option.

4.2.2.4 Utilities

Utilities would not be affected.

4.2.2.5 Noise

Intermodal operations would not be conducted in the All-truck Option. Alternative truck routes also carry substantial truck traffic. The redirection of trucks from existing truck routes to new trucks routes would cause no substantial increase in noise levels along these routes.

4.2.2.6 Air Quality

The anticipated air quality effects for transportation of the number of shipments being considered relative to current usage of the highways are negligible.

4.2.2.7 Water Resources

Water resources would not be involved.

4.2.2.8 Radiation, Safety, And Occupational Health

The risks of this option are incorporated in the analysis in Section 4.2.1.8.

4.2.2.9 Biological Resources

The probability of effects on biological resources along this route from any waste release in transportation accidents is negligible. The possibility of an accidental release occurring during transport of waste is extremely low, and if a release does occur, contaminants would be contained within the highway and adjacent areas, and cleaned up quickly. Although contaminants may travel farther from roads if accidents occur where the route crosses perennial streams, the likelihood of this occurring is negligible, given that these areas are less than 1 percent of the entire route.

4.2.2.10 Cultural Resources

Cultural resources would not be affected by this option.

4.2.2.11 Geology and Soils

Geology and soils would not be affected by this option.

4.2.2.12 Socioeconomics

This option does not involve socioeconomic effects.

4.2.2.13 Environmental Justice

The All-truck Option avoids Las Vegas and involves no new construction. There would be no direct effect on land use or cultural resources. Because of the lower density of population compared to the route through the Las Vegas Valley, the All-truck Option would have lower risks to the general public than the current route from incident-free transportation (i.e., cancer fatalities) and transportation accident radiation-related cancer fatalities. The All-truck Option would have higher risks from transportation accident-related traffic fatalities, primarily due to the increased mileage of the routes that do not go through Las Vegas. These affects would result in no disproportionately high and adverse effects on minority and low-income populations.

4.3 OPTION 3 – CURRENT ROUTE

The Current Route Option would entail continued use of the current routes for the potential waste shipments identified in Option 3 (Expanded Use) of the NTS EIS. Therefore, each resource is assessed relative to the effects that may occur with continued future use of the current route.

4.3.1 Transportation

In the Current Route Option, waste shipments would continue along the current route that enters Nevada on US 93 from Arizona via Hoover Dam/Boulder City to Las Vegas through the I-15/US 95 interchange, continuing north on US 95 to the NTS. The increase from 435 shipments in FY 1997 to an annual average of 2,508 anticipated by the Expanded Use Option of the NTS EIS would have a negligible effect on traffic congestion on the existing truck routes. Accidents could result in temporary road closures.

4.3.2 Land Use

Use and ownership of the different federal, state, city, and private lands along the current route would not be affected by continued operations.

4.3.3 Visual Resources

Visual resources would be unaffected by continued use of the current route.

4.3.4 Utilities

Utility use is not involved.

4.3.5 Noise

No intermodal operations are currently conducted. Use of the current route would cause no change in the noise environment in the area.

4.3.6 Air Quality

The anticipated air quality effects for transportation of the number of shipments being considered relative to current usage of the highways are negligible.

4.3.7 Water Resources

Water resources are not involved.

4.3.8 Radiation, Safety, and Occupational Health

The health risks of the Current Route Option are the same as the All-truck Option routes through the Las Vegas Valley described in Section 4.2.1.8.

4.3.9 Biological Resources

The current route is within the Mojave Desert from its origin to the NTS. Native vegetation associations along the route include Mojave mixed scrub, creosotebush scrub, and desert saltbush scrub (Utah State University, 1996). Vegetation along the Colorado River and other perennially moist waterways may include a combination of species of cattail, rushes, willows, cottonwoods, and saltcedar.

This route passes through habitat for the threatened desert tortoise from its origin to the NTS (Bury et al., 1994; BLM, 1992, 1994b). This route does not cross areas identified as critical habitat for this species (FWS, 1994b). The route crosses Hoover Dam on the Colorado River which contains three endangered fish, the Colorado Squawfish, the bonytail chub, and the razorback sucker.

The probability of effects to biological resources along this route from waste release in transportation accidents is negligible. The possibility of an accidental release occurring during transport of waste is extremely low, and if a release does occur, contaminants will be contained within the highway and adjacent areas, and cleaned up quickly. Although contaminants may travel farther from roads if accidents occur where the route crosses perennial streams, the likelihood of this occurring is negligible, and the small quantity and low radiation level of the waste compared with stream flows and background radiation would not be detectable.

4.3.10 Cultural Resources

Cultural resources would be unaffected by continued use of the current route.

4.3.11 Geology and Soils

Geology and soils would be unaffected by this option.

4.3.12 Socioeconomics

This option does not involve socioeconomic effects.

4.3.13 Environmental Justice

The Las Vegas area contains urban population densities, high levels of growth, and associated traffic, noise, and air emissions. This area is currently experiencing truck transportation of LLW shipments associated with the NTS.

No significant adverse environmental or health effects have been identified for this option and no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur.

5.0 CUMULATIVE EFFECTS

Cumulative effects are most likely to arise when a relationship exists between the transportation options and other activities expected to occur in a similar location and time period.

Six types of activities have been identified that, in combination with the proposed options, have the potential for contributing to cumulative effects. They are:

- Expansion of U.S. Army operations at Fort Irwin that would affect a 36-km (22-mi) segment of the CA 127 route in the Barstow, Yermo, and All-truck Options.
- Shipment of TRU waste from the NTS to the Waste Isolation Pilot Plant in Carlsbad, New Mexico, in the 2000 to 2003 period, using the same route as the Barstow, Yermo, and All-truck Options.
- Shipments of LLW from environmental restoration activities at the NTS using US 95 from Tonopah to Mercury to reach disposal areas on the NTS, estimated at 14,000 shipments over 10 years in the NTS EIS.
- Construction and operation of a new trucking and maintenance operation associated with the Caliente sites.
- Construction and operation of a rail facility for loading copper concentrate from trucks to railcars at the Caliente South site.
- Construction and operation of an intermodal facility for transferring spent fuel rods and high-level radioactive waste (HLW) waste in rail casks to legal-weight and heavy-haul trucks, also at the Caliente South site.

In the following text, each of the activities listed above are described, accompanied by an analysis of the potential cumulative effects for each resource area resulting from the incremental effects of the options. The analysis is limited to the route for the Barstow, Yermo, and All-truck Options that use CA 127 and the two intermodal facility sites in Caliente.

5.1 OPTION 1 – INTERMODAL OPERATIONS

5.1.1 Option 1A – Barstow

Two foreseeable projects would involve CA 127. One is expansion of U.S. Army operations at Fort Irwin. The U.S. Army has proposed acquisition of land to support the training mission of the Army's National Training Center at Fort Irwin. The 331,217-acre area proposed for acquisition is in the Silurian Valley, adjacent to and east of the existing training center. CA 127 bisects the area for a distance of 36 km (22 mi). The full area is proposed for military staging, support, and limited military training activities. Construction is limited to erecting communications equipment and constructing up to six underpasses for military vehicles crossing CA 127. Public access to the area within the proposed acquisition would be restricted.

The second project would use CA 127 to transport TRU waste in legal-weight trucks from the NTS to the Waste Isolation Pilot Plant in Carlsbad, New Mexico, according to the schedule in Table 5-1.

Table 5-1. TRU Waste Shipments

FY	*Number of Shipments*
2000	37
2001	29
2002	13
2003	10
Total	*89*

The route to be used would exit the NTS at Mercury, turn east on US 95 to Amargosa Valley, south on NV 373 and CA 127 to Baker, west on I-15 to Barstow, and east on I-40 through Kingman to Albuquerque. During the shipping campaign, special equipment and training will be provided to emergency response organizations along the route (DOE, 1997c).

Additions to this section, recommended by the AITC, are in Appendix E, Section E.3.31.

5.1.1.1 Transportation

Effects on transportation would be minimal. The incremental effects resulting from an increase in traffic within this option would not affect traffic congestion during the construction of the underpasses, nor during the TRU shipping project.

5.1.1.2 Land Use

There would be no changes in land use.

5.1.1.3 Visual Resources

There would be no change in visual resources.

5.1.1.4 Utilities

There would be no change in utilities.

5.1.1.5 Noise

There would not be a perceptible change in noise levels from traffic.

5.1.1.6 Air Quality

The incremental effects resulting from an increase in air pollutants would not result in a significant cumulative effect.

5.1.1.7 Water Resources

Water resources are not affected.

5.1.1.8 Radiation, Safety, and Occupational Health

The incremental increase in risk would not result in a measurable effect.

5.1.1.9 Biological Resources

There would be no cumulative effect for biological resources.

5.1.1.10 Cultural Resources

There would be no cumulative effect.

5.1.1.11 Geology and Soils

There would be no cumulative effect.

5.1.1.12 Socioeconomics

There would be no cumulative effect.

5.1.1.13 Environmental Justice

There would be no cumulative effect.

5.1.1.14 American Indians

This section, recommended by the AITC, is in Appendix E, Section E.3.32.

5.1.2 Option 1B – Caliente In-town

A trucking operation is planned in Caliente to support the intermodal facilities. A high-end estimate prepared by one of the trucking companies indicates a terminal on 10 to 15 acres, a maintenance building 21 by 22.5 m (70 by 75 ft), 9 tractors and 27 trailers, and 11 employees. One proposed location is shown in Figure 2-3 in Chapter 2. Trucks would not pass through the town of Caliente to reach the intermodal site.

Shipments of LLW from environmental restoration activities at the NTS using US 95 from Tonopah to Mercury to reach disposal areas on the NTS, estimated at 14,000 shipments over 10 years in the NTS EIS.

5.1.2.1 Transportation

Although trucks would need to cross Rainbow Canyon Road within the City of Caliente to reach the intermodal facility, it would not result in a significant increase in traffic congestion. The transportation capacity analysis conducted for routes serving this intermodal facility indicated that there would not be an increase in congestion on these routes. Therefore, there are no cumulative effects in terms of increased traffic congestion within the city and on routes serving the intermodal facility.

The Caliente Option would add a maximum of 2,500 truck trips per year on US 95 from Tonopah to Mercury to the 1,400 round trips planned by the environmental restoration program at the NTS. Both of these activities would make a small contribution to the 190,000 trucks per year currently using this route, and they would not result in a significant increase in traffic congestion.

5.1.2.2 Land Use

Due to the current zoning of the property associated with this option there would be no cumulative effect to land use at the intermodal site.

5.1.2.3 Visual Resources

There would be no cumulative effect on visual resources at the intermodal site.

5.1.2.4 Utilities

The current city water system, sewage disposal and electric power resources are adequate to support both the trucking and intermodal operations.

5.1.2.5 Noise

Due to current activities adjacent to the option site, noise generated by the intermodal operations would not result in a significant increase to existing levels.

5.1.2.6 Air Quality

The incremental effects resulting from an increase in air pollutants would not result in a significant cumulative effect.

5.1.2.7 Water Resources

Water resources would not be affected.

5.1.2.8 Radiation, Safety, and Occupational Health

The incremental increase in risk would not result in a significant cumulative effect.

5.1.2.9 Biological Resources

There would be no incremental effect on biological resources.

5.1.2.10 Cultural Resources

There would be no cumulative effect on cultural resources from this action.

5.1.2.11 Geology and Soils

There would be no cumulative effect on geology and soils from this action.

5.1.2.12 Socioeconomics

The incremental increase in employment would result in a small socioeconomic benefit.

5.1.2.13 Environmental Justice

There would be no cumulative environmental justice effects.

5.1.3 Option 1C – Caliente South

Two projects are planned for the Caliente South site in addition to the intermodal facility.

1. Apex Bulk Commodities is negotiating with BHP Copper of Ely, Nevada, to build an intermodal transfer station at the Caliente South site. They anticipate one diesel truck per hour carrying 40 tons of copper concentrate moving along Front Street 24 hours per day for 15 years. An improved access road and 4,200 m (14,000 ft) of new rail would be constructed. The transfer facility would be housed in a building 90 by 30 m (300 by 100 ft) designed to retain dust, water, and spills generated during the transfer process. Air emission particulates would be collected in two baghouses. Apex would also need a truck maintenance facility housed in a building 30 by 18 m (100 by 60 ft) that could probably be shared with the LLW facility. The locomotive for moving railcars could also be shared as needed. An above-ground storage tank for 12,000 gallons of diesel fuel is also planned. Apex estimates 25 new jobs for Caliente and a payroll of $800,000 per year.

2. Three sites in Nevada have been identified by DOE as potential sites for location of an intermodal transfer station, if the Yucca Mountain site is determined to be suitable as a repository and licensed by the NRC to begin operations. Shipments of SNF and HLW would be expected to arrive in Nevada using a combination of rail and highway. DOE will need to decide how to handle shipments arriving on rail. DOE would either construct a new rail line from existing mainline rail lines or use an intermodal transfer of the rail casks to a heavy-

haul truck for transport to Yucca Mountain. The DOE anticipates that a transfer station would require approximately 50 acres of land and would have a small office building, a vehicle and crane maintenance building, a security building, two outdoor intermodal transfer cranes, a rail siding, and a heavy-haul vehicle parking area.

During peak years, as many as 11 loaded rail casks would arrive weekly. If heavy-haul trucks are used to transport these casks to the Yucca mountain site, there would be an average of 22 heavy-haul truck trips per week, 11 each way. Heavy-haul trucks with casks would weigh as much as 226,796 kilograms (kg) (500,000 pounds [lb]) with dimensions of 61 m (200 ft) long and 3 m (10 ft) wide. The facility would be operated with a staff of 18.

Assuming the Yucca Mountain site is determined to be suitable and licensed by the NRC, and program schedules are maintained as currently envisioned, transportation operations would begin in 2010.

A possible layout plan for all three projects is shown on Figure 5-1.

5.1.3.1 Transportation

Although trucks carrying LLW would enter US 93 at the same point as the Apex truck traffic, both entering and leaving the access road to the south site, the incremental increase in highway traffic resulting from this option would not result in a significant cumulative effect.

The Apex truck traffic would also use the same 550 m (1,800 ft) segment of US 93 as the trucks from the In-town Intermodal Facility described in Section 5.1.2, between the In-town facility and the access road to the South Site. The incremental increase in highway traffic resulting from this option would not result in a significant cumulative effect.

Trucks carrying LLW may occasionally contribute to traffic delays if they encounter heavy-haul trucks from the Yucca Mountain Project following the same route to the NTS. The incremental increase in delays resulting from this option would not result in a significant cumulative effect.

5.1.3.2 Land Use

The incremental effects resulting from changes in land use within this option would not result in a significant cumulative effect.

5.1.3.3 Visual Resources

The incremental effects resulting from a change in visual resources within this option would not result in a significant cumulative effect.

5.1.3.4 Utilities

The incremental effects resulting from an increase in utility requirements within this option would not result in a significant cumulative effect.

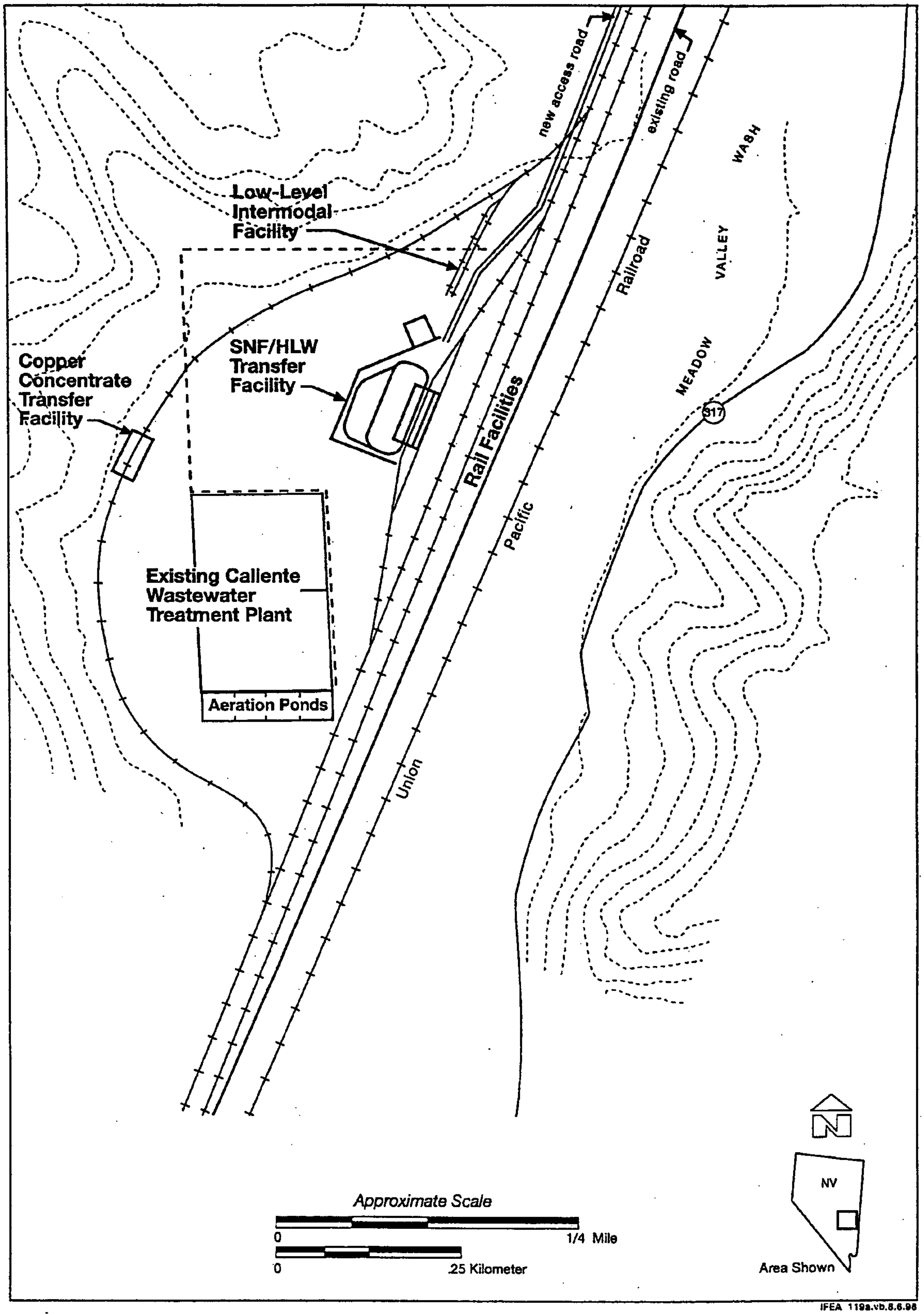

Figure 5-1. Potential Rail Projects, Caliente South Site.

5.1.3.5 Noise

The incremental effects resulting from an increase in noise within this option would not result in a significant cumulative effect.

5.1.3.6 Air Quality

The incremental effects resulting from an increase in air pollutants within this option would not result in a significant cumulative effect.

5.1.3.7 Water Resources

The incremental effects resulting from an increase in water requirements within this option would not result in a significant cumulative effect.

5.1.3.8 Radiation, Safety, and Occupational Health

The incremental effects resulting from an increase in risk within this option would not result in a significant cumulative effect.

5.1.3.9 Biological Resources

The incremental effects to biological resources within this option would not result in a significant cumulative effect.

5.1.3.10 Cultural Resources

The incremental effects to cultural resources within this option would not result in a significant cumulative effect.

5.1.3.11 Geology and Soils

The incremental effects to soils resulting from this option would not result in a significant cumulative effect.

5.1.3.12 Socioeconomics

The incremental beneficial socioeconomic effects resulting from this option would not result in a significant cumulative effect.

5.1.3.13 Environmental Justice

There would be no cumulative environmental justice effects from these action.

5.1.4 Option 1D – Yermo

Potential incremental effects of this option with the Fort Irwin expansion proposal and the TRU waste shipping program affecting the CA 127 portion of the transportation route from Yermo to the NTS, are discussed under the Barstow Option in Section 5.1.1.

5.2 OPTION 2 – ALL-TRUCK ROUTE

5.2.1 Option 2A – Kingman to Yermo to the NTS

Potential incremental effects of this option with the Fort Irwin expansion proposal affecting the CA 127 portion of the transportation route from Yermo to the NTS are discussed under the Barstow Option in Section 5.1.1. The incremental effect of the TRU waste shipping program described in Section 5.1.1 would result in no significant cumulative effects.

5.2.2 Option 2B – Mesquite, Nevada, Route to the NTS via Tonopah

Trucks carrying LLW may occasionally contribute to traffic delays if they encounter heavy-haul trucks from the Yucca Mountain Project following the same route to the NTS. The incremental increase in delays resulting from this option would not result in a significant cumulative effect.

5.3 OPTION 3 – CURRENT ROUTE

No cumulative effects would result from continuing to use the current route.

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8.0 GLOSSARY

Ambient Noise Level. The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.

Area of potential effect. In the context of Section 106 of *the National Historic Preservation Act*, the area in which planned development may directly or indirectly affect a cultural resource.

As low as reasonably achievable (ALARA). An approach to radiation protection designed to manage and control individual and collective radiation doses to the workforce and the general public, and to ensure that exposure is kept to the lowest level reasonably achievable. The ALARA approach considers aspects of the social, technical, economic, practical, and public impacts.

Average annual daily traffic. For a 1-year period, the total volume passing a point or segment of a highway facility in both directions, divided by the number of days in the year.

Baseline. The initial environmental conditions against which the environmental consequences of various alternatives are evaluated.

Capacity (traffic). The maximum rate of flow at which vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specified time period under prevailing roadway, traffic, and control conditions.

Census block. Cluster of blocks within the same census tract. Census blocks do not cross county or census tract boundaries and generally contain between 250 and 550 housing units.

Collective effective dose equivalent (person-rem). A summation of the radiation doses received by individuals in an exposed population dose.

Community Noise Equivalent Level (CNEL). The average A-weighted noise level during a 24-hour day obtained after addition of 5 decibels in the evening from 7:00 p.m. to 10:00 p.m., and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.

Cumulative impact. The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Curie (Ci). A unit of radiation that describes the number of atoms undergoing nuclear transformations per unit time, i.e. 3.7 X 10^{10} disintegrations per second.

Day/Night Noise Level (L_{dn}). The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 p.m. and 7:00 a.m.

Decibel (dB). A standard unit of measuring sound-pressure levels based on a reference sound pressure of 0.0002 dynes per square centimeter. This is the smallest sound a human can hear.

Decibel, A-weighted (dBA). Adjusted unit of sound measurement that corresponds to the relative sensitivity of the human ear at specified frequency levels. This represents the loudness as perceived by humans.

Direct impact. Effects resulting solely from the proposed program.

Dose equivalent. The product of the absorbed dose in the tissue or organ of interest, the applicable quality factor(s), and all other necessary modifying factors at the point of interest.

Environmental Impact Statement (EIS). A detailed written statement that helps public officials make decisions that are based on understanding of environmental consequences and to take actions that protect, restore, and enhance the environment.

Equivalent Noise Level (L_{eq}). The average A-weighted noise level during the measurement period.

Flood plain. That portion of a river valley, adjacent to the river channel, which is built of sediments during the present regimen of the stream and which is covered with water when the river overflows its banks at flood stages.

Frequency. The number of complete pressure fluctuations per second above and below atmospheric pressure.

Geologic. Any natural process acting as a dynamic physical force on the earth; i.e. faulting, erosion, and mountain-building resulting in rock formations.

Groundwater. Subsurface water within the zone of saturation.

Hazardous waste. Wastes that are designated as hazardous by the EPA or state regulations. Hazardous waste, defined under the *Resource Conservation and Recovery Act*, is waste from production or operation activities that poses a potential hazard to human health or the environment when improperly treated, stored, or disposed. Hazardous wastes that appear on special EPA lists or possess at least one of the four following characteristics: ignitability, corrosivity, reactivity, and toxicity.

Intermodal. Involving more than one form of carrier during a single transport.

Intrusive (noise). That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content, as well as the prevailing ambient noise level.

L_{01}, L_{10}, L_{50}, L_{90}. The A-weighted noise levels that are exceeded 1 percent, 10 percent, 50 percent, and 90 percent of the time during the measurement period.

L_{max}, L_{min}. The maximum and minimum A-weighted noise level during the measurement period.

Level of service (LOS) (traffic). The concept of LOS uses qualitative measures that characterize operational conditions within a traffic stream and their perception by motorists and passengers. Six levels of service are defined for each type of roadway facility. They are given letter designations, from A to F, with LOS A representing the best operating condition, and LOS F the worst. Each level of service represents a range of operating conditions.

Low-level radioactive waste (LLW). Radioactive waste not classified as high-level waste, transuranic waste, or spent nuclear fuel, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic elements is less than 100 nCi per gram.

Mixed waste. Waste containing both radioactive and hazardous components, as defined by the *Atomic Energy Act* and the *Resource Conservation and Recovery Act*, respectively.

Noise. Any sound that is undesirable because it interferes with speech and hearing or is intense enough to damage hearing.

Noise sensitive receptor. A noise sensitive receptor is a land use where noise could reasonably be expected to interfere with normal activity. Noise sensitive receptors include residential areas, schools, and sanctuaries.

Playa. A dry, vegetation free, flat area at the lowest point of an undrained basin.

Radiation. The emissions, either electromagnetic or particulate, resulting from the transformation of an unstable atom or nucleus.

Radiation detriment. Radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic defects) in the exposed population.

Radioactive waste. Solid, liquid, or gaseous material that contains radioactive nuclides regulated under the *Atomic Energy Act of 1954*, as amended, and of negligible economic value considering costs of recovery.

Record of Decision (ROD). A public document that explains which alternative will be selected for the area of concern.

Region of influence (ROI). The physical area that bounds the environmental, sociological, economic, or cultural feature of interest for the purpose of analysis.

Riparian. The banks of a body of water.

Significant. The common meaning of significant is "having or likely to have considerable influence or effect". As it pertains to NEPA, "significant" requires that both context and intensity be considered in evaluating impacts (40 CFR Part 1508). Context could include surrounding circumstances such as society as a whole, the affected region, the affected interests, and the locality. Intensity refers to the severity of the impact, and requires that several factors be evaluated. These factors may include the degree to which public health and safety are affected, unique characteristics of the geographic area, and others.

Single Event Level (SEL). A descriptor for the A-weighted noise exposure or dose of a transient event. The SEL compresses the sound energy of a single noise event into an equivalent sound level occurring in a one-second time interval (e.g., an aircraft flyby with a duration of 15 seconds with a maximum sound level of 70 dB would have an SEL of about 80 dB).

Stakeholder. Interested and/or affected people or groups.

Transuranic (TRU) waste. Radioactive waste containing alpha-emitting radionuclides having an atomic number greater than 92 and half-lives greater than 20 years, in concentrations greater than 100 nCi per gram.

Wetlands. An area that is regularly saturated by surface water or groundwater and subsequently supports vegetation that is adapted for life in saturated soil conditions.

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APPENDIX A

TRANSPORTATION HIGHWAY TABLES

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A.0 TRANSPORTATION HIGHWAY TABLES

Table A-1. Current Route Option, Potential Truck Concerns Observed During Field Review (Text Section 3.1.1.3)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
Route from the Southwest, I-15, Baker to Las Vegas		
CA I-15 - MP 136.6		West Baker overpass.
CA I-15 - MP 137.5		East Baker overpass.
CA I-15 - MP 139		Begin truck climbing lane (3 lanes northbound [NB]). Extreme summer temperatures are possible in this area.
CA I-15 - MP 148.5		Halloran Springs overpass.
CA I-15 - MP 154.4	N 35° 24.099' W 115° 47.680'	Halloran Summit (1,219-m [4,000-ft] elevation) Halloran Summit Road overpass.
CA I-15 - MP 156		End truck climbing lane, begin downhill section.
CA I-15 - MP 162.7	N 35° 26.702' W 115° 40.197'	Cima Road overpass. Bottom of basin.
CA I-15 - MP 163.4		Begin climbing lane. Extreme summer temperatures are possible in this area.
CA I-15 - MP 170.5	N 35° 28.169' W 115° 32.662'	Summit (approx. 1,402-m [4,600-ft] elevation).
CA I-15 - MP 170.8		End truck climbing lane, begin steep downhill grade (sign indicates 6 percent grades).
CA I-15 - MP 173		No guard rail.
CA I-15 - MP 175.4	N 35° 27.760' W 115° 27.797'	Runaway truck ramp on downgrade.
CA I-15 - MP 176.4		Nipton Road overpass.
CA I-15 - MP 176.5-180		Very steep downgrade.
CA I-15 - MP 181.4		Yates Well Road overpass.
CA I-15 - MP 182	N 35° 33.266' W 115° 24.792'	Dry lake area. Road 1.2 to 1.5 m (4 to 5 ft) above lakebed, some potential for flooding.
NV I-15 - MP 0-1		Casino area, tourist activity, overhead monorail and tourist rail lines.
NV I-15 - MP 12.4-13		Casino area, tourist activity. Begin shallow uphill section.
NV I-15 - MP 20.8	N 35° 52.345' W 115° 14.442'	Summit (approx. 1,036-m [3,400-ft] elevation).
NV I-15 - MP 22.5		Begin shallow downhill section.
NV I-15 - MP 25-28		Community of Sloan area, a few scattered residences, mostly set back from I-15.
NV I-15 - MP 30 +		Residences near or adjacent to I-15 from here to US 93 junction (see Las Vegas area notes).
Route from the Northeast, I-15 South - Mesquite, Nevada to Las Vegas, Nevada		
MP 120		Begin - Community of Mesquite. Tourist area.
MP 117-110.5		Several steep uphill sections.
MP 107-99		Roadway is elevated 0.9 to 1.8 m (3 to 6 ft) from ground level with few sections of guardrail.
MP 94.7		Steep downhill section from here to exit for NV 168.
MP 63.3		UP railroad overpass.
MP 61.7		UP railroad overpass.
MP 50.2		Lamb Blvd overpass.
MP 48.4		Craig Road overpass (see Las Vegas area notes in text).

Table A-1. Current Route Option, Potential Truck Concerns Observed During Field Review (Text Section 3.1.1.3) (Continued)

	Route from the Southeast, US 93 - Las Vegas to Kingman	
Las Vegas, Boulder City, and Hoover Dam areas		See discussion in text.
NV MP 4.5		Lake Mead Visitors area. Significant cross-traffic, tourist area.
MP 3.6		Gold Strike Inn Casino, left (NB) side of road with gas station on right (southbound [SB]) side. Significant truck traffic, tourist traffic, pedestrians.
NV MP 1		Brake check area for SB direction.
NV MP 0		Hoover Dam area. Significant traffic congestion, pedestrians, with narrow road, and heavy truck traffic.
AZ MP 0.4		Begin uphill section.
MP 4		Narrow bridge over deep canyon.
MP 4-7		Drop-offs with no guardrail on some sections.
MP 10-14		Roadway is elevated in relation to the canyon of the Colorado River. Heavy crosswinds experienced during field review (05/20/1998).
MP 14		Willow Beach Road junction. Tourist area, significant cross traffic.
MP 16		End upgrade.
MP 17		Begin divided highway. No shoulders, rough pavement.
MP 27-28		A few scattered residences.
MP 32		Dirt/gravel, right shoulder begins.
MP 36		Detrital Wash Bridge (new structure), but no shoulders. Blowing dust from wash experienced during field review.
MP 40-43		A few scattered residences.
MP 51		Big Wash Road - NB road is elevated in relation to SB, crossover from SB to Big Wash Road has very poor sight distance.
MP 52.7		Piece Ferry Road - residences on east (NB) side of US 93.
MP 54.4		NB road is elevated in relation to SB, crossover from SB to cross-street has very poor sight distance.
MP 58.7		Mineral Park Road - mine & landfill, some cross-traffic.
MP 63.6		Begin uphill section.
MP 64.4		Ranch Road - residences, cross-traffic.
MP 65		End divided highway.
MP 65.8		Divided highway under construction.
MP 71		I-40 overpass 16 ft 7 in clearance.
	Route from Las Vegas to Mercury, US 95.	
		Few residences on this route past the Las Vegas area, with the exception of Indian Springs. Roadway generally in excellent condition, paved right shoulder, few drop-offs past the right shoulder. Some tourist traffic, but generally light past the Mt. Charleston turn-off.

Table A-2. Option 1A, Barstow – BNSF Intermodal Transfer Facility Route, Potential Truck Concerns Observed During Field Review (Text Section 3.1.2.3)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
	CA 58 to I-15	
I-15, Barstow to Baker		I-15 goes under several underpasses. No clearances posted. This is a major truck route, so clearance is not anticipated to be a concern. The locations of the underpasses are: Minneola Road MP 88.5 Harvard Road MP 91.9 Arlovd Mountain Rd. MP 99.5 Field Road MP 103.6 Afton Road MP 111.6 Basin Road MP 124.2 Rasor Road MP 124.2 Zzyzx Road MP 130.2
MP 125.3, Baker exit		Pavement past exit ramp to junction of CA 127 is poor, with observed rutting. There are businesses and residences closely adjacent to the roadway.
1.6 km (1 mi) north Junction I-15/CA 127	N 35° 16.522' W 116° 04.422'	Baker High School is located on CA 127, 1.6 km (1 mi) north of Junction I-15 and CA 27. High School is 91 m (100 yards) east of CA 127.
MP 3.5 to MP 9.0		CA 127 runs through a low area. There is a potential for flooding of the roadway.
MP 27.6		A wash at this location.
MP 30 to MP 34		Road runs through a playa. There are flood warning signs and numerous wash crossings.
MP 31		Recreation site.
MP 31.9		Low water bridge over a wash at MP 31.9.
MP 34		Road to BLM recreation site - Dumont Dunes at MP 34. A long upgrade begins at this milepost.
MP 40		Winding road through mountain pass (Ibex Pass) begins at MP 40. There are some areas with shoulder drop-offs and no guardrail.
MP 41.5		Ibex Pass Summit - elevation 637 m (2,090 ft). Road climbs about 300 m (1,000 ft) from MP 34 to MP 41.5.
CA 127 - MP 0		Enter Inyo County.
MP 5.7 to MP 6.0		A wash at this location.
MP 6.4		Road to Tecopa Hot Springs (recreation area and small town) at this MP.
MP 6.6 to MP 9		Several washes occur through a low area between MP 6.6 and MP 9.
Junction CA 178 and Community of Shoshone	N 35° 58.339' W 116° 16.228'	Shoshone is built very close to CA 127. This is a tourist area with residences, commercial areas, and a church.
MP 16.3 to MP 23.5		Junction with CA 178 west at MP 16.3. CA 127 has narrow, winding sections from the junction of CA 178 west to approximately MP 23.5. There is a wash with a water depth gage at MP 22.5 and MP 23.

Table A-2. Option 1A, Barstow – BNSF Intermodal Transfer Facility Route Potential Truck Concerns Observed During Field Review (Text Section 3.1.2.3) (Continued)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
MP 27.3		Road is signed "Area Subject to Flooding Next 11 km (7 mi).
MP 29.3		Water depth gage on road.
MP 31.4		Water depth gage on road.
Route 127 at Death Valley Junction	N 36° 18.059' W 116° 24.844'	Restricted sign distance on left-turn into community of Death Valley Junction, CA. This is signed at 40 kilometers per hour (kmph) (25 mph). There are two buildings on either side of CA 127 that are close to the roadway.
Junction CA 190		A wash near the junction. Potential flood prone area.
MP 48		Wash signed for flooding at MP 48. There are several smaller washes between Junction 190 and MP 48.
California/Nevada State Line	N 36° 24.511' W 116° 25.350'	Route becomes NV 373 (Nye County MP 0). There is a small commercial area at the border with a motel and casino.
MP 6.1 to MP 8.5		Widely spaced residences and commercial areas on west side of road. These are set back from the road.
MP 11	N 36° 34.130' W 116° 24.827'	School on Farm Road, west of NV 373 at MP 11. The school is set back 0.16 km (0.1 mi) from NV 373.
Jct. of US 95/NV 373		
MP 30.3	N 36° 38.617' W 116° 24.062'	Small commercial area (Lathrop Wells) includes roadside rest area and RV park.
MP 13.7	N 36° 35.875' W 116° 07.243'	Junction NV 160, leads to Pahrump, NV.
MP 6.8		Mercury interchange begins. Trucks would use an underpass to access Mercury. There are two dirt roads just prior to the Mercury interchange.

Table A-3. Option 1B & C – Caliente Intermodal Transfer Facility Route Potential Truck Concerns Observed During Field Review (Text Section 3.1.3.3)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
Caliente, NV		Homes and businesses and LDS church located across US 93 from intermodal site.
MP 86.6 MP 83.3 MP 77.6, Delmar Valley MP 64.7	N 37° 35.547' W 114° 40.972'	Ice on roadway. Oak Spring Summit, elevation 1,903 m (6,243 ft). Winding roadway. End of mountain pass. Rough pavement, limited shoulder width.
MP 54 - MP 52		Winding roadway between MP 54 and MP 52.
MP 50.9, Junction NV 375		Pittman Wildlife Management Area near junction.
MP 47, Junction NV 375/ NV 318	N 37° 31.906' W 115° 13.825'	There is a short left-turn bay for vehicles to turn to continue on NV 375.
MP 42.3		Narrow bridge, no shoulder.
MP 39.4		Begin upgrade to Hancock Summit. This is a winding mountain road.

Table A-3. Option 1B & C – Caliente Intermodal Transfer Facility Route Potential Truck Concerns Observed During Field Review (Text Section 3.1.3.3) (Continued)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
MP 38.7		In westbound (WB) direction, cracked pavement, no guardrail for a very short section.
MP 38.0		Rest area on north side of road. Cars leaving rest area have restricted sight distance to NV 375 WB.
MP 37.7	N 37° 25.951' W 115° 22.466'	Hancock Summit, elevation 1,704 m (5,592 ft).
MP 36.0		Steep downgrade begins.
MP 34.5		Steep downgrade ends. Dirt road towards NTS junctions to the left.
MP 32.5		Begin Tikaboo Valley. Large dirt pull-out located here. Low valley area. Many culverts under roadway through valley. Some flooding potential.
Lincoln County MP 29.6	N 37° 27.415' W 115° 28.975'	Dirt road junctions left at MP 29.6.
MP 22.6		Dirt road junctions left at MP 22.6.
MP 20.0		East end of Tempiute Road junctions to the right.
MP 18.0	N 37° 33.84.2' W 115° 38.714'	Begin update to Coyote Summit. Winding mountain road.
MP 16.0	N 37° 34.326' W 115° 40.100'	Coyote Summit. Blowing snow area.
MP 15.0		Begin downgrade. Downgrade is not severe.
MP 11.8		West end of Tempiute Road. NV 375 is in a valley area. There appears to be some flooding potential.
MP 10 to MP 11.5		Town of Rachel is south of NV 375 approximately 0.16 km (0.1 mi). Local traffic uses side streets and a frontage road. Some tourist traffic noted.
MP 3.4		Cattle water tank. Area around NV 375 is open range. The road northwest of Rachel has several cattle crossings.
Nye County MP 50		Mileposts change at county line.
MP 45.8		Queen City Summit, elevation 1,817 m (5,960 ft).
MP 45.8 to MP 43.5		Steep downgrades, curves, some areas with no guardrails.
MP 43.5		Blowing snow area near bottom of downgrade.
MP 15.3	N 38° 0.9.33' W 116° 0.6.892'	Road passes through small playa (dry lake), which was full of water (ice) for about 0.1 mi. The road is only about 1.5 m (5 ft) above the water line. There is a 0.6-m (2-ft) wide shoulder on either side and no guardrail.
MP 0	N 38° 08.080' W 116° 22.196'	Junction of US 6 at Warm Springs (no services).
MP 51		Begin US 6, Nye County.
MP 35.3		Five Mile Ranch (a residence) is adjacent to US 6 at this location.
MP 31		Saulsberry Summit, elevation 1,988 m (6,522 ft).
MP 30.3	N 38° 0.8.080' W 116° 44.333'	National Forest Boundary.
MP 25.2	N 38° 07.509' W 116° 48.847'	Designated Rest Area. Some tourist traffic possible.
MP 21 to MP 19		McKinley Tanks Summit, elevation 1,948 m (6,391 ft). Winding mountain road and blowing snow area.

Table A-3. Option 1B & C – Caliente Intermodal Transfer Facility Route Potential Truck Concerns Observed During Field Review (Text Section 3.1.3.3) (Continued)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
MP 17.6	N 38° 05.104' W 116° 56.234'	End of National Forest.
MP 13.5	N 38° 64.762' W 117° 00.585'	US 6 junction with road to TTR.
MP 8.8	N 38° 0.4.372' W 117° 06.034'	Entrance to City of Tonopah, NV.
MP 7.2		Junction NV 376.
MP 6.5		Enter City of Tonopah. Residences and commercial buildings are adjacent to US 6.
US 6 MP 0, Junction US 6/ US 95		Junction US 6/US 95 unsignalized intersection is four lanes here. Trucks must make a left turn across traffic. Intersection is relatively busy.
Junction US 6/US 95	N 38° 03.462' W 117° 13.011'	Tonopah High School and a new commercial area are approximately 3.2 km (2 mi) south of the intersection of US 6/US 95. Tonopah Summit is near the high school at elevation 1,916 m (6,287 ft). Enter Esmeralda County.
MP 20		Enter City of Goldfield, NV, at MP 20. Road narrows, narrow bridge at beginning of town. Residences and commercial buildings are close to the roadway.
MP 18.8		Tight right-turn through City of Goldfield.
MP 18.4		City of Goldfield ends.
MP 17.0		Goldfield Summit, elevation 1,855 m (6,087 ft).
MP 4.2		Junction NV 266.
MP 0 Esmeralda County = MP 107 Nye County		Re-enter Nye County.
MP 103		Stonewall Pass, elevation 1,428 m (4,686 ft). There is some shoulder drop off without a guard rail at the top of the pass.
MP 95.3		Junction NV 267 - Scotty's Junction.
MP 94 - MP 93		Widely separated residences and businesses. These are set back from US 95.
MP 70		Community of Springdale. A small group of residences, some close to US 95. A school bus stops here.
MP 63		Town of Beatty, NV, begins. There are commercial areas (casino, RV park, gas station) and residences adjacent to US 95.
MP 61		Junction of US 95/NV 374. Trucks must turn left to continue on US 95.
MP 59	N 36° 54.03' W 116° 45.441'	Beatty High School is approximately 0.3 km (0.2 mi) south of US 95.
MP 30.3	N 36° 38.617' W 116° 24.062'	Small commercial area (Lathrop Wells) includes roadside rest area, RV park.

Table A-4. Option 1D – Yermo Intermodal Transfer Facility Route Potential Truck Concerns Observed During Field Review (Text Section 3.1.4.3)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
MP 13.7	N 36° 35.875' W 116° 07.243'	Junction NV 160, leads to Pahrump, NV.
MP 6.8		Mercury interchange begins. Trucks would use an underpass to access Mercury. There are two dirt roads just prior to the interchange that lead to Mercury.
Yermo Intermodal Transfer Site		There is an Elementary and a High School on the west side of the MCLB. These are well away from the multimodal transfer site.
I-15, Yermo to Baker		I-15 goes under several overpasses. No clearances posted. This is a major truck route, so clearance is not anticipated to be a concern. The location of the overpasses are: Minneola Road MP 88.5 Harvard Road MP 91.9 Arlovd Mountain Road MP 99.5 Field Road MP 103.6 Afton Road MP 111.6 Basin Road MP 124.2 Rasor Road MP 124.2 Zzyzx Road MP 130.2
MP 125.3, Baker exit		Pavement past exit ramp to junction of CA 127 is poor, with observed trenching. There are businesses and residences closely adjacent to the roadway.
1.6 km (1 mi) north Junction I-15/CA 127	N 35° 16.522' W 116° 04.422'	Baker High School is located on CA 127, 1.6 km (1 mi) north of Junction I-15 and CA 27. High School is 91 m (100 yards) east of CA 127.
MP 3.5 to MP 9.0		CA 127 runs through a low area. There is a potential for flooding of the roadway.
MP 27.6		Wash at this location.
MP 30 to MP 34		Road runs through a playa. There are signs warning of flooding and numerous wash crossings.
MP 31		Recreation site.
MP 31.9		Low water bridge over wash at MP 31.9.
MP 34		Road to BLM Recreation site - Dumont Dunes at MP 34. A long upgrade begins at this milepost.
MP 40		Winding road through mountain pass (Ibex Pass) begins at MP 40. There are some areas with shoulder drop-offs and no guardrail.
MP 41.5		Ibex Pass Summit, elevation 637 m (2,090 ft). Road climbs about 305 m (1,000 ft) from MP 34 to MP 41.5.
CA 127 - MP 0		Enter Inyo County.
MP 5.7 to MP 6.0		A wash at this location.
MP 6.4		Road to Tecopa Hot Springs (recreation area and small town) at this MP.
MP 6.6 to MP 9		Several washes occur through a low area between MP 6.6 and MP 9.
Junction CA 178 and Community of Shoshone	N 35° 58.339' W 116° 16.228'	Shoshone is built very close to CA 127. This is a tourist area with residences, commercial areas, and a church.

Table A-4. Option 1D – Yermo Intermodal Transfer Facility Route Potential Truck Concerns Observed During Field Review (Text Section 3.1.4.3) (Continued)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
MP 16.3 to MP 23.5		Junction with CA 178 west at MP 16.3. CA 127 has narrow, winding sections from the junction of CA 178 west to approximately MP 23.5. There is a wash with a water depth gage at MP 22.5 and MP 23.
MP 27.3		Road is signed "Area Subject to Flooding Next 11 km (7 mi)."
MP 29.3		Water depth gage on road.
MP 31.4		Water depth gage on road.
Route 127 at Death Valley Junction	N 36° 18.059' W 116° 24.844'	Blind left-turn into community of Death Valley Junction, CA. This is signed at 40 kmph (25 mph). There are two buildings on either side of CA 127 that are close to the roadway.
Junction CA 190		A wash near the junction. Potential flood prone area.
MP 48		Wash signed for flooding at MP 48. There are several smaller washes between Junction 190 and MP 48.
California/Nevada State Line	N 36° 24.511' W 116° 25.350'	Route becomes NV 373 (Nye County MP 0). There is a small commercial area at the border with motel and casino.
MP 6.1 to MP 8.5		Widely spaced residences and commercial areas on west side of road. These are set back from the road.
MP 11	N 36° 34.130' W 116° 24.827'	School on Farm Road, west of NV 373 at MP 11. The school is set back 0.16 km (0.1 mi) from NV 373.
MP 30.3	N 36° 38.617' W 116° 24.062'	Small commercial area (Lathrop Wells) includes roadside rest area, RV park.
MP 13.7	N 36° 35.875' W 116° 07.243'	Junction NV 160, leads to Pahrump, NV.
MP 6.8		Mercury interchange begins. Trucks would use an underpass to access Mercury. There are two dirt roads just prior to the interchange that leads to Mercury.

Table A-5. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from the East Via I-40 (Text Section 3.1.5.3)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
AZ I-40 – MP 51		Begin I-40 WB from Kingman, AZ.
AZ I-40 – MP 44.8		Overpass 4.9 m (16 ft 2 in) clearance.
AZ I-40 – MP 37		Griffith Road overpass 5.2 m (17 ft 0 in) clearance.
AZ I-40 – MP 29.2		Old Trails Road overpass 5.0 m (16 ft 6 in) clearance.
AZ I-40 – MP 26.1		Proving Ground Road overpass 5.2 m (17 ft 0 in) clearance.
AZ I-40 – MP 25.7		Pedestrian overpass 5.4 m (17 ft 8 in) clearance.
AZ I-40 – MP 25.2		Alamo Road overpass 5.0 m (16 ft 5 in) clearance.
AZ I-40 – MP 22.3		Happy Jack Road overpass 5.1 m (16 ft 7 in) clearance.
AZ I-40 – MP 20.2		Gem Acres Road overpass 5.1 m (16 ft 7 in) clearance.
AZ I-40 – MP 13.1		Franconia Road overpass 5.4 m (17 ft 9 in) clearance.

Table A-5. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from the East Via I-40 (Text Section 3.1.5.3) (Continued)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
AZ I-40 – MP 10		US 95/Havasu Road overpass 5.7 m (18 ft 10 in) clearance.
AZ I-40 – MP 3		Needle Mountain Road overpass 5.0 m (16 ft 3 in) clearance.
AZ I-40 – MP 0.6		Topock Road overpass 5.0 m (16 ft 3 in) clearance.
AZ I-40 – MP 0		Colorado River – CA State line.
CA I-40 - MP 153.3		Park Moabi overpass.
CA I-40 - MP 141		Broadway/River Road overpass.
CA I-40 - MP 139.1		Overpass.
CA I-40 - MP 132.7		US 95 North overpass.
CA I-40 - MP 131.6		Begin truck lane (3 lanes WB). Start long uphill section.
CA I-40 - MP 126		Steep upgrade (truck lane continues).
CA I-40 - MP 125	N 34° 51.375' W 114° 53.149'	Sacramento Mountains, top of pass, end truck lane (2 lanes WB). Begin downgrade.
CA I-40 - MP 120		Water Road overpass.
CA I-40 - MP 118.6		Begin truck lane (3 lanes WB). Begin upgrade.
CA I-40 - MP 115.2	N 34° 39.811' W 115° 03.200'	Mountain Springs Summit, elevation 844 m (2,770 ft) and Mountain Springs Road overpass.
CA I-40 - MP 114.6		End truck lane (2 lanes WB).
CA I-40 - MP 99.7		Essex Road overpass.
CA I-40 - MP 93	N 34° 46.895' W 115° 28.441'	Top of a long shallow uphill section.
CA I-40 - MP 80	N 34° 43.435' W 115° 38.688'	Mountain pass.
CA I-40 - MP 74-73	N 34° 43.055' W 115° 45.266'	Mountain pass area, high cross-winds possible.
CA I-40 - MP 69-68		Sections with a drop-off beyond the right shoulder that are not protected by guardrail.
CA I-40 - MP 67.4	N 34° 43.976' W 115° 51.851'	Mountain pass.
CA I-40 - MP 64.3		Begin long downhill section.
CA I-40 - MP 60.4		Section with a drop-off beyond the right shoulder that is not protected by guardrail.
CA I-40 - MP 56.7-55.7		Section with a drop-off beyond the right shoulder that is not protected by guardrail.
CA I-40 - MP 53-52		Sections with a drop-off beyond the right shoulder that is not protected by guardrail.
CA I-40 - MP 51	N 34° 46.626' W 116° 08.154'	End of downhill section.
CA I-40 - MP 50		Community of Ludlow, CA, a few residences near I-40.
CA I-40 - MP 41.8		Overpass.
CA I-40 - MP 33-30		Sections with a drop-off beyond the right shoulder that are not protected by guardrail.

Table A-5. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from the East Via I-40 (Section 3.1.5.3) (Continued)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
CA I-40 - MP 27-24	N 34° 48.287' W 116° 32.800'	Dry lake area, potential for occasional flooding.
CA I-40 - MP 23.3		Newberry Springs overpass.
CA I-40 - MP 20.3		Overpass.
CA I-40 - MP 20-14		Sections with a drop-off beyond the right shoulder that are not protected by guardrail.
CA I-40 - MP 20-14		Sections with a drop-off beyond the right shoulder that are not protected by guardrail.
CA I-40 - MP 7.1		Dagget overpass.
CA I-40 - MP 7-4.5		Sections with a drop-off beyond the right shoulder that are not protected by guardrail.
CA I-40 - MP 2.6		MCLB Road overpass.
CA I-40 - MP 2.2		Section with a drop-off beyond the right shoulder that are not protected by guardrail.
CA I-40 - MP 1		East Main Street Exit to I-15 North 1.1 km (0.7 mi) from I-40 to I-15. Commercial area, some residences.
CA I-40 - MP 0		I-15 South.
I-15, Barstow to Baker		I-15 goes under several overpasses. No clearances posted. This is a major truck route, so clearance is not anticipated to be a concern. The location of the overpasses are: Minneola Road MP 88.5 Afton Road MP 111.6 Harvard Road MP 91.9 Basin Road MP 124.2 Arlovd Mountain Rd. MP 99.5 Rasor Road MP 124.2 Field Road MP 103.6 Zzyzx Road MP 130.2
MP 125.3, Baker exit		Pavement past exit ramp to junction of CA 127 is poor, with observed rutting. There are businesses and residences closely adjacent to the roadway.
1.6 (1 mi) north Junction I-15/127	N 35° 16.522' W 116° 04.422'	Baker High School is located on CA 127, 19 km (1 mi) north of Junction I-15 and CA 27. High School is 91 km (100 yards) east of CA 127.
MP 3.5 to MP 9.0		CA 127 runs through a low area. There is a potential for flooding of the roadway.
MP 27.6		A wash at this location.
MP 30 to MP 34		Road runs through a playa. There are signs warning of flooding and numerous wash crossings.
MP 31		Recreation site.
MP 31.9		Low water bridge over a wash at MP 31.9.
MP 34		Road to BLM Recreation site - Dumont Dunes at MP 34. A long upgrade begins at this milepost.
MP 40		Winding road through mountain pass (Ibex Pass) begins at MP 40. There are some areas with shoulder drop-offs and no guard rail.
MP 41.5		Ibex Pass Summit, elevation 637 m (2,090 ft). Road climbs about 305 m (1,000 ft) from MP 34 to MP 41.5.

Table A-5. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from the East Via I-40 (Section 3.1.5.3) (Continued)

Location	*Latitude/Longitude*	*Description of Potential Truck Route Considerations*
CA 127 - MP 0		Enter Inyo County.
MP 5.7 to MP 6.0		A wash at this location.
MP 6.4		Road to Tecopa Hot Springs (recreation area and small town) at this MP.
MP 6.6 to MP 9		Several washes occur through a low area between MP 6.6 and MP 9.
Junction CA 178 and Community of Shoshone	N 35° 58.339' W 116° 16.228'	Shoshone is built very close to CA 127. This is a tourist area with residences, commercial areas, and a church.
MP 16.3 to MP 23.5		Junction with CA 178 west at MP 16.3. CA 127 has narrow, winding sections from the junction of CA 178 west to approximately MP 23.5. There is a wash with a water depth gage at MP 22.5 and MP 23.
MP 27.3		Road is signed "Area Subject to Flooding Next 11 km (7 mi)."
MP 29.3		Water depth gage on road.
MP 31.4		Water depth gage on road.
CA 127 at Death Valley Junction	N 36° 18.059' W 116° 24.844'	Restricted sight distance for left-turn into community of Death Valley Junction, CA. This is signed at 40 kmph (25 mph). There are two buildings on either side of CA 127 that are close to the roadway.
Junction CA 190		A wash near the junction. Potential flood prone area.
MP 48		Wash signed for flooding at MP 48. There are several smaller washes between Junction 190 and MP 48.
CA/NV State Line	N 36° 24.511' W 116° 25.350'	Route becomes NV 373 (Nye County MP 0). There is a small commercial area at the border with a motel and casino.
MP 6.1 to MP 8.5		Widely spaced residences and commercial areas on west side of road. These are set back from the road.
MP 11	N 36° 34.130' W 116° 24.827'	School on Farm Road, west of NV 373 at MP 11. The school is set back 0.16 km (0.1 mi) from NV 373.
MP 30.3	N 36° 38.617' W 116° 24.062'	Small commercial area (Lathrop Wells) includes roadside rest area, RV park.
MP 13.7	N 36° 35.875' W 116° 07.243'	Junction NV 160, leads to Pahrump, NV.
MP 6.8		Mercury interchange begins. Trucks would use an underpass to access Mercury. There are two dirt roads just prior to the Mercury interchange.

Table A-6. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from Mesquite Via I-15 (Text Section 3.1.5.3)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
	I-15 South - Mesquite, Nevada to US 93	
MP 120		Begin - Community of Mesquite, NV. Tourist area.
MP 117-110.5		Several steep uphill sections.
MP 107-99		Roadway is elevated 0.9 to 1.8 m (3 to 6 ft) above ground level with few sections of guardrail. Approximately a 3.7-m (12-ft) right shoulder, 0.6- to 0.9-m (2- to 3-ft) left shoulder.
MP 94.7		Steep downhill section from here to exit for NV 168.
	Option to Use NV 168 – I-15 to US 93	
MP 0-2.5		Community of Moapa, NV, residences, commercial, and governmental buildings. Ute V. Perkins School.
MP 3.5		Enter Moapa Indian Reservation.
MP 4.9		Leave Moapa Indian Reservation.
MP 6.4-6.2		Scattered residences near roadway.
MP 9.3-10		Scattered residences near roadway.
MP 11		Wash area.
MP 12		Blind curve, washes, drop-off with no guardrail.
MP 16		Wash area.
MP 19-20.2		Steep downhill section. Drop-offs with no guardrail in some sections.
MP 21.5-22		Drop-offs with no guardrail in some sections.
MP 23.8		Junction of US 93.
	US 93 - I-15 to NV 375	
Clark MP 53		Begin northbound.
Clark MP 57-58		Sections with drop-offs and no guardrail.
Clark MP 60.6-61		Sections with drop-offs and no guardrail.
Clark MP 67.6-68		Sections with drop-offs and no guardrail.
Clark MP 72-73		Sections with drop-offs and no guardrail.
Lincoln MP 3.3		Deep wash not guardrail protected.
Lincoln MP 5-6.3		Sections with drop-offs and no guardrail.
Lincoln MP 8.5		Truck crossing from sand and gravel works.
Lincoln MP 23.7		Enter Pahranagat Wildlife Refuge – tourist area.
Lincoln MP 28.5		Picnic tables, rest area right side of US 93.
Lincoln MP 29		Sections with drop-offs and no guardrail.

Table A-6. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from Mesquite Via I-15 (Text Section 3.1.5.3) (Continued)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
Lincoln MP 31		Wildlife viewing area, left side of US 93.
Lincoln MP 31.3		Sections with drop-offs and no guardrail.
Lincoln MP 31.8		Pahranagat Wildlife Refuge Headquarters – tourist area, left side of US 93.
Lincoln MP 32.6		Upper Pahranagat Lake – tourist area.
Lincoln MP 33.4-33.6		Sections with drop-offs and no guardrail.
Lincoln MP 36.4-37		Sections with drop-offs and no guardrail.
Lincoln MP 38.2-39.8		Community of Alamo, NV – residences near roadway.
Lincoln MP 45-45.3		Community of Ash Springs, NV – residences near roadway.
Lincoln MP 51		Junction of NV 375.
MP 50.9, Junction NV 375		Pittman Wildlife Management Area near Junction NV 375.
MP 47, Junction NV 375/NV 318	N 37° 31.906' W 115° 13.825'	There is a short left-turn bay for vehicles to turn to continue on NV 375.
MP 42.3		Narrow bridge, no shoulder.
MP 39.4		Begin upgrade to Hancock Summit. This is a winding mountain road.
MP 38.7		In WB direction, cracked pavement, no guardrail for a very short section.
MP 38.0		Rest area on north side of road. Cars leaving rest area have restricted sight distance to NV 375 WB.
MP 37.7	N 37° 25.951' W 115° 22.466'	Hancock Summit, elevation 1,704 m (5,592 ft).
MP 36.0		Steep downgrade begins.
MP 34.5		Steep downgrade ends. Dirt road towards NTS junctions to the left.
MP 32.5		Begin Tikaboo Valley. Large dirt pull-out located here. Low valley area. Many culverts under roadway through valley. Some flooding potential.
Lincoln County MP 29.6	N 37° 27.415' W 115° 28.975'	Dirt road junctions left at MP 29.6.
MP 22.6		Dirt road junctions left at MP 22.6.
MP 20.0		East end of Tempiute Road junctions to the right.
MP 18.0	N 37° 33.84.2' W 115° 38.714'	Begin update to Coyote Summit. Winding mountain road.
MP 16.0	N 37° 34.326' W 115° 40.100'	Coyote Summit. Blowing snow area.
MP 15.0		Begin downgrade. Downgrade is not severe.
MP 11.8		West end of Tempiute Road. NV 375 is in a valley area. There appears to be some flooding potential.

Table A-6. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from Mesquite Via I-15 (Text Section 3.1.5.3) (Continued)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
MP 10 to MP 11.5		Town of Rachel, NV, is south of NV 375 approximately 0.16 km (0.1 mi). Local traffic uses side streets and a frontage road. Some tourist traffic noted.
MP 3.4		Cattle water tank. Area around NV 375 is open range. The road northwest of Rachel has several cattle crossings.
Nye County MP 50		Mileposts change at county line.
MP 45.8		Queen City Summit, elevation 1,817 m (5,960 ft).
MP 45.8 to MP 43.5		Steep downgrades, curves, some areas with no guardrails.
MP 43.5		Blowing snow area near bottom of downgrade.
MP 15.3	N 38° 0.9.33' W 116° 0.6.892'	Road passes through small playa (dry lake), which was full of water (ice) for about 0.16 km (0.1 mi). The road is only about 1.5 m (5 ft) above the water line. There is a 0.6-m (2-ft) wide shoulder on either side and no guardrail.
MP 0	N 38° 08.080' W 116° 22.196'	Junction of US 6 at Warm Springs (no services).
MP 51		Begin US 6, Nye County.
MP 35.3		Five Mile Ranch (a residence) is adjacent to US 6 at this location.
MP 31		Saulsberry Summit, elevation 1,988 m (6,522 ft).
MP 30.3	N 38° 0.8.080' W 116° 44.333'	National Forest Boundary.
MP 25.2	N 38° 07.509' W 116° 48.847'	Designated Rest Area. Some tourist traffic possible.
MP 21 to MP 19		McKinley Tanks Summit, elevation 1,948 m (6,391 ft). Winding mountain road and blowing snow area.
MP 17.6	N 38° 05.104' W 116° 56.234'	End of National Forest.
MP 13.5	N 38° 64.762' W 117° 00.585'	US 6 junction with road to TTR.
MP 8.8	N 38° 0.4.372' W 117° 06.034'	Entrance to City of Tonopah, NV.
MP 7.2		Junction NV 376.
MP 6.5		Enter City of Tonopah. Residences and commercial buildings are adjacent to US 6.
US 6 MP 0 Junction US 6/US 95		Junction US 6/US 95-unsignalized intersection is four lanes here. Trucks must make a left turn across traffic. Intersection is relatively busy.
Junction US 6/US 95	N 38° 03.462' W 117° 13.011'	Tonopah High School and a new commercial area are approximately 3.2 km (2 mi) south of the intersection of US 6/US 95. Tonopah Summit is near the high school at elevation 1,916 m (6,287 ft). Enter Esmeralda County, NV.

Table A-6. Option 2 – All-Truck Route Potential Truck Concerns Observed During Field Review of Truck Route Approach from Mesquite Via I-15 (Text Section 3.1.5.3) (Continued)

Location	*Latitude/ Longitude*	*Description of Potential Truck Route Considerations*
MP 20		Enter City of Goldfield, NV, at MP 20. Road narrows, narrow bridge at beginning of town. Residences and commercial buildings are close to the roadway.
MP 18.8		Tight right-turn through City of Goldfield.
MP 18.4		City of Goldfield ends.
MP 17.0		Goldfield Summit, elevation 1,855 m (6,087) ft.
MP 4.2		Junction NV 266.
MP 0 Esmeralda County = MP 107 Nye County		Re-enter Nye County, NV.
MP 103		Stonewall Pass, elevation 1,428 m (4,686 ft). There is some shoulder drop off without guardrail at the top of the pass.
MP 95.3		Junction NV 267 - Scotty's Junction, NV.
MP 94 - MP 93		Widely separated residences and businesses. These are set back from US 95.
MP 70		Community of Springdale, NV. A small group of residences, some close to US 95. A school bus stops here.
MP 63		Town of Beatty, NV, begins. There are commercial areas (casino, RV park, gas station) and residences adjacent to US 95.
MP 61		Junction of US 95/NV 374. Trucks must turn left to continue on US 95.
MP 59	N 36° 54.03' W 116° 45.441'	Beatty High School is approximately 0.3 km (0.2 mi) south of US 95.
MP 30.3	N 36° 38.617' W 116° 24.062'	Small commercial area (Lathrop Wells) includes roadside rest area, RV park.
MP 13.7	N 36° 35.875' W 116° 07.243'	Junction NV 160, leads to Pahrump, NV.
MP 6.8		Mercury interchange begins. Trucks would use an underpass to access Mercury. There are two dirt roads just prior to the Mercury interchange.

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APPENDIX B

NOISE

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B.0 NOISE

B.1 BACKGROUND INFORMATION ON NOISE

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its pitch or its loudness. Pitch is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. Loudness is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A dB is a unit of measurement, which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 dB represents a ten-fold increase in acoustic energy, while 20 dB is 100 times more intense, 30 dB is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 dB increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table B-1.

There are several methods of characterizing sound. The most common in the United States is the A-weighted sound level or dBA. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table B-2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night – because excessive noise interferes with the ability to sleep – 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The CNEL is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 p.m. to

Table B-1. Definitions of Acoustical Terms

Term	*Definitions*
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).
Frequency (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure.
A-Weighted Sound Level (dBA)	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted, unless reported otherwise.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1, 10, 50, and 90 percent of the time during the measurement period.
Single Event Level (SEL)	A descriptor for the A-weighted noise exposure or dose of a transient event. The SEL compresses the sound energy of a single noise event into an equivalent sound level occurring in a one-second time interval (e.g., an aircraft flyby with a duration of 15 seconds with a maximum sound level of 70 dB would have an SEL of about 80 dB).
Equivalent Noise Level (L_{eq})	The average A-weighted noise level during the measurement period.
Community Noise Equivalent Level (CNEL)	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 dB in the evening from 7:00 pm to 10:00 pm and after addition of 10 dB to sound levels measured in the night between 10:00 pm and 7:00 a.m.
Day/Night Noise Level (L_{dn})	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 dB to levels measured in the night between 10:00 pm and 7:00 a.m.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

10:00 p.m.) and a 10 dB addition to nocturnal (10:00 p.m. to 7:00 a.m.) noise levels. The L_{dn} is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this 3-hour period are grouped into the daytime period.

Table B-2. Typical Sound Levels Measured in the Environment and Industry

At a Given Distance From Noise Source	*A-Weighted Sound Level in Decibels*	*Noise Environments*	*Subjective Impression*
	140		
Civil Defense Siren (100 ft)	130		
Jet Takeoff (200 ft)	120		Pain Threshold
	110	Rock Music Concert	
Pile Driver (50 ft)	100		Very Loud
Ambulance Siren (100 ft)			
	90	Boiler Room	
Freight Cars (50 ft)		Printing Press Plant	
Pneumatic Drill (50 ft)	80	In Kitchen With Garbage Disposal Running	
Freeway (100 ft)			
	70		Moderately Loud
Vacuum Cleaner (10 ft)	60	Data Processing Center	
		Department Store	
Light Traffic (100 ft)	50	Private Business Office	
Large Transformer (200 ft)			
	40		Quiet
Soft Whisper (5 ft)	30	Quiet Bedroom	
	20	Recording Studio	
	10		Threshold of Hearing
	0		

B.2 EFFECTS OF NOISE

B.2.1 Hearing Loss

While physical damage to the ear from an intense noise impulse is rare, a degradation of auditory acuity can occur even within a community noise environment. Hearing loss occurs mainly due to chronic exposure to excessive noise, but may be due to a single event such as an explosion. Natural hearing loss associated with aging may also be accelerated from chronic exposure to loud noise.

The U.S. Occupational Safety and Health Administration (OSHA) has a noise exposure standard which is set at the noise threshold where hearing loss may occur from long-term exposures. The maximum allowable level is 90 dBA averaged over 8 hours. If the noise is above 90 dBA, the allowable exposure time is correspondingly shorter.

B.2.2 Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noise of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12 to 17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57 to 62 dBA L_{dn} with open windows and 65 to 70 dBA L_{dn} if the windows are closed. Levels of 55 to 60 dBA are common along collector streets and secondary arterials, while 65 to 70 dBA is a typical value for a primary/major arterial. Levels of 75 to 80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

B.2.3 Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 55 dBA L_{dn}. At an L_{dn} of about 60 dBA, approximately 2 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 12 percent of the population. There is, therefore, an increase of about 1 percent per dBA between an L_{dn} of 60 to 70 dBA. Between an L_{dn} of 70 to 80 dBA, each decibel increase increases by about 2 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 10 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 2 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 3 percent increase in the percentage of the population highly annoyed.

APPENDIX C

HUMAN HEALTH RISK

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C.0 HUMAN HEALTH RISK

C.1 SUMMARY

C.1.1 Human Health Risk

There are several types of human health risks associated with the transportation of LLW to the NTS involving an intermodal transfer. They include cross-country accidents while traveling to the intermodal transfer facility, risks associated with both normal operations and accidents at the facility, and incident-free and accident risks associated with truck transportation from the facility to the NTS. Risks include fatalities from both accidents and cancer induced by radiation exposure.

A comparison of the relative safety of rail and truck for cross-country movement of shipments to the intermodal facility is published in the *Programmatic EIS* for DOE Waste Management. This document included an analysis of moving the same quantity of waste to the NTS from numerous DOE sites by both rail and truck. It stated that the ratio of fatalities from truck traffic accidents to fatalities from rail accidents was 76/1. The ratio of latent cancer fatalities from radiation exposure from truck transportation to fatalities from rail was 7/1.

Risks analyzed at the intermodal transfer facility were radiation risks during normal operations and as a result of an accidental fire involving waste containers. No adverse health effects would be expected. The likelihood of a single cancer fatality in the worker population as a result of normal operations is about 1 in 600.

For comparison, Table S-1 lists the chances of death from several activities encountered in daily life.

Table S-1. Risk Comparisons

Cause of Death	*Lifetime Risk of Dying One Chance In:*
Cancer, all causes	5
Automobile Accident	87
Cancer, naturally occurring radiation	93
Fire	500
Poisoning	1000
Lightning	39,000
Cancer, fossil fuel emissions	55,000

Source: National Safety Council, 1993.

A fire near a shipping container could possibly be ignited by a fuel leak in a vehicle used in the transfer operation. Based on safety data for waste management operations at the NTS, the likelihood of such a fire would be estimated at once every 25,000 years. The risk of a collective radiation dose to the population in the Caliente region, from the fire causing a rupture of a shipping container and release of its contents to the atmosphere, would be one chance in 43,000 of a single cancer fatality within the entire population. The risk in the Yermo region would be one chance in 26,000, and the Barstow region risk would be one chance in 6,000.

The transportation risks were analyzed for two routes from the intermodal facilities; one avoiding the Las Vegas Valley and one passing through the valley, for the following situations:

- all shipments through Barstow
- all shipments through Caliente
- all shipments through Yermo.

Comparisons were also made with risk analyses of maintaining the current situation of transporting waste through the valley by truck and a truck option taking routes that avoid the valley.

Tables S-2 through S-5 summarize the differences in incident-free risk for the general population for the two routes for each situation involving 25,084 shipments over a 10-year period. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller population than urban routes through the valley. The exception is the All-truck Option where valley avoidance routes are much longer than routes through the valley. Larger values indicate less risk.

Table S-2. Incident-free Transportation – Barstow

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	227	(59)
Through Las Vegas Valley	145	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table S-3. Incident-free Transportation – Caliente

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	263	(22)
Through Las Vegas Valley	204	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table S-4. Incident-free Transportation – Yermo

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	152	(37)
Through Las Vegas Valley	111	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table S-5. Incident-free Transportation – All-truck

Route	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	101	13
Through Las Vegas Valley	116	

*Percentage that the avoidance route risk is higher (or lower) than the route through the valley.

If no intermodal transfer facilities are utilized and all shipments continue to move through the Las Vegas Valley, the risk of radiation-induced cancer fatalities to the general population would be one chance in 116, the same as the All-truck routes through the Las Vegas Valley.

Tables S-6 through S-9 indicate the results of the risk analysis for transportation accidents. Fatalities for both vehicle-related accidents and radiation exposure to the general public are shown. Vehicle-related accidents typically result in higher risks for the route that avoids the valley because the mileage is longer. Radiation risks are typically lower for the valley avoidance routes because they are in rural areas with smaller population than urban routes through the valley.

Table S-6. Transportation Accident Risks – Barstow

Route	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Route**	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	4.2	(35)	59 million	(2,169)
Through Las Vegas Valley	3.1		2.6 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table S-7. Transportation Accident Risks – Caliente

Route	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes**	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Route**
Avoids Las Vegas Valley	2.9	(16)	630 million	(21,624)
Through Las Vegas Valley	2.5		2.9 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

If no intermodal transfer facilities are utilized and all shipments continue to move through the Las Vegas Valley, the risk of vehicle-related fatalities to the general population is one chance in 6.3 and radiation-induced cancer fatalities of one chance in 1.5 million, the same as the All-truck route through the Las Vegas Valley.

Table S-8. Transportation Accident Risks – Yermo

Route	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes**	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	4.0	(29)	50 million	(1,823)
Through Las Vegas Valley	3.1		2.6 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

Table S-9. Transportation Accident Risks – All-truck

Route	*Vehicle-related Fatalities*		*Radiation-related Fatalities*	
	Risk of Traffic Fatality One Chance in:	*Percentage Difference Between Routes**	*Risk of Cancer Fatality One Chance in:*	*Percentage Difference Between Routes**
Avoids Las Vegas Valley	2.3	64	18 million	(1,100)
Through Las Vegas Valley	6.3		1.5 million	

*Percentage that the avoidance route risk is higher or (lower) than the route through the valley.

The risk values presented in the previous tables take into account the likelihood that accidents would occur. Tables S-10 and S-11 show the cancer fatality risk assuming that the accident would occur.

Table S-10. Maximum Reasonably Foreseeable Accident – Caliente

Route	*Risk of Cancer Fatality One Chance in:*	*Years Between Accidents*
Avoids Las Vegas Valley	3,333	135,000
Through Las Vegas Valley (and the All-truck Option)	625	24,000

Table S-11. Maximum Reasonable Foreseeable Accident – Yermo and Barstow

Route	*Risk of Cancer Fatality One Chance in:*	*Years Between Accidents*
Avoids Las Vegas Valley	625	166,000
Through Las Vegas Valley	625	50,000

If no intermodal transfer facilities are utilized and all shipments continue to move through the Las Vegas Valley (the All-truck and Current Route options), the likelihood of a single radiation-induced fatal cancer in the exposed population would be one chance in 625 from a maximum reasonably foreseeable accident due to the urban designation of these routes compared with the rural designation for the Caliente route that avoids the valley.

C.2 INTRODUCTION

This appendix summarizes the methods and results of analysis for determining the human health risks associated with the intermodal transport of LLW from the DOE generator sites to the NTS. The scope of the analyses summarized in this appendix includes three principal activities: (1) human health risks associated with activities at the three proposed intermodal transfer sites (Barstow, California; Caliente, Nevada; and Yermo, California), (2) human health risks associated with the truck transport of LLW from the intermodal sites to the NTS, and (3) human health risks associated with truck transport not related with intermodal sites.

Human health risks associated with transportation of LLW by rail from the DOE generator sites to Nevada have been analyzed in DOE NEPA evaluations and are not further evaluated in this report. These analyses show that risks associated with rail transport are lower than transport by truck. For example, the following table (Table C-1) from the *Waste Management Programmatic EIS* compares LLW shipments to the NTS by both rail and truck, transporting the same volume of waste over 20 years (DOE, 1997b).

Table C-1. Transportation Risks

Option	*Number Shipments*	*Number of Radiological Fatalities*		*Fatalities from Traffic Accidents*
		Public	*Crew*	
Centralized 2 (NTS) Truck	257,270	9	6	35
Centralized 2 (NTS) Rail	96,880	1	1	1

Source: DOE, 1997b.

However, the radiological results are somewhat misleading because the RADTRAN 4 computer program, which is widely used within the DOE, does not analyze the two transportation modes with equal degrees of conservatism. Further, when uncertainty in the risk estimates is taken into consideration, it is doubtful if there is any significant difference between the two modes based on radiological risk. The important points from these analyses are that the radiological risks from either transportation mode are low, and the risks of fatalities from traffic accidents strongly favor rail.

C.3 HUMAN HEALTH RISKS ASSOCIATED WITH INTERMODAL TRANSFER SITES ACTIVITIES

C.3.1 Normal Operations

During intermodal transfer operations, workers are subject to normal risks of injury or fatality present in an industrial workplace, as well as radiation risk resulting from routine radiation exposure from work in proximity to LLW shipping containers. The radiation dose received by the workers is a function of the time spent in the vicinity of and the distance from the shipping container. The dose rate for exposed individuals can be determined from the radiation dose rate near the container surface. The radionuclide content of the material and the characteristics of the container determine the dose rate.

C.3.1.1 Description of Intermodal Transfer Activities

Containers of LLW are on railcars when they arrive at the intermodal transfer site. They are removed from the railcars and placed on a chassis for subsequent transfer by truck. When they arrive on the railcars, some of the LLW containers may already be on truck trailers. When the containers arrive they are manually unlatched by personnel and then removed from the railcars by lifting equipment (crane or packer). The containers with trailers are off-loaded with their trailers. The containers without trailers are off-loaded and attached to individual trailer chassis. Individual trailers (trailers and trailer chassis) are then connected to the yard tractor and moved to a staging lot for transport by truck.

Removing the containers without trailers requires the additional step of attaching the containers to a trailer chassis. Because of this additional exposure step, off-loading the containers without trailers is the limiting scenario for occupational dose under normal circumstances. For this analysis it is conservatively assumed that all containers arrive at the intermodal transfer site without trailers.

The following are considered tasks involving occupational exposure:

- unlatching the shipping container*,
- operating the lifting equipment,
- latching the shipping container to the trailer chassis*,
- connecting the trailer chassis to the yard tractor*,
- driving the yard tractor, and
- disconnecting the trailer chassis from the yard tractor*.

C.3.1.2 Methodology

The RISKIND computer code (Yuan et al., 1995) was used to estimate radiation doses to the workers directly involved in intermodal transfer operations. Radiation doses to railway personnel were calculated at distances of 1 and 3 m (3.28 and 9.84 ft) from the shipping container, using a 1-hour exposure duration. A dose rate of 0.5 mrem per hour at 1 m from the shipping container was taken from Anderson (1997). The 1-m (3.28-ft) distance is representative of personnel latching/unlatching shipping containers and of personnel connecting and disconnecting from the yard tractor (UP, 1998). The 3-m (9.84-ft) distance is representative of equipment operators including the yard tractor driver and the lifting equipment operator (UP, 1998).

The following equation was used to calculate dose per container:

* These operations are assumed to be performed by the same yard worker and to take a combined time of 15 minutes.

$D_{CONTAINER} = D_{RISKIND} * T$

Where:
$D_{CONTAINER}$ = Container Dose (rem/container) at distance of concern
$D_{RISKIND}$ = RISKIND 1 hour dose (rem/hr) at distance of concern
T = Exposure duration per container (hrs/container)

The containers and the container transfer processes are assumed to be the same at the Barstow, Caliente, and Yermo transfer facilities. Therefore, a dose per shipping container at the various occupational exposure distances of concern was calculated for use in estimating occupational exposure, as shown in Table C-2. Health effects were estimated using risk factors recommended by the ICRP, (1991).

Table C-2. Occupational Dose per Shipping Container Transferred

Task	*Distance (meters)*	*Exposure Duration (hr/container)*	*Dose Rate (rem/hr)*	*Dose/Container (rem/container)*
Lift Equipment Operator	3	0.1	1.8e-04	1.8e-05
Yard Tractor Driver	3	0.14	1.8e-04	2.52e-5
Yard Worker	1	0.25	5.0e-04	1.25e-04
Dose per Container Occupational Dose Summary			*Person-Rem/Container*	*1.68e-04*

C.3.1.3 Results of Calculations

The detailed calculations of radiation doses and potential health effects resulting from normal operations at the proposed intermodal transfer sites are documented in Hall (1999).

Table C-3 shows the estimated collective doses and health effects to workers resulting from routine radiation exposure due to intermodal transfer operations. Total worker doses and health effects are the same for Options 1A, 1B, 1C, and 1D. The total collective dose from the entire intermodal shipment campaign is estimated to be about 4.21 person-rem. No adverse health effects would be expected in the worker population as a result of this exposure. The likelihood of a single cancer fatality in the entire worker population as a result of these doses is estimated to be 1.7×10^{-3}, or a likelihood of about 1 in 600 that a single fatal cancer would occur in the worker population as a result of this exposure.

C.3.2 Accidents

Most accidents that can be postulated to occur during intermodal transfer operations, such as dropping a shipping container during transfer, would be expected to have small radiological consequences because they do not result in the release and dispersal of large amounts of radioactive waste. The scenario expected to result in the highest consequences would be a large

Table C-3. Collective Doses and Health Effects for Workers at Intermodal Transfer Facilities Under Normal Operations

Option 1A – Barstow	
Occupational dose per container transferred (person-rem)	1.68×10^{-4}
Number of containers transferred	25,084
Cumulative occupational dose (person-rem)	4.21
Radiation-induced cancer fatalities[1]	1.7×10^{-3}
Radiation-induced detriment[2]	6.7×10^{-4}
Option 1B and 1C – Caliente	
Occupational dose per container transferred (person-rem)	1.68×10^{-4}
Number of containers transferred	
Cumulative occupational dose (person-rem)	4.21
Radiation-induced cancer fatalities[1]	1.7×10^{-3}
Radiation-induced detriment[2]	6.7×10^{-4}
Option 1D – Yermo	
Occupational dose per container transferred (person-rem)	1.68×10^{-4}
Number of containers transferred	25,084
Cumulative occupational dose (person-rem)	4.21
Radiation-induced cancer fatalities[1]	1.7×10^{-3}
Radiation-induced detriment[2]	6.7×10^{-4}
Option 2 – All-truck	
No intermodal transfer operations occur	
Option 3 – Current Route	
No intermodal transfer operations occur	

[1] A cancer occurring 20 or so years after exposure, resulting in a fatality.
[2] Other chronic health effects including nonfatal cancer, genetic damage or birth defect.
[3] NA – Not Applicable.

fire near the shipping containers that results in damage to a shipping container, release of its radioactive waste contents, and dispersal of radioactivity into the atmosphere. This section evaluates the probability and consequences of such an accident occurring at each of the proposed intermodal facilities.

C.3.2.1 Methodology

The general methodology used for the analysis of a radiological accident at the proposed intermodal facilities follows the methodology used by SAIC, (1996) for facility accidents in the NTS EIS. The Radiological Safety Analysis Computer Program, RSAC-5 (Wenzel, 1994), was used for estimating radiation doses resulting from the airborne release of radionuclides. The radiological source term (Q) for the accident scenario was developed as follows:

$$Q = MAR \times DR \times ARF \times RF$$

where: MAR = material at risk, i.e., the contents of the shipping container
DR = damage ratio, the fraction of the MAR exposed to the fire
ARF = airborne release fraction, the fraction of the material made airborne
RF = respirable fraction, the fraction of the material that is respirable, i.e., particle sizes less than 10 microns.

The MAR representative of the LLW shipped from DOE facilities was developed using the waste characterization data from the NTS EIS and assuming a shipping container volume of 27 m^3 (941 cubic feet) (DOE, 1996a). The DR was assumed to be 1.0, i.e., the entire contents of the shipping container was spilled and exposed to the fire. An ARF of 0.006 and a RF of 0.01 were used based on recommendations in the *DOE Handbook 3010-94* (DOE, 1994) for nonreactive compounds subjected to thermal stress. Table C-4 summarizes this data and provides the resulting source term used in the RSAC-5 calculations.

Atmospheric dispersion of the radiological source term was modeled assuming stable meteorological conditions which give rise to minimal dispersion. As discussed in SAIC (1996), stable meteorological conditions result in the calculation of the 95 percent value of the dispersion factors (χ/Q). That is, 5 percent of the observed dispersion factors would be larger (less conservative) than the 95 percent value, and 95 percent of the values would be less than or equal to it. For modeling a 1-hour release, the 95 percent dispersion factor is calculated using the Pasquill Category F wind stability class and wind speed of 0.5 m per second for receptors less than 2 km (1.2 mi) from the source; 2 m per second for receptors greater than 2 km (1.2 mi) distant. This approach results in a conservative upper bound on the consequences of the accident.

Exposure pathways included in this analysis were inhalation exposure from the passing plume, external exposure from the passing plume, and external exposure from ground-deposited radionuclides. The ingestion pathway was not included because of the small amount of agricultural activity in the regions of interest and because results of accident assessments for the NTS EIS showed the ingestion pathway to be an insignificant contributor to the total dose (SAIC, 1996). The respirable fraction (RF) discussed previously was applied only to the calculation of doses from the inhalation pathway.

Radiological doses were calculated for (a) an involved worker located 10 m (32.8 ft) from the accident scene; (b) a noninvolved worker located 100 m (328 ft) from the accident scene, and (c) the general population within 80 km (50 mi) of the accident. Population data for communities within 80 km (50 mi) of the intermodal transfer sites are shown in Tables C-5 through C-7 respectively. Health effects were estimated using risk factors recommended by the International Commission on Radiological Protection (ICRP, 1991).

Table C-4. Radiological Source Term for Fire Involving One LLW Shipping Container at the Proposed Intermodal Transfer Sites

Radionuclide	*MAR (Ci)*	*Damage Ratio*	*Aerosolized Fraction*	*Respirable Fraction*	*Released Curies*
Ba-137m	2.86×10^{-4}.	1.0	0.006	0.01	1.72×10^{-6}
Bi-212	1.19×10^{-6}	1.0	0.006	0.01	7.16×10^{-9}
C-14	1.48×10^{-4}	1.0	0.006	0.01	8.87×10^{-7}
Co-58	5.12×10^{-3}	1.0	0.006	0.01	3.07×10^{-5}
Co-60	5.17×10^{-3}	1.0	0.006	0.01	3.10×10^{-5}
Cs-134	5.73×10^{-3}	1.0	0.006	0.01	3.44×10^{-5}
Cs-137	7.53×10^{-3}	1.0	0.006	0.01	4.52×10^{-5}
H-3	1.00×10^{-3}	1.0	0.006	0.01	6.01×10^{-6}

Table C-4. Radiological Source Term for Fire Involving One LLW Shipping Container at the Proposed Intermodal Transfer Sites (Continued)

Radionuclide	*MAR (Ci)*	*Damage Ratio*	*Aerosolized Fraction*	*Respirable Fraction*	*Released Curies*
Mn-54	5.54×10^{-3}	1.0	0.006	0.01	3.33×10^{-5}
Pa-234m	2.95×10^{-6}	1.0	0.006	0.01	1.77×10^{-8}
Pb-212	9.95×10^{-7}	1.0	0.006	0.01	5.97×10^{-9}
Po-212	2.57×10^{-8}	1.0	0.006	0.01	1.54×10^{-10}
Po-216	3.98×10^{-10}	1.0	0.006	0.01	2.39×10^{-12}
Ra-224	9.95×10^{-8}	1.0	0.006	0.01	5.97×10^{-10}
Ra-228	5.95×10^{-8}	1.0	0.006	0.01	3.57×10^{-10}
Sr-90	1.39×10^{-4}	1.0	0.006	0.01	8.36×10^{-7}
Tc-99	1.23×10^{-4}	1.0	0.006	0.01	7.38×10^{-7}
Th-228	1.59×10^{-9}	1.0	0.006	0.01	9.55×10^{-12}
Th-231	2.87×10^{-5}	1.0	0.006	0.01	1.72×10^{-7}
Th-232	2.41×10^{-8}	1.0	0.006	0.01	1.45×10^{-10}
Th-234	1.47×10^{-2}	1.0	0.006	0.01	8.82×10^{-5}
U-235	1.14×10^{-4}	1.0	0.006	0.01	6.86×10^{-7}
U-238	1.50×10^{-1}	1.0	0.006	0.01	9.00×10^{-4}
Y-90	3.47×10^{-3}	1.0	0.006	0.01	2.08×10^{-5}

C.3.2.2 Results

The detailed calculations of radiation doses and potential health effects resulting from a large fire near the shipping containers at the proposed intermodal transfer sites are documented in Hall (1999).

Table C-5. Consequences of Fire Involving LLW Shipping Container at Caliente Site

Receptor Location	*Distance (km)*	*Population*	*Total EDE (rem)*	*Radiation Cancer Fatality*	*Radiation Detriment*
Involved worker at 10 m (32.8 ft)	0.01	1	*0.17*	7.0×10^{-5}	2.8×10^{-5}
Noninvolved worker at 100 m (328 ft)	0.1	1	*2.2×10^{-2}*	8.8×10^{-6}	3.5×10^{-6}
Cities within 80 km (50 mi) of Caliente Transfer Site[1]			*(Person-rem)*		
Caliente	1.5	1,081	4.3×10^{-2}	2.2×10^{-5}	1.0×10^{-5}
Panaca	24	1,000	6.9×10^{-4}	3.4×10^{-7}	1.6×10^{-7}
Pioche	32	1,000	4.6×10^{-4}	2.3×10^{-7}	1.1×10^{-7}
Total (Caliente and cities within 80 km [50 mi])			*4.4×10^{-2}*	*2.3×10^{-5}*	*1.0×10^{-5}*

[1] Alamo, Ash Springs, and Tonopah are within 80 km (50 mi) of Caliente but are protected from the release by intervening mountain ranges.

Table C-6. Consequences of Fire Involving LLW Shipping Container at Yermo Site

Receptor Location	*Distance (km)*	*Population*	*Total EDE (rem)*	*Radiation Cancer Fatality*	*Radiation Detriment*
Involved worker at 10 m (32.8 ft)	0.01	1	*0.17*	7.0×10^{-5}	2.8×10^{-5}
Noninvolved worker at 100 m (328 ft)	0.1	1	*2.2×10^{-2}*	8.8×10^{-6}	3.5×10^{-6}
Yermo Annex Maintenance Building	0.61	937	*1.76×10^{-1}*	8.78×10^{-5}	4.04×10^{-5}
Cities within 80 km (50 mi) of Yermo Transfer Site			*(Person-rem)*		
Yermo	3	600	8.2×10^{-3}	4.1×10^{-6}	1.9×10^{-6}
Barstow	18	22,250	2.4×10^{-2}	1.2×10^{-5}	5.5×10^{-6}
Victorville	48	59,900	1.5×10^{-2}	7.6×10^{-6}	3.5×10^{-6}
Apple Valley	43	52,800	1.6×10^{-2}	7.8×10^{-6}	3.6×10^{-6}
Hesperia	56	59,300	1.2×10^{-2}	6.0×10^{-6}	2.8×10^{-6}
Total (Yermo and cities within 80 km [50 mi])			*7.5×10^{-2}*	*3.8×10^{-5}*	*1.7×10^{-5}*

Table C-7. Consequences of Fire Involving LLW Shipping Container at Barstow Site

Receptor Location	*Distance (km)*	*Population*	*Total EDE (rem)*	*Radiation Cancer Fatality*	*Radiation Detriment*
Involved worker at 10 m (32.8 ft)	0.01	1	*0.17*	7.0×10^{-5}	2.8×10^{-5}
Noninvolved worker at 100 m (328 ft)	0.1	1	*2.2×10^{-2}*	8.8×10^{-6}	3.5×10^{-6}
Cities within 80 km (50 mi) of Caliente Transfer Site			*(Person-rem)*		
Barstow	3	22,250	3.1×10^{-1}	1.5×10^{-4}	7.0×10^{-5}
Yermo	20	600	5.4×10^{-4}	2.7×10^{-7}	1.2×10^{-7}
Victorville	52	59,900	1.4×10^{-2}	6.8×10^{-6}	3.1×10^{-6}
Apple Valley	53	52,800	1.2×10^{-2}	5.8×10^{-6}	2.7×10^{-6}
Hesperia	67	59,300	9.2×10^{-3}	4.6×10^{-6}	2.1×10^{-6}
Total (Barstow and cities within 80 km [50 mi])			*3.5×10^{-1}*	*1.7×10^{-4}*	*7.8×10^{-5}*

The postulated accident involves a fire in close proximity to a LLW shipping container. The fire ruptures the shipping container, releasing the contents and resulting in an unmitigated release to the atmosphere. One possible initiating event for such a fire would be a fuel leak in a vehicle used in the intermodal transfer operation.

The *Safety Analysis Report* for the Area 5 and Area 3 waste management areas at the NTS (REECo, 1994) describes initiating event probabilities for diesel powered equipment fires. A fuel leak in a diesel vehicle will result in a fire at a rate of 1.6×10^{-4} per year. If it is assumed that the crane or yard tractor handles a LLW shipping container one-fourth of the time, the rate of fires involving the LLW shipping containers would be estimated at 4×10^{-5} per year.

Tables C-5 through C-7 summarize the consequences of the postulated accident for the Caliente, Yermo, and Barstow sites. For an accident occurring at the Caliente facility, the maximum radiation dose to a worker was estimated to be 0.17 rem, assuming that all unprotected workers follow normal emergency actions and evacuate upwind of the fire within the first 10 minutes. It is unlikely that this worker would experience any detrimental health effects form this radiation exposure with a risk of radiation-induced cancer fatality of 7.0×10^{-5}, or one chance in 14,000. The general population within 80 km (50 mi) of the accident could receive a collective dose up to 4.5×10^{-2} person-rem. Most of this dose would be delivered to the population in Caliente, assuming unfavorable wind in the direction of Caliente. It is unlikely that any member of the public would experience any detrimental health effects from this radiation exposure with a risk of radiation-induced cancer fatality of 2.3×10^{-5}, or one chance in 43,000 of a single cancer fatality within the entire population.

For an accident occurring at the Yermo facility, risks to workers are estimated to be the same as those calculated for the Caliente facility. The general population within 80 km (50 mi) of the accident could receive a collective dose up to 7.5×10^{-2} person-rem. It is unlikely that any member of the public would experience any detrimental health effects from this radiation exposure with a risk of radiation-induced cancer fatality of 3.8×10^{-5}, or one chance in 26,000 of a single cancer fatality within the entire population.

For an accident occurring at the Barstow facility, risks to workers are estimated to be the same as those calculated for the Caliente and Yermo facilities. The general population within 80 km (50 mi) of the accident could receive a collective dose up to 0.34 person-rem. It is unlikely that any member of the public would experience any detrimental health effects from this radiation exposure with a risk of radiation-induced cancer fatality of 1.7×10^{-4}, or one chance in 6,000 of a single cancer fatality within the entire population.

C.4 HUMAN HEALTH RISKS ASSOCIATED WITH TRANSPORTATION

C.4.1 Transportation Modes and Routes

For this report, with the exception of the All-truck Option and the Current Route, all LLW shipments are assumed to be shipped from the DOE generator sites by rail. In cases where the generator site does not have direct rail access, it is assumed that the LLW is shipped by truck to the nearest rail access where the shipping containers are loaded onto railcars. For purposes of analysis, the shipping container is assumed to be a 6.1-m (20-ft) ISO-type Dry Cargo Steel Container (exterior dimensions: 6.058m x 2.438m x 2.591m). Rail routing from the DOE generator sites to the State of Nevada has been evaluated in DOE NEPA documents (DOE, 1997b), and no further analysis of rail routing is needed for this report. For the All-truck Option and the Current Route, truck routing from the DOE generator sites to the State of Nevada has also been evaluated in DOE NEPA documents (DOE, 1996a), and no further analysis of truck routing outside the State of Nevada is needed except for the portion of the All-truck Option truck route between (1) Kingman, Arizona, and the Hoover Dam; (2) Kingman, Arizona, and Barstow, California; and (3) Barstow, California, and the Nevada state line.

Rail shipments are assumed to terminate at one of three intermodal transfer facilities located at Caliente, Nevada; Yermo, California; and Barstow, California. Transfer of the shipping containers from railcar to truck is accomplished at these facilities as discussed in Section 2.2. The LLW is then shipped by truck to the NTS via primary routes designed to avoid the Las Vegas metropolitan area. For purposes of relative comparison of risks only, this analysis also evaluates secondary routes that transport the waste through Las Vegas on its way to the NTS.

The truck routes from each intermodal transfer site that are considered in this analysis are described below:

Barstow, California

Primary: North from Barstow, California, on I-15 to CA 127 and NV 373, to US 95, to the NTS.

Secondary: North from Barstow, California, on I-15 to US 95 (Las Vegas), northwest to the NTS.

Caliente, Nevada

Primary: West from Caliente, Nevada, on US 93 to NV 375, north to US 6, west to US 95, south to the NTS.

Secondary: South from Caliente, Nevada, on US 93 to I-15, southwest to US 95 (Las Vegas), northwest to the NTS.

Yermo, California

Primary: North from Yermo, California, on I-15 to CA 127 and NV 373, to US 95 to the NTS.

Secondary: North from Yermo, California, on I-15 to US 95 (Las Vegas), northwest to the NTS.

For the All-truck Option, two primary routes (avoiding Las Vegas) and three secondary routes (through Las Vegas) are evaluated.

All-truck Option

Primary-1: Starting on I-15 at the Nevada border northeast of Las Vegas (Mesquite), south to US 93, north to NV 375, west on US 6 to Tonopah, Nevada, south on US 95 to the NTS.

Primary-2: Starting at Kingman, Arizona, west on I-40 to Barstow, California, north on I-15 to CA 127 and NV 373, to US 95 to the NTS.

Secondary-1: Starting on I-15 at the Nevada border (Mesquite, Nevada), southwest to US 95 (Las Vegas), northwest to the NTS.

Secondary-2: Starting at Kingman, Arizona, northwest on US 93 over Hoover Dam, to US 95 (Las Vegas), northwest to the NTS.

Secondary-3: Starting at Barstow, California, north on I-15 to US 95 (Las Vegas), northwest to the NTS.

For the Current Route Option, existing truck shipments of LLW are assumed to use the following three routes, all of which pass through Las Vegas en route to the NTS.

Current Route Option

Kingman route: Starting at Kingman, Arizona, northwest on US 93 over Hoover Dam, to US 95 (Las Vegas), northwest to the NTS.

Barstow route: North from Barstow, California, on I-15 to US 95 (Las Vegas), northwest to the NTS.

Mesquite route: Starting on I-15 at the Nevada border (Mesquite, Nevada), southwest to US 95 (Las Vegas), northwest to the NTS.

For most of the routes, the return route used by the empty trucks is the same as the route used by the trucks carrying LLW. The exceptions are the primary route from Caliente and the Primary-1 route under the All-truck Option, for which the return routes for empty trucks are assumed to be the shorter routes through Las Vegas, described above as the Caliente Secondary and the All-truck Secondary-1 routes.

Route characteristics, such as total shipment distance, route distances within Nevada and outside Nevada, and the fractions of travel in rural, suburban, and urban population density zones, were calculated using the HIGHWAY computer code (Johnson et al., 1993). The HIGHWAY database is a computerized road atlas that currently describes approximately 386,243 km (240,000 mi) of roads. A complete description of the Interstate Highway System, U. S. highways, most of the principal state highways, and a number of local and community highways are identified in the database. The results of the HIGHWAY analysis are documented in Anderson (1999) and summarized in Tables C-8a and C-8b.

C.4.2 Shipments

The number of shipments of LLW from the DOE generator sites to the NTS is based on data provided in the NTS EIS. Option 3 of the NTS EIS estimated 25,084 truck shipments of LLW from generator sites outside Nevada over a 10-year period. The average volume of LLW to be shipped from outside Nevada over this time period was estimated to be approximately 27 m^3 (941 cubic feet) per shipment. This average volume per shipment is approximately the same as the volume of a single 6.1-m (20-ft) ISO-type Dry Cargo Steel Container. Assuming that a truck transports one cargo container per trip, the total number of truck shipments from the intermodal sites to the NTS will be 25,084.

Table C-8a. Distances (miles) from Intermodal Transfer Sites to NTS[1]

Intermodal Transfer Site	*Primary Routes*	*Secondary Routes*
Caliente, Nevada (100 percent inside Nevada)		
Rural	343.3	201.0
Suburb	0.6	8.9
Urban	0.0	6.9
Yermo, California		
INSIDE NEVADA		
Rural	46.0	93.9
Suburban	0.0	9.6
Urban	0.0	5.5
Intermodal Transfer Site	*Primary Routes*	*Secondary Routes*
OUTSIDE NEVADA		
Rural	141.0	100.0
Suburban	0.2	0.2
Urban	0.7	0.7
TOTAL		
Rural	*187.0*	*193.9*
Suburban	*0.2*	*9.8*
Urban	*0.7*	*6.2*
Barstow, California		
INSIDE NEVADA		
Rural	46.0	93.9
Suburban	0.0	9.6
Urban	0.0	5.5
OUTSIDE NEVADA		
Rural	152.0	111.0
Suburban	0.2	0.2
Urban	0.7	0.7
TOTAL		
Rural	*198.0*	*204.9*
Suburban	*0.2*	*9.8*
Urban	*0.7*	*6.2*

[1] Distances calculated using HIGHWAY computer code (Johnson et al., 1993).

Table C-8b. Distances (miles) for All-truck Option and Current Routes to NTS[1]

All-truck Option					
	Primary Routes		*Secondary Routes*		
	Primary-1	Primary-2	Secondary-1	Secondary-2	Secondary-3
INSIDE NEVADA					
Rural	444.4	46.0	130.7	73.7	93.9
Suburban	0.6	0.0	10.4	13.2	9.6
Urban	0.0	0.0	6.9	13.2	5.5
OUTSIDE NEVADA					
Rural	0.0	376.1	0.0	89.7	111.0
Suburban	0.0	10.5	0.0	4.1	0.2
Urban	0.0	1.4	0.0	0.4	0.7
TOTAL					
Rural	*444.4*	*422.1*	*130.7*	*163.4*	*204.9*
Suburban	*0.6*	*10.5*	*10.4*	*17.3*	*9.8*
Urban	*0.0*	*1.4*	*6.9*	*13.6*	*6.2*

Table C-8b. Distances (miles) for All-truck Option and Current Routes to NTS[1] (Continued)

	Current Route		
	Kingman	*Barstow*	*Mesquite*
INSIDE NEVADA			
Rural	73.7	93.9	130.7
Suburban	13.2	9.6	10.4
Urban	13.2	5.5	6.9
OUTSIDE NEVADA			
Rural	89.7	111.0	0.0
Suburban	4.1	0.2	0.0
Urban	0.4	0.7	0.0
TOTAL			
Rural	*163.4*	*204.9*	*130.7*
Suburban	*17.3*	*9.8*	*10.4*
Urban	*13.6*	*6.2*	*6.9*

[1] Distances calculated using HIGHWAY computer code (Johnson et al., 1993).
Primary-1: Primary route from northeast (Mesquite) avoiding Las Vegas.
Primary-2: Primary route from south/southeast (Kingman) avoiding Las Vegas.
Secondary-1: Secondary route from northeast (Mesquite) through Las Vegas.
Secondary-2: Secondary route from south/southeast (Kingman) through Las Vegas.
Secondary-3: Secondary route from south/southwest (Barstow) through Las Vegas.
Kingman: Current route from Kingman through Las Vegas to NTS.
Barstow: Current route from Barstow through Las Vegas to NTS.
Mesquite: Current route from Nevada border (near Mesquite) through Las Vegas to NTS.

Under Option 1A, all 25,084 truck shipments would come from Barstow. Under Options 1B and 1C, all 25,084 truck shipments would come from Caliente. Under Option 1D, all 25,084 truck shipments would come from Yermo. Under Option 3 of this report, Current Route, there are no shipments through any of the proposed intermodal facilities, but 25,084 truck shipments over 10 years enter the NTS distributed among the three routes described in Section C.3.1 as follows: Kingman route – 20,945 (83.5 percent), Barstow route – 2,458 (9.8 percent), and Mesquite route – 1,681 (6.7 percent). The distribution of shipments for the Current Route Option is based on the routes used by existing shippers of LLW to the NTS (DOE, 1998b).

Under Option 2, the All-truck Option, some shipments will enter Nevada from the northeast and others will enter from the south or southeast. The percentage of shipments entering from the northeast or south is based on the shipment routes used by recent shippers of LLW to the NTS (DOE, 1998b). For the primary routes that avoid Las Vegas, it is assumed that 1,681 truck shipments (6.7 percent) will enter Nevada from the northeast (from Mesquite, Nevada) and 23,403 truck shipments (93.3 percent) will enter Nevada from the south (from Kingman, Arizona, via Barstow, California) over a 10-year period. For the secondary routes that go through Las Vegas, it is assumed that 1,681 truck shipments (6.7 percent) will enter Nevada from the northeast (from Mesquite, Nevada), 20,945 truck shipments (83.5 percent) will enter Nevada from the southeast (from Kingman, Arizona, via Boulder Dam), and 2,458 truck shipments (9.8 percent) will enter Nevada from the southwest (from Barstow, California) over a 10-year period.

C.4.3 Incident-free Transportation Risks

This report evaluates the incident-free transportation risks from truck transportation of LLW from the proposed intermodal facilities to the NTS and transportation of LLW to the NTS by the All-truck Option and the current route. Incident-free risks associated with rail transport of LLW from DOE generator sites to the State of Nevada have been evaluated in DOE NEPA documents (DOE, 1997b), and no further analysis of cross-country rail transportation risks is needed for this report.

C.4.3.1 Methodology

Radiological dose during normal, incident-free transportation of LLW results from exposure to the external radiation field that surrounds the shipping containers. The dose is a function of the number of people exposed, their proximity to the container, their length of time of exposure, and the intensity of the radiation field surrounding the containers. Nonradiological effects are those health effects associated with the vehicle exhaust emissions. Individual and collective effects are calculated for members of the public as well as the crew (drivers) of the transport vehicle.

Collective doses for the general population were calculated using the RADTRAN 4 computer code (Neuhauser and Kanipe, 1992) and the RISKIND computer code (Yuan et al., 1995). A dose rate of 0.5 millirem per hour at 1 m (3.28 ft) from the shipping container was assumed based on data contained in the NTS EIS. The shipment is assumed to be exclusive use (i.e., the LLW will be the only commodity on the truck). Three doses are calculated for the general population; off-link, on-link, and during stops. The off-link population are persons within 800 m (2,625 ft) of the road, while the on-link population are persons sharing the road. The incident-free parameter values used in the RADTRAN 4 calculations are shown in Table C-9.

Table C-9. Incident-free Parameter Values Used in RADTRAN 4

Parameter	*Value*
Population density in rural zone	6 persons/km^2
Population density in suburban zone	719 persons/km^2
Population density in urban zone	3,861 persons/km^2
Speed in rural population zone	88.49 km/hr
Speed in suburban population zone	40.25 km/hr
Speed in urban population zone	24.16 km/hr
Package size	6.06 m
External dose rate @ 1m (3.28 ft) from package	0.5 mrem/hr
Stop time per trip[1]	0.0 hr/km
Minimum stop time per trip[1]	0.0 hr

[1]Routes evaluated in this report are short enough that there would be no stops required per standard DOT driving rules (49 CFR 395.3). For routes that cross a state line, one stop of 1-hour duration is assumed for inspection of each shipment.

Standard DOT driving rules are applied for determining stopping times. According to 49 CFR 395.3, a driver is allowed to drive for 10 hours following 8 consecutive hours off duty. The driver is not allowed to be on duty for more that 15 hours following 8 consecutive hours off duty.

On duty is defined as "all time from the time a driver begins to work or is required to be in readiness to work until the time he/she is relieved from work and all responsibility for performing work" (49 CFR 395.2). This includes driving, inspection, and fueling time. Assuming an average vehicle speed of 72.4 to 80.5 km (45 to 50 mi) per hour, the one-way trip for all of the evaluated routes can be driven in less than 10 hours, and no stops would be required. This applies to each of the routes listed above. Therefore, no stops are assumed for the All-truck and current northeast routes. However, because some routes cross a state line, one stop per shipment for inspection in Nevada is assumed for these routes. Each stop is assumed to take 1 hour and involve two people standing an average of 5 m (16.4 ft) from the shipping container for the entire hour. The dose during stops was calculated using the RISKIND computer code (Yuan et al., 1995). The persons performing the inspection are assumed to be outdoors (i.e., no shielding).

The collective dose for the crew was calculated using Equation 1 and assumes a two-person crew. A dose rate of 0.1 mrem/hr inside the cab (4.27 m [14 ft] from the shipping container) was calculated using the RISKIND computer code (Yuan et al., 1995) and assuming automobile shielding values.

$$\left[\frac{\text{Dist}_{\text{rural}}}{\text{Vel}_{\text{rural}}} + \frac{\text{Dist}_{\text{suburban}}}{\text{Vel}_{\text{suburban}}} + \frac{\text{Dist}_{\text{urban}}}{\text{Vel}_{\text{urban}}} \right] * 0.1\ \text{mrem/hr} \qquad (1)$$

Shipment risk factors were developed by Anderson (1999) based on travel within rural, suburban, and urban population zones and the routing information derived from the HIGHWAY computer code. Table C-10a and C-10b contain the shipment risk factors for the routes evaluated in this report.

For the Yermo site, the intermodal transfer facility is located at the MCLB. However, railcars entering the MCLB are first routed through the rail yards at Barstow and Yermo. Stop time at the Barstow Yard can vary from hours up to 2 days depending on rail traffic at the yard and the availability of crews. Therefore, the incident-free shipment risk factors for the Yermo site include the impacts of railcar transfers and stop time in the Barstow and Yermo rail yards.

The typical case for rail cars destined for the Yermo site involves an average stop time of 16 hours within 152.4 m (500 ft) of residential housing. The rail car is then moved from the Barstow Yard to the Yermo Yard where stop time is typically short, about 1 hour, and about 152.4 m (500 ft) from residential housing. The rail car is then moved to the MCLB where the time to transfer the shipping container from rail car to truck is typically short, about one hour. There is no residential housing near the MCLB, but there is a worker population of 937 workers approximately 609.6 m (2,000 ft) from the storage track.

Maximum individual radiological doses for routine truck transport were estimated for the crew, as well as members of the general population. Doses for the maximally exposed member of the general population were calculated using the RISKIND computer code (Yuan et al., 1995).

Table C-10a. Incident-free Shipment Risk Factors for Truck Shipments of LLW from Intermodal Transfer Sites to the NTS

Route	*Exposure group*	*Shipment risk factor (person-rem/shipment)*		
		Within Nevada	*Outside Nevada*	*Total*
Caliente 1	Collective public	3.01×10^{-4}	0.00	3.01×10^{-4}
	Collective worker	1.25×10^{-3}	0.00	1.25×10^{-3}
Caliente 2	Collective public	3.90×10^{-4}	0.00	3.90×10^{-4}
	Collective worker	8.93×10^{-4}	0.00	8.93×10^{-4}
Yermo 1	Collective public	2.06×10^{-4}	3.17×10^{-4}	5.23×10^{-4}
	Collective worker	1.67×10^{-4}	5.67×10^{-4}	7.34×10^{-4}
Yermo 2	Collective public	4.42×10^{-4}	2.81×10^{-4}	7.23×10^{-4}
	Collective worker	4.91×10^{-4}	4.18×10^{-4}	9.09×10^{-4}
Barstow 1	Collective public	2.06×10^{-4}	1.46×10^{-4}	3.52×10^{-4}
	Collective worker	1.67×10^{-4}	5.63×10^{-4}	7.30×10^{-4}
Barstow 2	Collective public	4.42×10^{-4}	1.10×10^{-4}	5.43×10^{-4}
	Collective worker	4.92×10^{-4}	4.15×10^{-4}	9.07×10^{-4}

Caliente 1: primary route avoiding Las Vegas; Caliente 2: secondary route through Las Vegas; Yermo 1: primary route avoiding Las Vegas; Yermo 2: secondary route through Las Vegas; Barstow 1: primary route avoiding Las Vegas; Barstow 2: secondary route through Las Vegas.

Table C-10b. Incident-free Shipment Risk Factors for Truck Shipments of LLW for the All-truck Option and Current Routes to the NTS

Route	*Exposure group*	*Shipment risk factor (person-rem/shipment)*		
		All-truck Option		
		Within Nevada	*Outside Nevada*	*Total*
Primary 1	Collective public	3.88×10^{-4}	0.00	3.88×10^{-4}
	Collective worker	1.62×10^{-3}	0.00	1.62×10^{-3}
Primary 2	Collective public	2.06×10^{-4}	6.15×10^{-4}	8.21×10^{-4}
	Collective worker	1.67×10^{-4}	1.47×10^{-3}	1.64×10^{-3}
Secondary 1	Collective public	3.43×10^{-4}	0.0	3.43×10^{-4}
	Collective worker	6.50×10^{-4}	0.0	6.50×10^{-4}
Secondary 2	Collective public	6.09×10^{-4}	1.23×10^{-4}	7.32×10^{-4}
	Collective worker	5.49×10^{-4}	3.63×10^{-4}	9.12×10^{-4}
Secondary 3	Collective public	4.42×10^{-4}	1.10×10^{-4}	5.52×10^{-4}
	Collective worker	4.92×10^{-4}	4.15×10^{-4}	9.07×10^{-4}
		Current Route		
Kingman	Collective public	6.09×10^{-4}	1.23×10^{-4}	7.32×10^{-4}
	Collective worker	5.49×10^{-4}	3.63×10^{-4}	9.12×10^{-4}
Barstow	Collective public	4.42×10^{-4}	1.10×10^{-4}	5.52×10^{-4}
	Collective worker	4.92×10^{-4}	4.15×10^{-4}	9.07×10^{-4}
Mesquite	Collective public	3.43×10^{-4}	0.0	3.43×10^{-4}
	Collective worker	6.50×10^{-4}	0.0	6.50×10^{-4}

Primary 1: primary route from northeast (Mesquite) avoiding Las Vegas; Primary 2: primary route from south/southeast (Kingman) avoiding Las Vegas; Secondary 1: secondary route from northeast (Mesquite) through Las Vegas; Secondary 2: secondary route from south/southeast (Kingman) through Las Vegas; Secondary 3: secondary route from south/southwest (Barstow) through Las Vegas; Kingman: Current route from Kingman through Las Vegas to NTS; Barstow: Current route from Barstow through Las Vegas to NTS; Mesquite: Current route from Nevada border (near Mesquite) through Las Vegas to NTS.

Three scenarios for members of the general population were analyzed: (a) a person caught in traffic and located 1 m (3.28 ft) away from the surface of the shipping container for one-half hour, (b) a resident living 10.7 m (35 feet) away from the highway used to transport the shipping container, and (c) a service station worker working at a distance of 20 m (65.6 ft) from the shipping container for 2 hours. The doses for scenarios (a) and (c) are single events and are based on a dose rate of 0.5 mrem/hr at a distance of 1 m (3.28 ft) from the shipping container. For scenario (b), the hypothetical maximum exposed individual radiological dose was accumulated over the 10-year period that shipments are expected to occur.

Radiological effects for the maximally exposed worker are calculated using a dose rate of 0.1 mrem/hr inside the cab (4.27 m [14 ft] from the shipping container). The maximum exposed transportation worker is a driver who was assumed to drive shipments on the roundtrip route for up to 2,000 hours per year for the entire 10 years that shipments are made. Radiation exposure to the driver occurs only half of this time (1,000 hrs/yr) since the truck is empty on the return trip from the NTS.

The incident-free nonradiological effects were estimated using a unit risk factor (URF). The URF provides an estimate of the fatalities caused by vehicle exhaust emissions from transporting one shipment over a unit distance of travel and has units of fatalities per kilometer. The URF is combined with routing information and the total number of shipments to determine the fatalities for the total number of shipments between a given origin and destination. It should be noted that the distances used to estimate these effects must be doubled to reflect round trip distance because nonradiological effects occur whether or not the shipment contains radioactive material. The URF from EPA (1993), 7.20×10^{-11} fatalities per km, was used. This URF is applicable in all population zones (i.e., rural, suburban, and urban). The total incident-free nonradiological effects were calculated using Equation 2.

$$\textit{Total incident-free nonradiological effects} = \textit{URF} \times \textit{Number of Shipments} \times \textit{Total Distance per Shipment} \times 2 \qquad (2)$$

C.4.3.2 Results of Incident-free Transportation Risks Analysis

The detailed calculations of effects resulting from incident-free transportation are documented in Anderson (1999). The results of these calculations are summarized by option in the following sections.

<u>Option 1A – Barstow</u>

Under Option 1A, over the 10-year shipment campaign, 25,084 truck shipments are estimated to occur between Barstow and the NTS. Table C-11 shows that the primary route, which avoids the Las Vegas area, results in 36 percent lower risk of radiation-induced cancer fatalities to the general population compared with the secondary route which passes through Las Vegas. Under his option, the primary route benefits from both shorter mileage and less mileage in high population zones. The risk of nonradiological fatalities from vehicle exhaust emissions is about 8 percent lower for the primary route compared to the secondary route because of the lower route mileage.

Table C-11. Incident-free Transportation Effects for Option 1A – Barstow

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
General Population						
Maximum individual dose (rem)[1]	--	--	*3.5×10^{-4}*	--	--	*3.5×10^{-4}*
Collective dose (person-rem)	5.17	3.66	*8.83*	11.1	2.76	*13.86*
Radiation-induced cancer fatalities	2.6×10^{-3}	1.8×10^{-3}	*4.4×10^{-3}*	5.5×10^{-3}	1.4×10^{-3}	*6.9×10^{-3}*
Radiation-induced detriment	1.2×10^{-3}	8.4×10^{-4}	*2.0×10^{-3}*	2.6×10^{-3}	6.4×10^{-4}	*3.2×10^{-3}*
Nonradiological fatalities	2.7×10^{-4}	8.9×10^{-4}	*1.2×10^{-3}*	6.4×10^{-4}	6.5×10^{-4}	*1.3×10^{-3}*
Workers						
Maximum individual dose (rem)[2]	--	--	*1.00*	--	--	*1.00*
Collective dose (person-rem)	4.19	14.10	*18.29*	12.30	10.40	*22.70*
Radiation-induced cancer fatalities	1.7×10^{-3}	5.7×10^{-3}	*7.4×10^{-3}*	4.9×10^{-3}	4.2×10^{-3}	*9.1×10^{-3}*
Radiation-induced detriment	6.7×10^{-4}	2.3×10^{-3}	*3.0×10^{-3}*	2.0×10^{-3}	1.7×10^{-3}	*3.7×10^{-3}*

1. Resident living 10.7 m (35 ft) away from highway used to transport the shipping container.
2. Driver exposed to dose rate of 0.1 mrem/hour, 1,000 hours per year for 10 years.

Table C-11 shows that the incident-free risks of transporting LLW between the Barstow intermodal facility and the NTS are small for both the primary and secondary routes. For the general population, the primary route results in a total risk of radiation-induced cancer fatality of 4.4×10^{-3}, or about one chance in 230 of a single fatal cancer in the general population as a result of the entire shipment campaign over a 10-year period. The risk of nonradiological fatality from vehicle exhaust emissions is 1.2×10^{-3}, or about one chance in 800 of a single fatality in the general population.

The risk to workers driving the truck shipments is directly related to travel time with the shipment, so the shorter primary route results in a 19 percent lower risk of radiation-induced cancer fatalities compared with the secondary route. Fatal cancer risk to workers driving the primary route was estimated to be 7.4×10^{-3}, or about one chance in 135 of a single fatal cancer in the worker population as a result of the entire shipment campaign over 10 years.

<u>Options 1B and 1C – Caliente</u>

Under Options 1B and 1C, intermodal transfer operations occur at Caliente, Nevada. Over the 10-year shipment campaign, 25,084 truck shipments are estimated to occur between Caliente and the NTS. Table C-12 shows that the primary route, which avoids the Las Vegas area, results in 22 percent lower risk of radiation-induced cancer fatalities to the general population compared with the secondary route which passes through Las Vegas. The affect of the longer route distance associated with the primary route, which would tend to increase the risk, is offset by the primary route passing through fewer high population density zones compared to the secondary route. The risk of nonradiological fatalities from vehicle exhaust emissions is about 23 percent higher for the primary route compared to the secondary route because of the significantly higher route mileage.

Table C-12. Incident-free Transportation Effects for Options 1B and 1C – Caliente

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
General Population						
Maximum individual dose (rem)[1]	--	--	*3.5 x 10⁻⁴*	--	--	*3.5 x 10⁻⁴*
Collective dose (person-rem)	7.55	0.0	*7.55*	9.78	0.0	*9.78*
Radiation-induced cancer fatalities	3.8×10^{-3}	0.0	*3.8×10^{-3}*	4.9×10^{-3}	0.0	*4.9×10^{-3}*
Radiation-induced detriment	1.7×10^{-3}	0.0	*1.7×10^{-3}*	2.3×10^{-3}	0.0	*2.3×10^{-3}*
Nonradiological fatalities	1.6×10^{-3}	0.0	*1.6×10^{-3}*	1.3×10^{-3}	0.0	*1.3×10^{-3}*
Workers						
Maximum individual dose (rem)[2]	--	--	*1.0*	--	--	*1.0*
Collective dose (person-rem)	31.4	0.0	*31.4*	22.4	0.0	*22.4*
Radiation-induced cancer fatalities	1.3×10^{-2}	0.0	*1.3×10^{-2}*	9.0×10^{-3}	0.0	*9.0×10^{-3}*
Radiation-induced detriment	5.0×10^{-3}	0.0	5.0×10^{-3}	3.6×10^{-3}	0.0	*3.6×10^{-3}*

1. Resident living 10.7 m (35 ft) away from highway used to transport the shipping container.
2. Driver exposed to dose rate of 0.1 mrem/hour, 1,000 hours per year for 10 years.

Table C-12 shows that the incident-free risks of transporting LLW between the Caliente intermodal facility and the NTS are small for both the primary and secondary routes. For the general population, the primary route results in a total risk of radiation-induced cancer fatality of 3.8×10^{-3}, or about one chance in 250 of a single fatal cancer in the general population as a result of the entire shipment campaign over a 10-year period. The risk of nonradiological fatality from vehicle exhaust emissions is 1.6×10^{-3}, or about one chance in 600 of a single fatality in the general population.

The risk to workers driving the truck shipments is directly related to travel time with the shipment, so the longer primary route results in a 44 percent higher risk of radiation-induced cancer fatalities compared with the secondary route. Nevertheless, the risks are still low at 1.3×10^{-2}, or about one chance in 80 of a single fatal cancer in the worker population as a result of the entire shipment campaign over 10 years.

Option 1D – Yermo

Under Option 1D, intermodal transfer operations occur at Yermo, California. Over the 10-year shipment campaign, 25,084 truck shipments are estimated to occur between Yermo and the NTS. Table C-13 shows that the primary route, which avoids the Las Vegas area, results in 27 percent lower risk of radiation-induced cancer fatalities to the general population compared with the secondary route which passes through Las Vegas. Under this option, the primary route benefits from both shorter mileage and less mileage in high population zones. The risk of non-radiological fatalities from vehicle exhaust emissions is about 8 percent lower for the primary route compared to the secondary route because of the lower route mileage.

Table C-13. Incident-free Transportation Effects for Option 1D – Yermo

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
General Population						
Maximum individual dose (rem)[1]	--	--	*3.5 x 10⁻⁴*	--	--	*3.5 x 10⁻⁴*
Collective dose (person-rem)	5.17	7.95	*13.12*	11.1	7.05	*18.2*
Radiation-induced cancer fatalities	2.6×10^{-3}	4.0×10^{-3}	*6.6×10^{-3}*	5.5×10^{-3}	3.5×10^{-3}	*9.0×10^{-3}*
Radiation-induced detriment	1.2×10^{-3}	1.8×10^{-3}	*3.0×10^{-3}*	2.6×10^{-3}	1.6×10^{-3}	*4.2×10^{-3}*
Nonradiological fatalities	2.7×10^{-4}	8.3×10^{-4}	*1.1×10^{-3}*	6.4×10^{-4}	5.9×10^{-4}	*1.2×10^{-3}*
Workers						
Maximum individual dose (rem)[2]	--	--	*1.0*	--	--	*1.0*
Collective dose (person-rem)	4.19	14.2	*18.4*	12.3	10.5	*22.8*
Radiation-induced cancer fatalities	1.7×10^{-3}	5.7×10^{-3}	*7.4×10^{-3}*	4.9×10^{-3}	4.2×10^{-3}	*9.1×10^{-3}*
Radiation-induced detriment	6.7×10^{-4}	2.3×10^{-3}	*3.0×10^{-3}*	2.0×10^{-3}	1.7×10^{-3}	*3.7×10^{-3}*

1. Resident living 10.7 m (35 ft) away from highway used to transport the shipping container.
2. Driver exposed to dose rate of 0.1 mrem/hour, 1,000 hours per year for 10 years.

Table C-13 shows that the incident-free risks of transporting LLW between the Yermo intermodal facility and the NTS are small for both primary and secondary routes. For the general population, the primary route results in a total risk of radiation-induced cancer fatality of 6.6×10^{-3}, or about one chance in 150 of a single fatal cancer in the general population as a result of the entire shipment campaign over a 10-year period. The risk of non-radiological fatality from vehicle exhaust emissions is 1.1×10^{-3}, or about one chance in 900 of a single fatality in the general population.

The risk to workers driving the truck shipments is directly related to travel time with the shipment, so the shorter primary route results in a 19 percent lower risk of radiation-induced cancer fatalities compared with the secondary route. Fatal cancer risk to workers driving the primary route was estimated to be 7.4×10^{-3}, or about one chance in 135 of a single fatal cancer in the worker population as a result of the entire shipment campaign over 10 years.

<u>Option 2 – All-truck</u>

Under Option 2 – All-truck, intermodal transfer operations do not occur. All LLW is assumed to be shipped from the DOE generator sites by truck and enter the State of Nevada either northeast of Las Vegas on I-15 or from the south. Over the 10 years that shipments are projected to occur for the primary routes that avoid Las Vegas, an estimated 1,681 truck shipments would enter Nevada on I-15 northeast of Las Vegas, and 23,403 truck shipments would enter the state from the south. For the secondary routes that go through Las Vegas, an estimated 1,681 truck shipments (6.7 percent) would enter Nevada on I-15 northeast of Las Vegas, 20,945 truck shipments (83.5 percent) would enter Nevada from the southeast (from Kingman, Arizona, via Boulder Dam), and 2,458 truck shipments (9.8 percent) would enter Nevada on I-15 south of Las Vegas.

Table C-14 shows that the primary routes, which avoid the Las Vegas area, result in 15 percent higher risk of radiation-induced cancer fatalities to the general population compared with the secondary routes which pass through Las Vegas. This is a result of the significantly longer route distances for the primary routes, particularly the portions of the routes outside the State of Nevada. By comparing the effects for the "within Nevada" portions of the routes, it can be seen that the primary routes result in less than half the cancer fatality risk of the secondary routes by avoiding the high-population Las Vegas area. However, the portion of the routes "outside Nevada" that have been analyzed for this report result in a cancer fatality risk for the primary routes that is about 5 times greater than the risk for the secondary routes. This tends to bias the overall results in favor of the secondary routes. The routes "outside Nevada" originate at the DOE generator sites, and the transportation risks for these entire routes have been analyzed in DOE NEPA documentation. The risk of non-radiological fatalities from vehicle exhaust emissions is about 2.3 times higher for the primary routes because the unit risk factor recommended by the EPA (1993) is a function of total route mileage.

Table C-14. Incident-free Transportation Effects for Option 2 – All-truck

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
General Population						
Maximum individual dose (rem)[1]	--	--	*3.5×10^{-4}*	--	--	*3.5×10^{-4}*
Collective dose (person-rem)	5.47	14.40	*19.87*	14.4	2.85	*17.25*
Radiation-induced cancer fatalities	2.7×10^{-3}	7.2×10^{-3}	*9.9×10^{-3}*	7.2×10^{-3}	1.4×10^{-3}	*8.6×10^{-3}*
Radiation-induced detriment	1.3×10^{-3}	3.3×10^{-3}	*4.6×10^{-3}*	3.3×10^{-3}	6.6×10^{-4}	*4.0×10^{-3}*
Nonradiological fatalities	4.2×10^{-4}	2.1×10^{-3}	*2.5×10^{-3}*	6.1×10^{-4}	5.2×10^{-4}	*1.1×10^{-3}*
Workers						
Maximum individual dose (rem)[2]	--	--	*1.0*	--	--	*1.0*
Collective dose (person-rem)	6.63	34.4	*41.0*	13.8	8.62	*22.4*
Radiation-induced cancer fatalities	2.7×10^{-3}	1.4×10^{-2}	*1.7×10^{-2}*	5.5×10^{-3}	3.5×10^{-3}	*9.0×10^{-3}*
Radiation-induced detriment	1.1×10^{-3}	5.5×10^{-3}	*6.6×10^{-3}*	2.2×10^{-3}	1.4×10^{-3}	*3.6×10^{-3}*

[1] Resident living 10.7 m (35 ft) away from highway used to transport the shipping container.
[2] Driver exposed to dose rate of 0.1 mrem/hour, 1,000 hours per year for 10 years.

Table C-14 shows that the incident-free risks of transporting LLW by the All-truck Option are small for both the primary and secondary routes. For the general population, the primary routes result in a total risk of radiation-induced cancer fatality of 9.9×10^{-3}, or about one chance in 100 of a single fatal cancer in the general population as a result of the entire shipment campaign over a 10-year period. The risk of non-radiological fatality from vehicle exhaust emissions is 2.5×10^{-3}, or about one chance in 400 of a single fatality in the general population.

The risk to workers driving the truck shipments is directly related to travel time with the shipment, so the longer primary routes result in a 1.9 times higher risk of radiation-induced cancer fatalities compared with the secondary routes. Nevertheless, the risks are still low at 1.7×10^{-2}, or about one chance in 60 of a single fatal cancer in the worker population as a result of the entire shipment campaign over 10 years.

Option 3 – Current Route

Under Option 3, no intermodal transfer facilities are utilized, and LLW shipments would be trucked the entire distance between the DOE generator facilities and the NTS. A total 25,084 LLW shipments would be made over 10 years. The incident-free risks associated with these shipments are summarized in Table C-15.

Table C-15. Incident-free Transportation Effects for Option 3 – Current Route

	Within Nevada	*Outside Nevada*	*Total*
	General Population		
Maximum individual dose (rem)[1]			3.5×10^{-4}
Collective dose (person-rem)	14.4	2.85	17.25
Radiation-induced cancer fatalities	7.2×10^{-3}	1.4×10^{-3}	8.6×10^{-3}
Radiation-induced detriment	3.3×10^{-3}	6.6×10^{-4}	4.0×10^{-3}
Nonradiological fatalities	6.1×10^{-4}	5.2×10^{-4}	1.1×10^{-3}
	Workers		
Maximum individual dose (rem)[2]			1.0
Collective dose (person-rem)	13.8	8.62	22.4
Radiation-induced cancer fatalities	5.5×10^{-3}	3.5×10^{-3}	9.0×10^{-3}
Radiation-induced detriment	2.2×10^{-3}	1.4×10^{-3}	3.6×10^{-3}

1. Resident living 10.7 m (35 ft) away from highway used to transport the shipping container.
2. Driver exposed to dose rate of 0.1 mrem/hour, 1,000 hours per year for 10 years.

Table C-15 shows that for the general population, the current routes result in a total risk of radiation-induced cancer fatality of 8.6×10^{-3}, or about one chance in 115 of a single fatal cancer in the general population as a result of the entire shipment campaign over a 10-year period. The risk of nonradiological fatality from vehicle exhaust emissions is 1.1×10^{-3}, or about one chance in 900 of a single fatality in the general population.

The fatal cancer risk to workers driving the truck shipments is 9.0×10^{-3}, or about one chance in 110 of a single fatal cancer in the worker population as a result of the entire shipment campaign over 10 years.

C.4.4 Transportation Accident Risks

This report evaluates transportation accident risks from the truck transportation of LLW from the proposed intermodal facilities to the NTS and transportation of LLW to the NTS by the All-truck and Current Route options. Accident risks associated with rail transport of LLW from DOE generator sites to the State of Nevada have been evaluated in DOE NEPA documents (DOE, 1997b), and no further analysis of rail transportation risks is needed for this report.

C.4.4.1 Methodology

The risks associated with transportation accidents can be either vehicle-related or cargo-related. Vehicle-related risks are direct effects of the accident, i.e., injuries and fatalities, and are independent of the type of cargo. Cargo-related risks are associated with accident scenarios that release all, or a portion, of the cargo, resulting in exposure of people to radioactive material and potential health effects (e.g., cancer) that have been associated with human exposure to low-level radiation. This report uses route-specific accident, injury, and fatality rates developed from state statistical data for the years 1995 through 1998 (Enyeart and Anderson, 1999).

The cargo-related accident risk assessment was performed in two parts. First, an accident risk analysis was performed using methodology developed by the NRC for calculating the probabilities and consequences from a spectrum of unlikely accidents. Because it is not possible to predict where along a transport route such accidents might occur, the accident risk analysis uses route-specific data on population densities to develop accident risk factors for three population density zones: rural, suburban, and urban. Radiation doses for these three population zones were weighted by the accident probabilities using the RADTRAN 4 computer code (Neuhauser and Kanipe, 1992) to yield dose risk. Dose risk is a probabilistic term that sums the product of probability and consequences over the entire spectrum of reasonably foreseeable accidents.

The second part of the accident risk assessment analyzes the maximum reasonably foreseeable effects to individuals and populations if an accident actually occurred. This analysis differs from the accident risk analysis in that it focuses attention on a single severe accident, as opposed to a spectrum of accidents and severity types. The probability and consequences of the maximum reasonably foreseeable accident are presented separately, rather than presenting a "risk" value calculated from the product of the two. The maximum reasonably foreseeable accident is defined as the accident of highest consequences having a probability of occurrence greater than or equal to 1×10^{-7} per year. Radiological consequences were calculated for the maximum exposed individual and collective populations in each population zone using the RISKIND computer code (Yuan et al., 1995).

Accident severity categories for all potential radioactive material transportation accidents are described in NUREG-0170 (NRC, 1977). Severity is a function of the magnitude of the mechanical forces (effect) and thermal forces (fire) to which a shipping container may be subjected during an accident. The accident severity scheme takes into account all reasonably foreseeable transportation accidents. Transportation accidents are grouped into eight accident severity categories, ranging from high-probability events with low consequences to low-probability events with high consequences. Each accident severity category is assigned a conditional probability, which is the probability, given that an accident occurs, that the accident will be of the indicated severity. Table C-16 summarizes the accident severity fractions used as input for the RADTRAN 4 calculations.

Radioactive material releases from transportation accidents were calculated by assigning release fractions (the fraction of the radioactivity in the shipment that could be released in a given severity of accident) to each accident severity category. Release fractions for LLW were derived from NUREG-0170 and *DOE Handbook 3010-94* (DOE, 1994). Table C-17 summarizes the release fractions used as input for the RADTRAN 4 calculations.

Table C-16. Accident Severity Fractions for Input to RADTRAN 4

Accident Severity Category	*Fractional Occurrence*[1]	*Fractional Occurrence According to Population Density Zones*[1]			*Fraction of Accidents as a Function of Population Density Zone and Accident Severity Category*		
		Low	*Medium*	*High*	*Rural*	*Suburban*	*Urban*
1	0.55	0.1	0.1	0.8	5.50×10^{-2}	5.50×10^{-2}	4.40×10^{-1}
2	0.36	0.1	0.1	0.8	3.60×10^{-2}	3.60×10^{-2}	2.88×10^{-1}
3	0.07	0.3	0.4	0.3	2.10×10^{-2}	2.80×10^{-2}	2.10×10^{-2}
4	0.016	0.3	0.4	0.3	4.80×10^{-3}	6.40×10^{-3}	4.80×10^{-3}
5	0.0028	0.5	0.3	0.2	1.40×10^{-3}	8.40×10^{-4}	5.60×10^{-4}
6	0.0011	0.7	0.2	0.1	7.70×10^{-4}	2.20×10^{-4}	1.10×10^{-4}
7	8.5×10^{-5}	0.8	0.1	0.1	6.80×10^{-5}	8.50×10^{-6}	8.50×10^{-6}
8	1.5×10^{-5}	0.9	0.05	0.05	1.35×10^{-5}	7.50×10^{-7}	7.50×10^{-7}

1. Data for truck accidents (NRC, 1977).

Table C-17. Radioactive Material Release Fractions for Input to RADTRAN 4

Accident Severity Category	*Type A Container Release Fraction*[1]	*Aerosolized Fraction*[2]	*Release Fraction as a Function of Severity Category*
1	0	0	0
2	0.01	0.006	6×10^{-5}
3	0.1	0.006	6×10^{-4}
4	1	0.006	0.006
5	1	0.006	0.006
6	1	0.006	0.006
7	1	0.006	0.006
8	1	0.006	0.006

1. Data for truck accidents (NRC, 1977).
2. Data from DOE-HDBK-3010-94 (DOE, 1994).

Radioactive material released to the atmosphere is transported by wind. The amount of dispersion, or dilution, of the radioactive material concentrations in the air depends on the meteorological conditions at the time of the accident. Neutral meteorological conditions are the most frequently occurring atmospheric stability conditions in the United States and, therefore, are most likely to be present in the event of a radioactive waste shipment accident. For the accident risk analysis, neutral weather conditions (Pasquill Stability Class D) were assumed. For the maximum reasonably foreseeable accident analysis, doses were assessed under both neutral (Class D) and stable (Class F) conditions, representing the most likely weather and a worst-case weather situation, respectively.

Radiological doses were calculated for an individual near the scene of the accident and for populations within 80 km (50 mi) of the accident. Dose calculations considered a variety of exposure pathways, including inhalation and direct exposure (cloudshine) from the passing cloud, direct exposure (groundshine) from radioactivity deposited on the ground, and inhalation of resuspended radioactive particles from the ground. Human health effects that could result from the radiation doses were estimated using risk factors recommended by the ICRP (1991). Radiation health effects are presented in terms of radiation-induced cancer fatalities and radiation-induced detriment, consistent with the usage of these terms in the NTS EIS (DOE, 1996a).

Tables C-17a and C-17b contain the transportation accident shipment risk factors calculated by RADTRAN 4 for the routes evaluated in this report (Santee, 1999).

Table C-17a. Transportation Accident Shipment Risk Factors for Truck Shipments of LLW from Intermodal Transfer Sites to the NTS

Route	*Exposure Group*	*Accident Risk Factor (person-rem/shipment)*		
		Within Nevada	*Outside Nevada*	*Total*
Caliente 1	Collective public	1.2×10^{-10}	0.0	1.2×10^{-10}
Caliente 2	Collective public	3.4×10^{-8}	0.0	3.4×10^{-8}
Yermo 1	Collective public	1.1×10^{-11}	1.6×10^{-9}	1.6×10^{-9}
Yermo 2	Collective public	2.8×10^{-8}	1.5×10^{-9}	3.0×10^{-8}
Barstow 1	Collective public	1.1×10^{-11}	1.4×10^{-9}	1.4×10^{-9}
Barstow 2	Collective public	2.8×10^{-8}	1.4×10^{-9}	2.9×10^{-8}

Caliente 1: primary route avoiding Las Vegas; Caliente 2: secondary route through Las Vegas; Yermo 1: primary route avoiding Las Vegas; Yermo 2: secondary route through Las Vegas; Barstow 1: primary route avoiding Las Vegas; Barstow 2: secondary route through Las Vegas.

Table C-17b. Transportation Accident Shipment Risk Factors for Truck Shipments of LLW for the All-truck Option and Current Routes to the NTS

Route	*Exposure Group*	*Accident Risk Factor (person-rem/shipment)*		
		Within Nevada	*Outside Nevada*	*Total*
All-Truck Option				
Primary 1	Collective public	5.4×10^{-10}	0.0	5.4×10^{-10}
Primary 2	Collective public	1.1×10^{-11}	4.7×10^{-9}	4.7×10^{-9}
Secondary 1	Collective public	2.6×10^{-8}	0.0	2.6×10^{-8}
Secondary 2	Collective public	5.4×10^{-8}	2.4×10^{-9}	5.6×10^{-8}
Secondary 3	Collective public	2.8×10^{-8}	1.4×10^{-9}	2.9×10^{-8}
Current Route Option				
Kingman	Collective public	5.4×10^{-8}	2.4×10^{-9}	5.6×10^{-8}
Barstow	Collective public	2.8×10^{-8}	1.4×10^{-9}	2.9×10^{-8}
Mesquite	Collective public	2.6×10^{-8}	0.0	2.6×10^{-8}

Primary 1: primary route from northeast (Mesquite) avoiding Las Vegas; Primary 2: primary route from south/southeast (Kingman) avoiding Las Vegas; Secondary 1: secondary route from northeast (Mesquite) through Las Vegas; Secondary 2: secondary route from south/southeast (Kingman) through Las Vegas; Secondary 3: secondary route from south/southwest (Barstow) through Las Vegas; Kingman: Current route from Kingman, through Las Vegas to NTS; Barstow: Current route from Barstow through Las Vegas to NTS; Mesquite: Current route from Nevada border (near Mesquite) through Las Vegas to NTS.

C.4.4.2 LLW Characterization and Release Characteristics

For the NTS EIS, radionuclide distributions were developed for the LLW from each of the DOE generator sites. This data was reviewed for purposes of this report, and a representative radionuclide distribution was selected and applied to all shipments from outside the State of Nevada. The radionuclide distribution for a single shipping container is based on a shipment volume of 27 m^3 (941 cubic feet) and is shown in Table C-4.

For transportation accidents, radiological release characteristics are a function of the accident severity category and the physical/chemical properties of the material. Data from NUREG-0170 (NRC, 1977) were used to estimate the amount of material released from the shipping container for eight accident severity categories. Based on recommendations in *DOE Handbook 3010-94* (DOE, 1994) for nonreactive compounds subjected to thermal stress, the fraction of material released from the container that becomes airborne was estimated to be 0.006. Table C-18 summarizes the radiological release characteristics used in the transportation accident risk analysis.

Table C-18. Radiological Release Characteristics for Transportation Accident Risk Analysis

Accident Severity Category	*Container Release Fraction*[1]	*Aerolized Fraction*[2]	*Total Airborne Release Fraction*
1	0.0	0.0	*0.0*
2	0.01	0.006	*6.0 x 10^{-5}*
3	0.1	0.006	*6.0 x 10^{-4}*
4	1.0	0.006	*0.006*
5	1.0	0.006	*0.006*
6	1.0	0.006	*0.006*
7	1.0	0.006	*0.006*
8	1.0	0.006	*0.006*

1. Source: NCR, 1977.
2. Source: DOE, 1994.

C.4.4.3 Results of Transportation Accident Risk Analysis

The detailed calculations of effects resulting from transportation accidents are documented in Santee (1999). The results of these calculations are summarized by option in the following sections.

Option 1A – Barstow

Table C-19 shows the results of the accident risk analysis for Option 1A – Barstow. The primary route is shorter than the secondary route, so vehicle-related fatality risk for the primary route is 25 percent lower than the secondary route. Because the primary route also has less mileage in high population zones, the radiation-induced risk of cancer fatality is about 22 times lower than that for the secondary route, which is longer and passes through more high population zones.

Table C-19. Transportation Accident Risks for Option 1A – Barstow

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
Vehicle-related injuries	1.67	3.28	*4.96*	4.16	2.73	*6.88*
Vehicle-related fatalities	0.06	0.18	*0.24*	0.14	0.18	*0.32*
Collective dose (person-rem)	2.8×10^{-7}	3.5×10^{-5}	3.5×10^{-5}	7.1×10^{-4}	3.5×10^{-5}	7.5×10^{-4}
Radiation-induced cancer fatalities	1.4×10^{-10}	1.7×10^{-8}	1.7×10^{-8}	3.6×10^{-7}	1.8×10^{-8}	3.8×10^{-7}
Radiation-induced detriment	6.4×10^{-11}	8.0×10^{-9}	8.1×10^{-9}	1.6×10^{-7}	8.1×10^{-9}	1.7×10^{-7}

The risk of a vehicle-related fatality for the primary route was estimated to be 0.24, or about one chance in four of a single vehicle-related fatality throughout the duration of the 10-year shipment campaign. The risk of a radiation-induced cancer fatality from accidental release of radioactive material was estimated to be 1.7×10^{-8}, or about one chance in 60 million of a single cancer fatality in the general population throughout the entire shipment campaign.

The maximum reasonably foreseeable accident for both the primary and secondary routes are the same as those described for Option 1D.

Options 1B and 1C – Caliente

Table C-20 shows the results of the accident risk analysis for Options 1B and 1C. The primary route is longer than the secondary route but traverses primarily rural areas, so vehicle-related fatality risk for the primary route is 13 percent lower than the secondary route. Because the primary route has less mileage in high population zones, the radiation-induced risk of cancer fatality is about 99 percent lower than that for the secondary route, which passes through more high population zones. The risk of a vehicle-related fatality for the primary route was estimated to be 0.35, or about one chance in three of a single vehicle-related fatality throughout the duration of the 10-year shipment campaign.

Table C-20. Transportation Accident Risks for Options 1B and 1C – Caliente

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
Vehicle-related injuries	6.81	0.0	*6.81*	7.53	0.0	*7.53*
Vehicle-related fatalities	0.35	0.0	*0.35*	0.40	0.0	*0.40*
Collective dose (person-rem)	3.1×10^{-6}	0.0	3.1×10^{-6}	8.4×10^{-4}	0.0	8.4×10^{-4}
Radiation-induced cancer fatalities	1.6×10^{-9}	0.0	1.6×10^{-9}	4.2×10^{-7}	0.0	4.2×10^{-7}
Radiation-induced detriment	7.2×10^{-10}	0.0	7.2×10^{-10}	1.9×10^{-7}	0.0	1.9×10^{-7}

The risk of a radiation-induced cancer fatality from accidental release of radioactive material was estimated to be 1.6×10^{-9}, or about one chance in 600 million of a single cancer fatality in the general population throughout the entire shipment campaign.

The consequences of the maximum reasonably foreseeable accident are summarized in Table C-21 for rural, suburban, and urban population areas. The maximum reasonably foreseeable transportation accident for Options 1B and 1C would occur in a suburban population zone for the primary route because there are no urban zones along the primary route. Under stable weather conditions, the population within 80.5 km (50 mi) could receive up to 0.60 person-rem, resulting in a likelihood of 3.0×10^{-4}, or one chance in 3,333 of a single fatal cancer in the entire population. The frequency of this accident was estimated to be 7.4×10^{-6} per year. For the secondary route, which does include some urban population zones, the most severe consequences would occur in an urban population zone. The population within 80.5 km (50 mi) could receive a collective dose of 3.2 person-rem. This dose would not be expected to result in any detrimental health effects in the general population with a likelihood of 1.6×10^{-3}, or about one chance in 600 of a single fatal cancer in the entire population. The frequency of this accident was estimated to be 4.1×10^{-5} per year.

Table C-21. Consequences of the Maximum Reasonably Foreseeable Transportation Accident

	Meteorological Conditions	
	Neutral	*Stable*
Rural Population Zones		
Maximum individual dose (rem)	5.1×10^{-4}	4.3×10^{-5}
Population dose (person-rem)	0.15	0.29
Radiation-induced cancer fatalities	7.5×10^{-5}	1.5×10^{-4}
Radiation-induced detriment	3.5×10^{-5}	6.7×10^{-5}
Suburban Population Zones		
Maximum individual dose (rem)	5.1×10^{-4}	4.3×10^{-5}
Radiation-induced cancer fatalities	0.39	0.60
Population dose (person-rem)	2.0x 10-4	3.0 x 10-4
Radiation-induced detriment	9.0×10^{-5}	1.4×10^{-4}
Urban Population Zones		
Maximum individual dose (rem)	5.1×10^{-4}	4.3×10^{-5}
Population dose (person-rem)	2.1	3.2
Radiation-induced cancer fatalities	1.1 x 10-3	1.6×10^{-3}
Radiation-induced detriment	4.8 X 10-4	7.4×10^{-4}

<u>Option 1D – Yermo</u>

Table C-22 shows the results of the accident risk analysis for Option 1D. The primary route is shorter than the secondary route, so vehicle-related fatality risk for the primary route is 22 percent lower than the secondary route. Because the primary route also has less mileage in high population zones, the radiation-induced risk of cancer fatality is about 19 times lower than that for the secondary route, which is longer and passes through more high population zones.

The risk of a vehicle-related fatality for the primary route was estimated to be 0.25, or about one chance in four of a single vehicle-related fatality throughout the duration of the 10-year shipment campaign.

Table C-22. Transportation Accident Risks for Option 1D – Yermo

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
Vehicle-related injuries	1.67	3.39	*5.06*	4.16	2.66	*6.82*
Vehicle-related fatalities	0.06	0.19	*0.25*	0.14	0.17	*0.32*
Collective dose (person-rem)	2.8×10^{-7}	4.0×10^{-5}	4.0×10^{-5}	7.1×10^{-4}	3.8×10^{-5}	7.5×10^{-4}
Radiation-induced cancer fatalities	1.4×10^{-10}	2.0×10^{-8}	2.0×10^{-8}	3.6×10^{-7}	1.9×10^{-8}	3.8×10^{-7}
Radiation-induced detriment	6.4×10^{-11}	9.2×10^{-9}	9.3×10^{-9}	1.6×10^{-7}	8.7×10^{-9}	1.7×10^{-7}

The maximum reasonably foreseeable accident for both the primary and secondary routes would occur in an urban population zone under stable weather conditions. The consequences of the accident are the same as those described for the secondary route under Options 1B and 1C. The accident frequency is 6.0×10^{-6} per year for the primary route, and 2.0×10^{-5} per year for the secondary route.

Option 2 – All-truck

Table C-23 shows the results of the accident risk analysis for Option 2 – All-truck. The primary route is longer than the secondary route, so vehicle-related fatality risk for the primary route is about 2.7 times higher than the secondary route. However, the primary route has less mileage in high population zones, so the radiation-induced risk of cancer fatality is about 13 times lower than that for the secondary route.

Table C-23. Transportation Accident Risks for Option 2 – All-truck

	Primary Routes			*Secondary Routes*		
	Within Nevada	*Outside Nevada*	*Total*	*Within Nevada*	*Outside Nevada*	*Total*
Vehicle-related injuries	1.72	4.67	*6.39*	3.42	0.95	*4.37*
Vehicle-related fatalities	0.06	0.37	*0.43*	0.11	0.05	*0.16*
Collective dose (person-rem)	1.2×10^{-6}	1.1×10^{-4}	1.1×10^{-4}	1.3×10^{-3}	5.3×10^{-5}	1.4×10^{-3}
Radiation-induced cancer fatalities	5.9×10^{-10}	5.5×10^{-8}	5.5×10^{-8}	6.3×10^{-7}	2.7×10^{-8}	6.6×10^{-7}
Radiation-induced detriment	2.7×10^{-10}	2.5×10^{-8}	2.5×10^{-8}	2.9×10^{-7}	1.2×10^{-8}	3.0×10^{-7}

The risk of a vehicle-related fatality for the primary route was estimated to be 0.43, or about one chance in two of a single vehicle-related fatality throughout the duration of the 10-year shipment campaign. The risk of a radiation-induced cancer fatality from accidental release of radioactive material was estimated to be 5.5×10^{-8}, or about one chance in 18 million of a single cancer fatality in the general population throughout the entire shipment campaign.

The maximum reasonably foreseeable accident would occur in an urban population zone. The consequences of this accident are the same as those described for the secondary route under Options 1B and 1C.

Option 3 – Current Route

The accident risks associated with the current route are summarized in Table C-24.

The risk of a vehicle-related fatality for the current route was estimated to be about 0.16, or about one chance in six of a single vehicle-related fatality throughout the duration of the 10-year shipment campaign. The risk of a radiation-induced cancer fatality from accidental release of radioactive material was estimated to be 6.6×10^{-7}, or about one chance in 2 million of a single cancer fatality in the general population throughout the entire shipment campaign.

Table C-24. Transportation Accident Risks for Option 3 – Current Route

	Within Nevada	*Outside Nevada*	Total
Vehicle-related injuries	3.42	0.95	4.37
Vehicle-related fatalities	0.11	0.05	0.16
Collective dose (person-rem)	1.3×10^{-3}	5.3×10^{-5}	1.4×10^{-3}
Radiation-induced cancer fatalities	6.3×10^{-7}	2.7×10^{-8}	6.6×10^{-7}
Radiation-induced detriment	2.9×10^{-7}	1.2×10^{-8}	3.0×10^{-7}

1. Includes both LLW and mixed LLW shipments included under Option 3 of the NTS EIS.
2. The NTS EIS does not specifically identify the amounts attributable to LLW and mixed LLW separately. For this report, the LLW portion has been approximated by a simple ratio of the number of LLW shipments to the total shipments (25,084/40,499), or about 62 percent.

The maximum reasonably foreseeable accident would occur in an urban population zone. The consequences of this accident are the same as those described for the secondary route under Options 1B and 1C.

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APPENDIX D

U.S. DEPARTMENT OF ENERGY
EMERGENCY MANAGEMENT SYSTEM

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D.0 U.S. DEPARTMENT OF ENERGY EMERGENCY MANAGEMENT SYSTEM

DOE Order 151.1 establishes policy and assigns and describes roles and responsibilities for the DOE Emergency Management System (EMS). This Order is based on requirements established in Title 49 CFR for shipping of hazardous materials. The EMS provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and emergency actions for such incidents as an accident or release during shipment of radiological and nonradiological materials. One component of EMS is the Transportation Emergency Management Program (TEMP), which applies to all DOE nonweapons-related shipments involving both routine movements of hazardous materials (radiological and nonradiological) and other cargo and major DOE shipping campaigns.

The scope and extent of emergency planning and preparedness for DOE shipments of hazardous materials is performed in accordance with applicable federal, Tribal, state, and local laws, regulations, and ordinances. Hazard surveys and assessments are conducted to provide the technical basis to reduce potential health and safety impacts and/or identify shipment-specific emergency response concerns. A formal emergency response exercise program is established with exercises conducted with offsite organizations and agencies as part of a coordinated readiness assurance program to test the TEMP interfaces with responding agencies.

During response to an offsite transportation incident, the DOE provides assistance to local authorities and governments having primary responsibility to respond to and manage all emergencies within their jurisdiction. The DOE maintains an active emergency response program through eight Regional Coordinating Offices (RCOs) located across the U.S. These RCOs are trained and equipped to assist in response and receive support from other DOE offices, DOE contractors, and other federal agencies within their respective regions. Each RCO has comprehensive capabilities, including a designated, specialized staff on-call 24 hours a day, and readily deployable equipment. Assistance may range from technical advice to dispatching personnel with radiological monitoring equipment to assist an incident scene. The Department of Health and Human Services, DOT, EPA, Federal Emergency Management Agency, NRC, and U.S. Coast Guard also respond and provide emergency assistance as appropriate.

State, Tribal, and local jurisdictions have the primary responsibility to provide HAZMAT-related emergency response training to emergency responders. The DOE assists in training these jurisdictions by reinforcing roles and responsibilities and providing specialized training.

Figure D-1 provides a general layout of typical lines of communication, both internal to the DOE and external for a transportation emergency involving a DOE cargo. Procedures are established to ensure (1) the known nature and severity of an emergency is communicated to DOE Headquarters; (2) knowledgeable personnel are mobilized to monitor, assess, and provide assistance during an offsite transportation incident; and (3) federal, state, Tribal, and local authorities in the immediate vicinity are notified regarding the severity and likely consequences of an offsite transportation accident/incident.

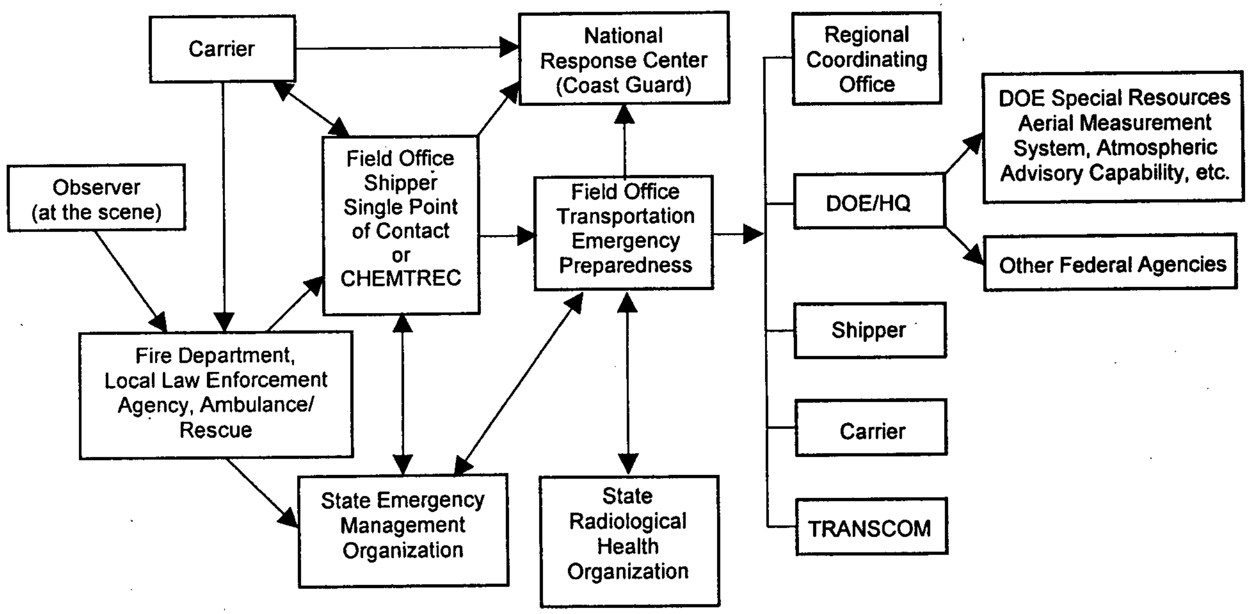

Figure D-1. Typical Lines of Emergency Communications.

APPENDIX E

AMERICAN INDIAN TRANSPORTATION COMMITTEE FIELD ASSESSMENT OF CULTURAL SITES REGARDING THE U. S. DEPARTMENT OF ENERGY PREAPPROVAL DRAFT ENVIRONMENTAL ASSESSMENT OF INTERMODAL TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE

[Field Assessments Conducted January 11-21, 1999]

Prepared by

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF ACRONYMS FOR APPENDIX E

ACEC	Area of Critical Environmental Concern
AITC	American Indian Transportation Committee
AIWS	American Indian Writers Subgroup
BLM	Bureau of Land Management
CA [127]	California Highway [127]
CEQ	Council on Environmental Quality
CGTO	Consolidated Group of Tribes and Organizations
CRIT	Colorado River Indian Tribes
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE NV	DOE Nevada Operations
DOI	U.S. Department of the Interior
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
IM EA	Intermodal Environmental Assessment
IPP	Intermountain Power Project
LLRW	Low-level Radioactive Waste
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
NTS	Nevada Test Site
RCA	rapid cultural assessment
ROI	Region of Influence
SR	State Route
TCP	Traditional Cultural Propery
TTR	Tonopah Test Range
UP	Union Pacific
US [93]	U.S. Highway [93]
USFWS	U.S. Fish and Wildlife Service
YMP	Yucca Mountain Project

E.1 SECTION ONE - BACKGROUND

This section of the report is provided to help contextualize the following sections that summarize and integrate findings of this study. This first section is intended to provide useful background information so that the American Indian Transportation Committee (AITC) summary of findings can be more quickly understood by tribal councils, whose opinions are being represented by the team of Indian people who participated in this study, and by the Department of Energy (DOE) environmental assessment team who is incorporating these Indian issues into the next draft of the Intermodal Environmental Assessment (IM EA).

Description of This Report

This is a summary of findings from an American Indian rapid cultural assessment (RCA). As such, this is not a formal report. The text in this summary of findings (Section Three) has been prepared to fit directly into the IM EA. Section Three is included in this Appendix. This summary of findings was prepared by a study team of Indian people directly from their own field observations.

The AITC was formed in August 1996 during a study of American Indian issues related to the transportation of Low-level Radioactive Waste (LLRW) to the Nevada Test Site (NTS). The AITC contained 9 members who were selected (with the approval of their respective governments) to represent the 29 tribes involved in the study (Austin, 1998:4). The AITC helped with all aspects of that study, they being deeply involved in developing culturally appropriate research methods, helping with the interviews, and closely reviewing the findings. Their efforts were finally presented in a report entitled *Native Americans Respond to the Transportation of Low Level Radioactive Waste to the Nevada Test Site* (September 1998) edited by Diane Austin.

While the initial Native American LLRW study was being completed, the DOE decided to conduct an *Environmental Assessment of the Intermodal Transportation of Low Level Radioactive Waste*. The term intermodal refers to the use of both railroad and trucks to haul LLRW from the producers to the NTS. The intermodal study introduced the concept of a entrepot (that is, a trans-shipment facility) where LLRW would be taken from railroads, perhaps stored for a period of time, and then reshipped via truck to the NTS (see Figure 1). The DOE asked the members of the AITC to take the findings from the Austin report and any pertinent previous studies and apply them directly to the IM EA. This task was accomplished at a meeting held in Tonopah, Nevada, and resulted in a report entitled *U.S. DOE Nevada Operations Office, Intermodal Transportation of LLRW to the Nevada Test Site, Summary of Meeting with Native Americans, November 18 to 20, 1998. Tonopah NV* (December 1998) by Stoffle and Toupal.

During the Tonopah meeting, the AITC observed that: (1) the Austin study was not designed to assess specific locations along its study-area highways, (2) the IM EA is considering some highway routes that had not been considered in the Austin study, and (3) the IM EA raises the issue of potential LLRW impacts along railroad routes. The AITC thus recommended to the DOE Nevada Operations (DOE NV) that they support the AITC to conduct on-site studies along

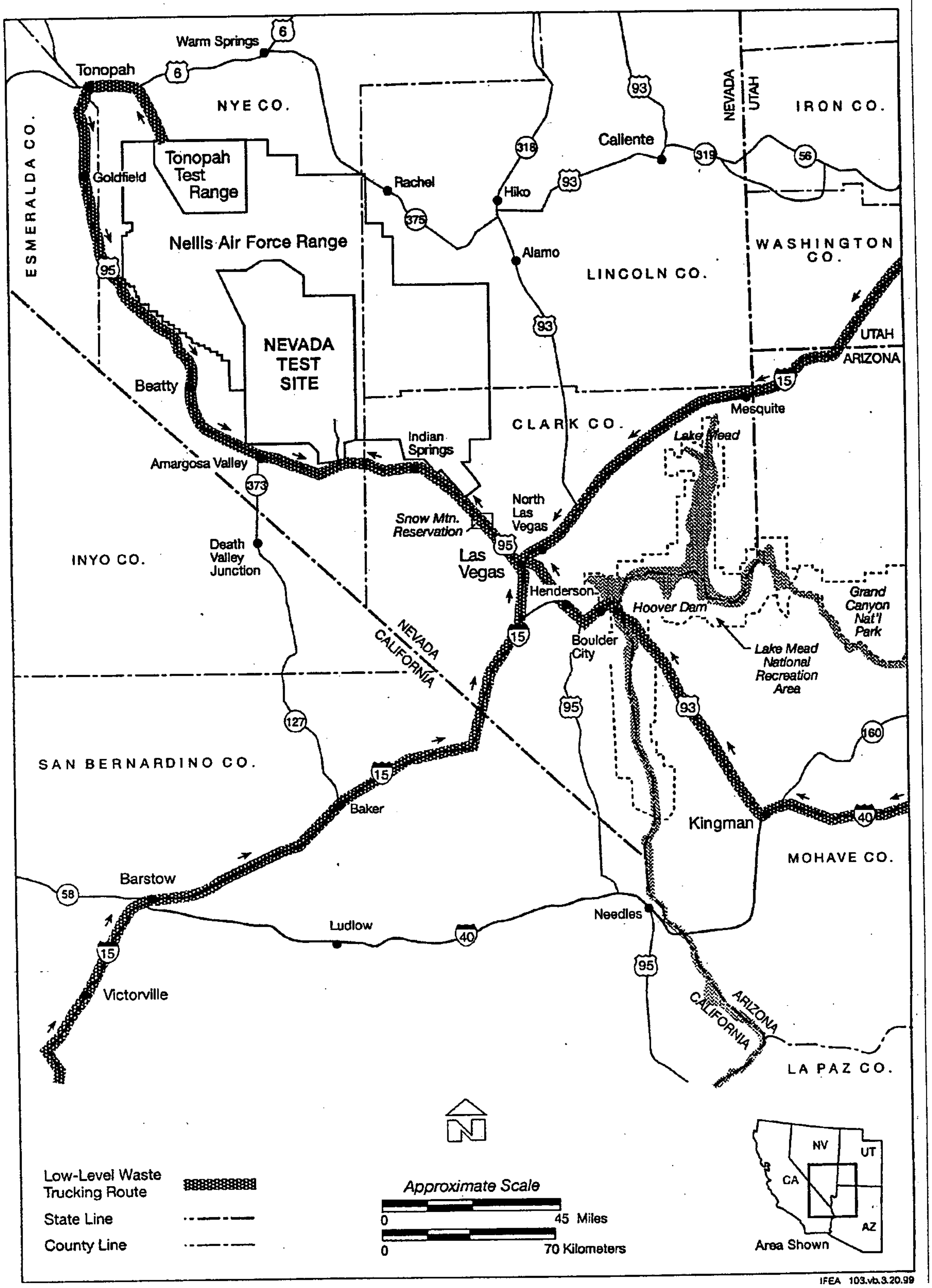


Figure 1. Current Low-level Radioactive Waste Trucking Routes. (Adapted from USDOE, 1998: 2-3).

the new highway routes. That request was translated into a formal research proposal submitted to the DOE on December 22, 1998. The proposal was funded on January 4, 1999. The AITC went into the field on January 11, 1999 and worked continuously until January 21, 1999 (see Figure 2). The direct field observations of the AITC during this period of study are the foundation for this summary of findings.

E.1.1 Tiering

This is not a formal report of findings. Such a report would have detailed discussions of research methods, a general background issues chapter, and would provide document support for each of the places discussed. Such discussions were not possible given the brief field session and quick follow-up editing required to prepare this document for the IM EA; nonetheless, it was possible to find certain original documents while in the field and to tier on previous documents.

This summary of findings has used a number of previous studies to better understand the American Indian cultural resources that exist in the study area. The AITC has taken these studies on face value. Key reports used and a brief discussion of their value to this study include:

(1) American Indian Writers Subgroup (AIWS)
1996 *American Indian Assessments: Final Environmental Impact Statement for the Nevada Test Site and Off-Site Location in the State of Nevada: A Native American Resource Document*, Appendix G. Las Vegas, NV: US DOE, Nevada Operations Office.

This document has become a foundation essay regarding Native Americans participating in federal agency *National Environmental Policy Act (NEPA)* compliance, or what are called environmental impact statements (EISs). This document was produced as part of the ten-year EIS for the NTS and its off-site activities. American Indian participation was funded by the DOE and the document took almost a year to produce. In the end, Appendix G summarized all American Indian opinions expressed in the EIS. Appendix G has been subsequently used as a foundation document in the Yucca Mountain Project (YMP) EIS, in NTS EISs, on Nellis Air Force Base EISs, and in various other federal agency EISs in the region. The document is valuable because it was the first comprehensive assessment of Native American EIS issues for the NTS and it was approved by the 17 American Indian tribes and 3 Indian organizations involved in that on-going consultation.

(2) Austin, Diane (ed.)
1997 *Native Americans Respond to the Transportation of Low Level Radioactive Waste to the Nevada Test Site*. Report prepared for the DOE, Nevada Operations Office, Las Vegas. Tucson, AZ: Bureau of Applied Research in Anthropology, University of Arizona.

This document was the first of its kind. It addressed risks that are perceived by American Indians that derive from the transportation of LLRW. The study involved the participation of 29 American Indian tribes (and tribal ethnic sub-units) and 3 Indian organizations. It focused on

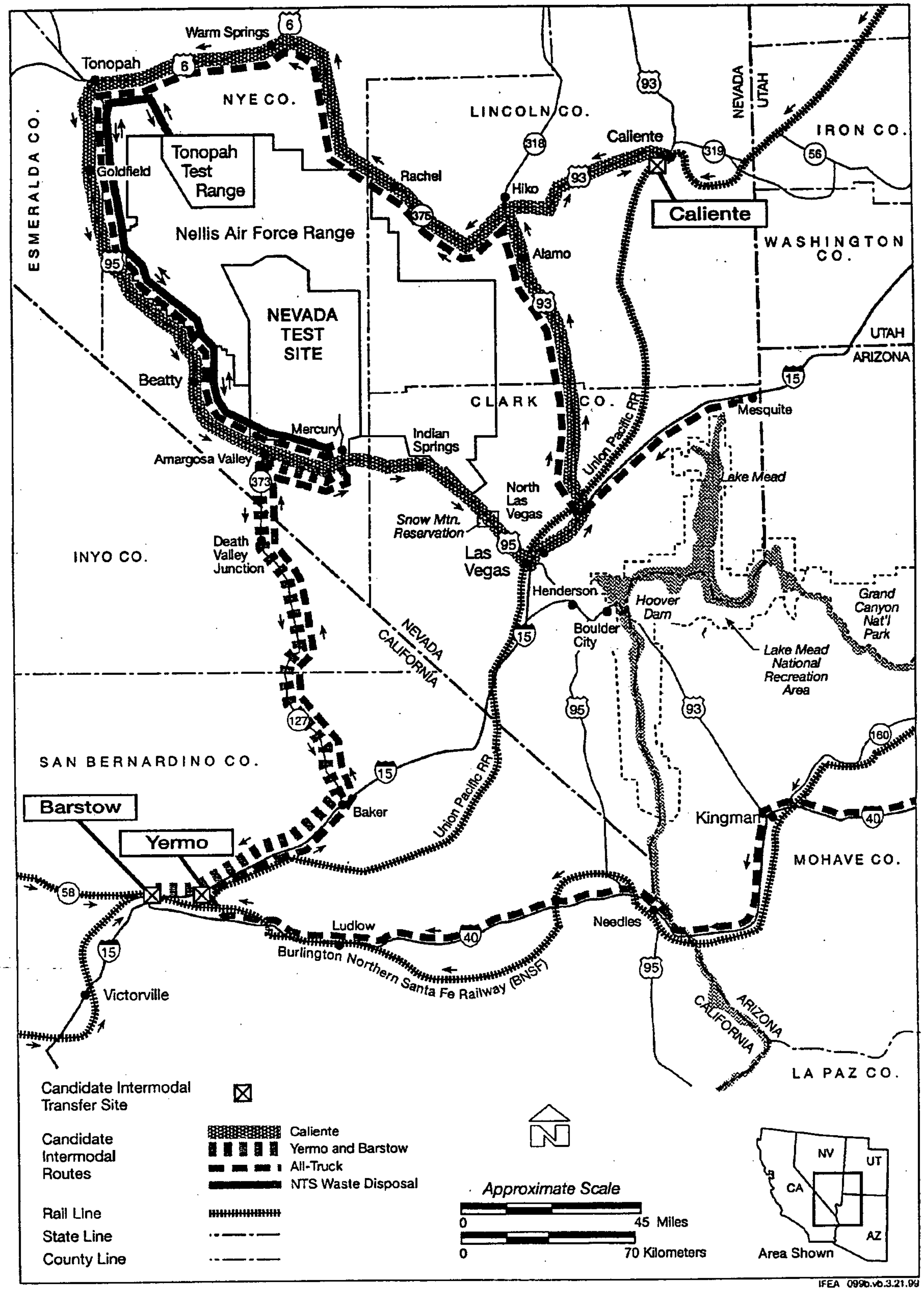


Figure 2. Proposed Intermodal Sites and Routes Studied by AITC.

three truck haul routes as these pass through in a four-state area that generally reflects the administrative responsibility of the DOE NV. The study involved a series of unique methods including both quantitative and qualitative data collection. Guiding the study was the AITC, composed of 9 Indian people who were chosen for this task by their respective tribal governments. The study documented that radiation is perceived as an Angry Rock by many Indian people. As such, it exists and acts according to epistemological rules that do not reflect those perceived as existing in western science. This is a critical finding because American Indian responses to radioactivity reflects its spiritual (or cultural), as well as, its physical (or western scientific) dimensions.

(3) Henningson, Durham and Richardson, Inc.

1980 *M-X Environmental Technical Report, ETR 21 Native American – Nevada/Utah (Preliminary FEIS)*. Report prepared for U.S. Air Force, Ballistic Missile Office, Norton Air Force Base, California. Santa Barbara, California: Henningson, Durham, & Richardson, Inc.

This document was produced as part of the M-X environmental assessment. This research was conducted in the late 1970s and was one of the early attempts to understand the full range of social, cultural, and economic impacts of a major project on American Indian peoples and their tribal communities. The study combines a wide range of data gathering methods including original sampling archaeology, document analysis, and interviews with tribal elders. The authors of the study had worked with local Indian tribes and were thus informed about Indian opinion on many issues, as well as, had rapport with most tribes in the study. One of the key M-X locations was south of Caliente, Nevada, so a number of studies and statistics were developed that are useful for this analysis. One of these is a hydrological map of the single drainage, which constitutes the White River, Pahranagat Valley, and Muddy River Valley. Another involves estimates of the number of Shoshone and Paiute archaeology that exist in various valleys. Both of these have been added to this analysis by the AITC for their final review and approval.

E.1.1.1 Intermountain Power Project

In the early 1980s the UofA research team, then located at the University of Wisconsin-Parkside in Kenosha, Wisconsin, was engaged in conducting American Indian cultural assessment studies related to a powerline project beginning in Delta, Utah and extending to the central portion of the Mohave Desert. This project was called the Intermountain Power Project (IPP). IPP interviews occurred along both the northern and southern portions of the IM EA study area. Some of these interviews have been used to support and further illustrate the AITC observations in this study. The IPP interviews that have been used were with Indian elders who are no longer alive, so their names have not been used in this study. The general findings from the IPP studies are in three reports (Stoffle and Dobyns, 1982, 1983; Stoffle, Dobyns, Evans (eds.), 1983).

E.1.2 Cultural Landscapes

The world is integrated in complex ways, but this study can only provide simple illustrations of these complex cultural relationships. In recent studies, the American Indian tribes involved in this study have argued that the concept of cultural landscape best represents how places of specific cultural value are integrated into larger cultural units. The concept of cultural landscape has recently received considerable federal and state agency attention because it appears to be useful for explaining the fit between the human and biological dimensions of ecosystems. Such an approach is suggested under recent federal ecosystem management regulations.

It is especially difficult to discuss cultural landscapes in a RCA because such an analysis works best when there are few limits placed on either time, location of study, or number of Indian experts involved. The current IM EA Indian site visits, however, did seek to illustrate the value of the concept by selecting two types of cultural landscapes that are involved in the study area and how these appear to be influenced by the study proposed alternatives. One of these is an ecoscape; the other is a songscape. The first is called an ecoscape (short for ecological cultural landscape) and it is greatly influenced by the hydrological features of the land. The second is called a songscape (short for a song-based cultural landscape) and it, as will be seen later in this essay, is totally unaffected by land topography. Members of the AITC believe that these two types of cultural landscapes do illustrate the diversity of the concept, as well as, its usefulness for environmental assessment and land use management.

E.1.3 AITC Data Collection

This study was guided by a series of agreed to methods for collecting data. Given the great distances and the time needed to assess each place visited along the proposed routes, it was agreed by the AITC that two kinds of site evaluations would be conducted. The first is a complete site evaluation and the second was called a mini-site evaluation. Each had his/her own forms. Each AITC member filled out one or the other form at each site that was identified along the proposed routes. At the end of three days of site visits, the AITC spent one day writing the results of their evaluations. These site descriptions and evaluations were fully discussed by the AITC; therefore, the text provided in this summary of findings has been agreed to by the entire AITC.

E.1.4 University of Arizona Editing

Staff at the University of Arizona edited the field summaries of the AITC and prepared this summary of findings. This process involved making as few changes as possible to the original text that was prepared by the AITC.

The third section of this report takes the January 1999 field summaries and integrates it with the previous IM EA text provided by the AITC in December 1998. The third section directly recommends text for specific sections of the IM EA. It is included in this Appendix.

Members of the AITC have reviewed these changes to assure accuracy.

E.1.5 AITC Recommendations

The AITC understands that this is an EA, however, they believe it is necessary to point out the need for further information. Such information is believed to be necessary so that Indian people can see a full range of their issues described in the assessment of this proposal.

1. **Adequacy of Present Findings**. The AITC believes it has documented sufficient potential adverse impacts to American Indian cultural sites and cultural landscapes along all proposed IM EA routes to warrant further study before a decision is made. The AITC does believe specific data collection steps are still needed before this report fully represents Indian opinion.

2. **Need for Elder Input**. The AITC has some ideas about the kinds of expertise of tribal elders that are needed to more fully assess potential spiritual impacts at various critical cultural locations along all proposed IM EA routes. Foremost among these are potential impacts to (1) the Salt Song trail and (2) the unburied spirits still at the Hiko, Nevada massacre site.

3. **Need for Local Indian Input**. There are local Indian issues that could not be represented in this RCA. These include the potential impacts to the large multi-ethnic community in Barstow and the small Paiute community in Caliente. The presence of a multi-ethnic Indian Health Center at Tecopa Hot Spring in California needs to be better documented and potential impacts need to be better understood.

4. **Need to Assess Other Indian Economic Opportunities**. Some of the potential economic opportunity costs of the IM proposal remain unconsidered. For example, hot springs located within sight of U.S. Highway 93 (US 93) north of Tonopah, in the town of Mina, are currently being used in an aquaculture business. Australia lobsters are being raised in warm water from the spring and, over the lobsters, tomatoes are being raised with hydroponics. The hot springs food products are selling at this time, mostly to local restaurants. Such economic ventures are within the interest and means of some of the tribes who have traditional cultural attachments to these hot springs. Whether or not such economic ventures would be considered in the future is unclear, but the presence of LLRW trucks near the hot springs is seen by the AITC as a potential use conflict.

5. **Need to Assess Railroad Routes** – Two recent train derailments along the study area have caused the AITC to identify the need to study the potential physical and spiritual impacts of LLRW haul on trains. On December 24, 1998, a Union Pacific (UP) train left the tracks 4 miles up stream on Clover Creek from Caliente. This accident took out a railroad bridge and placed many of the cars and their loads in the water of Clover Creek. The haul was coal, so it was scooped up and disposed of in big piles in the UP railroad yard in Caliente. Another accident occurred last year on the UP line that passes through the U. S. Desert Nature Preserve just south of California Highway 127 (CA 127) and on the way into Barstow, California. Both lines are being considered for LLRW haul under the IM EA, and both areas involved are well-known spiritual places to Native Americans.

E.2 SECTION TWO - SITE-BY-SITE DESCRIPTIONS

This section provides descriptions and evaluations for every site along the IM EA study area that were visited by the AITC during the January 11-21, 1999 field work. Each of the following sites is in the Region of Influence (ROI) for the American Indian section of the IM EA. Most sites are within a few yards of proposed LLRW transportation routes. The sites are listed as they were visited by the AITC. In the next section of the report these site-by-site descriptions and evaluations are placed within the outline of the IM EA.

E.2.1 Warms Springs, Glendale

The Warm Springs, Glendale site is located in the Muddy River Valley, near the Moapa Indian Reservation and near State Route (SR) 168. The Muddy River is the lower portion of a hydrological system that begins far to the north in central Nevada near the Pahroc Valley and in eastern Nevada near Panaca (Figure 3). The Muddy River eventually travels to the former Colorado River, passing the contemporary Nevada towns of Glendale, Logandale, and Overton. Indian people traditionally recognized this hydrological system and viewed it as culturally special landscape that is highlighted by a number of culturally special places -- some of which were visited during this study.

Warm Springs is one of a number of naturally occurring artesian springs that create a series of riverine oases. At these locations, there is a diverse flora and fauna. During the IPP studies, a Moapa elder pointed out that food from the plants at this spring become available each month of the year. Of special importance are the native palm trees, which are seen as traditional use plants by the Moapa elders. Hot springs are places of mixed power. They supply water for healing, and they represent a place that has its own spirits (Stoffle, Pittaluga, Earnest, Eisenberg, Amato, Dewey-Hefley, 1998). At this time, the drinking water of all towns and the Moapa Indian reservation come from this hydrological system (Site #1 photos).

Other Moapa Paiute elders have shared information about Paiute uses of native palms trees during the early 1920s (Source for the following excerpts from an article by William Spencer titled "Washingtonia filifera: Nevada's rejected ancient Palm." http://www.xeri.com/Moapa/wf-hr-foreword.htm):

> *"I remember Palm parts being used to make baskets. The baskets made in this way (from palms) were not the really fine sort, which were made from other materials. I never learned to make baskets. I remember my grandmother making them. I have also seen my grandparents making shelters out of palm leaves from the springs. My grandfather had a place that he took a sweat bath in. It wasn't right by the springs but near where he lived. But he would go to the headwater of the Muddy River at the Warm Springs because there was something sacred in the water. He would then talk to the water and bring it back to his sweat hut. No one lived in the springs themselves... We drank water out of the ditch and there were many Palms over there. Over at the springs was a very sacred place and as children we had to act a certain way whenever we went over there.*

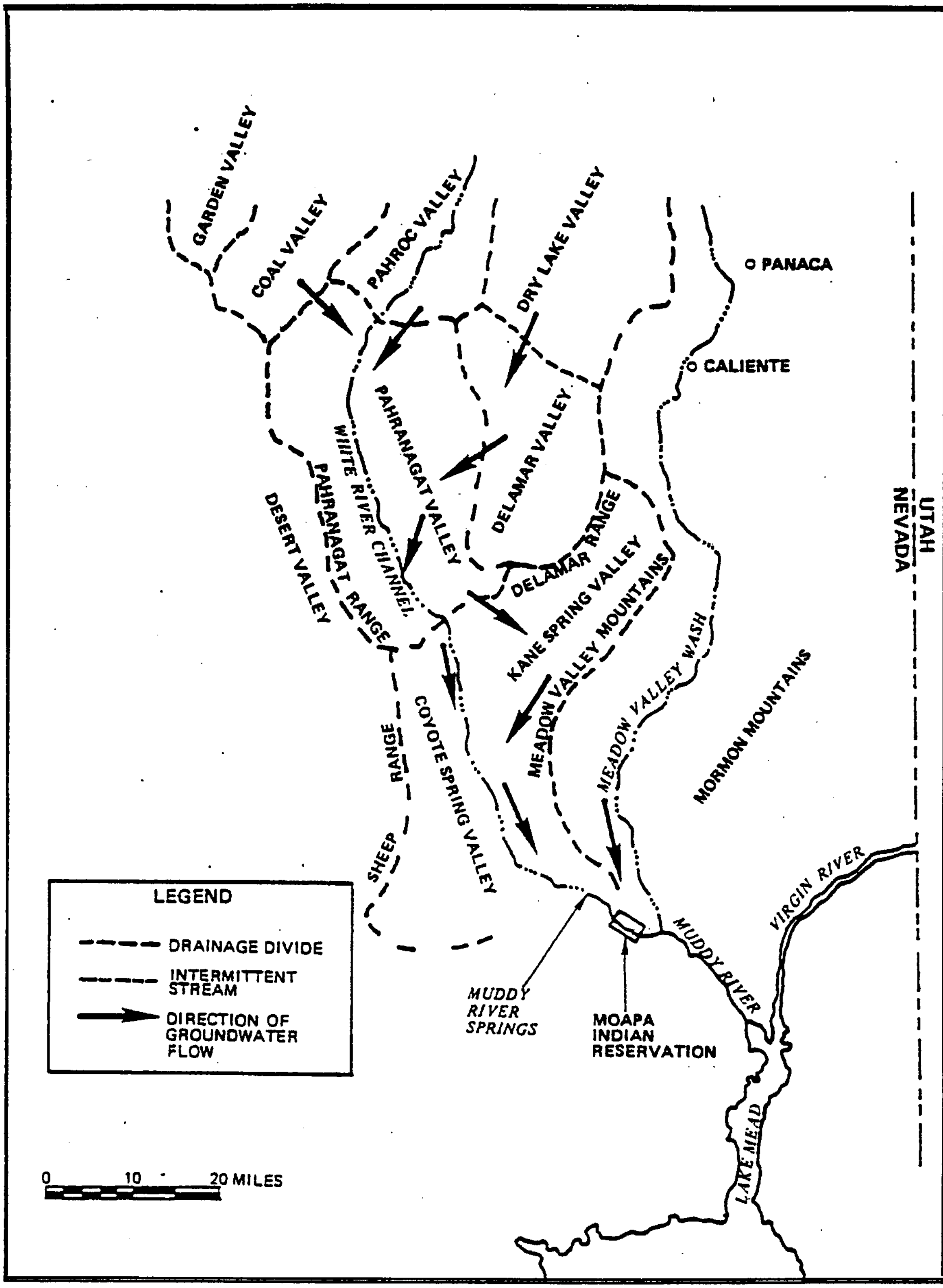
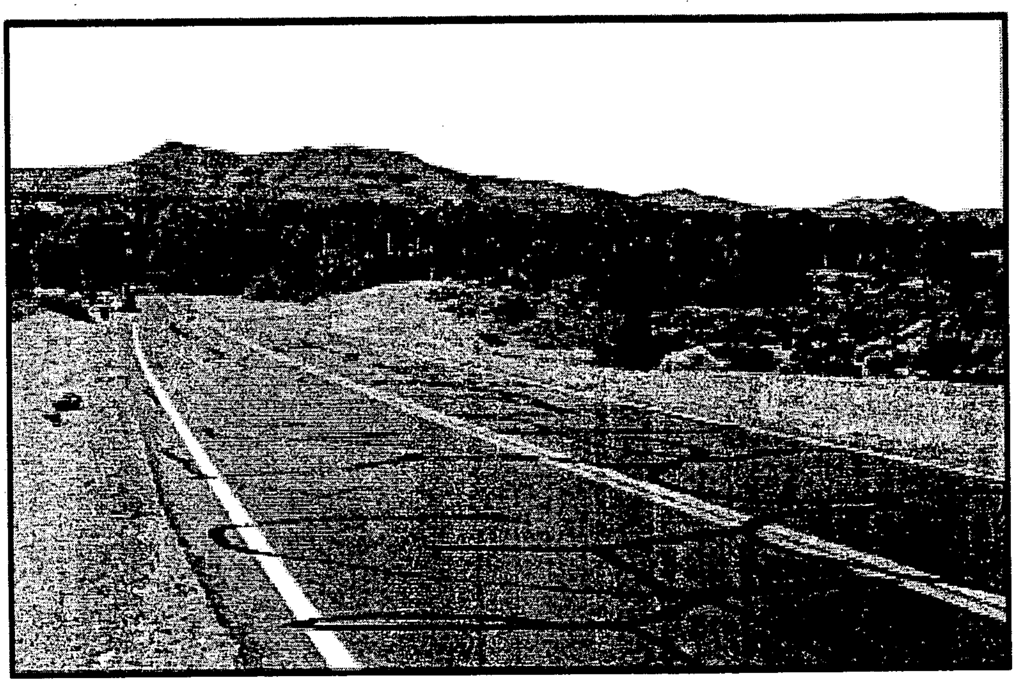


Figure 3. Muddy River Drainage Basin and Indian Ecoscape. (Adapted from Henningson et al., 1980:187).



Site #1. Warm Springs, Glendale.
Showing an oasis of native palm trees (*Washingtonia flifera*)
and abundant spring water.

"I also know where the deep stone holes are where Grandma used to work the Palm seeds. I was very little. The stones they used to grind the screwbeans and the mesquite were called Maddah and were different than the deep holes they used for Palm seeds.

"My Elders used to say that the whole area of the springs west of here was a designated spiritual area and very sacred. We know that the Palms have always been there. We Moapas have always known this."

-- Evelyn Samalar, Moapa Paiute, age: 76 years (1996)

"...they used Palms for small huts. I remember my grandparents using Palm leaves for shelters and small huts. I don't remember any other uses, I was very young. My grandfather said that the Palms are always here."

-- Irene Benn, Moapa Paiute, age: 73 years (1996)

"I remember seeing shelter built with Palm thatching and I remember my grandparents using Palms to build small huts and such. I also remember seeing my grandmother crush the black seeds from the Palms in a deep stone hole in the ground but I was very young and I don't remember how it was used. My father used to say that the Palms were always here. My grandparents always used to say that too...that the Palms have always been here. There are deep grinding holes in the rocks near my house. About four of them,...I'll show you. (spoken to Kaye Herron) ...where my grandmother used to grind the seeds of the Palms."

-- Maureen Frank, Moapa Paiute, age: 63 years (1996)

"I remember my grandmother used to take and soak the long things that hang down from the Palm trees. She would soak these in water until they were real white, then she made baskets out of them. The baskets made this way didn't make the good baskets. The good baskets were made from the reeds, which came from the river. I never learned basketry skills.

"My grandparents said that the palms have always been here. I also saw my grandmother grind the seeds from the palms using some special holes in the rocks by my house. I think they made a gravy. She used to crush them in the deep stone holes by my house. There used to be a Paiute word for the gravy they made with the seeds but I don't remember what it was. Irene might remember. We have always known that white men did not bring the palms with them. Among ourselves we've always known that the palms were here before any white man came."

-- Juanita Kinlichinie, Moapa Paiute, age: 64 years (1996)

Potential impacts include possible physical contamination that would derive from an overturned truck along US 93, north of the junction with SR 168. Impacts also could derive from an overturned truck along SR 168. SR 168 is perceived as a possible short-cut violation of the I-15 and US 93 since they are a preferred all-truck haul route. Not only are these two routes susceptible to violent flash floods, but also have stretches of open grazing. Spiritual contamination could occur from truck accidents, parking, and drive-bys.

E.2.2 Potato Woman

The Potato Woman site is located along the southern flank of Mormon Mountains, the western edge of Mormon Mesa, just north of Weiser Wash. Potato Woman's hair touches I-15. Potato Woman is a creator being. According to a Paiute elder interviewed in 1982 during the IPP study, she is especially powerful because she is related to two other Creator beings -- the Po-ni (skunk, *Spilogale putorius*) and the Un-nam-but (badger, *Taxidea taxus).* As a Creator being, Potato Woman has a permanent responsibility for creating a small variety of Nah'-gah (Mountain Sheep, *Ovis spp.*), which predominates in the Arrow Canyon Mountain Range. This Nah'gah, in turn, has brought, does bring, and will bring songs, stories, and medicine to Indian people.

Potato Woman is known as a powerful place. So powerful, that traditionally, Indian people would not camp near her. In 1982, during the IPP studies, a Paiute elder provided a detailed story of a medicine man who spent the night near her. He became sick and only because of his personal power was he able to heal himself. Some of the power of the place comes from unburied spirits caused by an epidemic that killed lots of people in Moapa Valley. This story was provided to illustrate the power of Potato Woman.

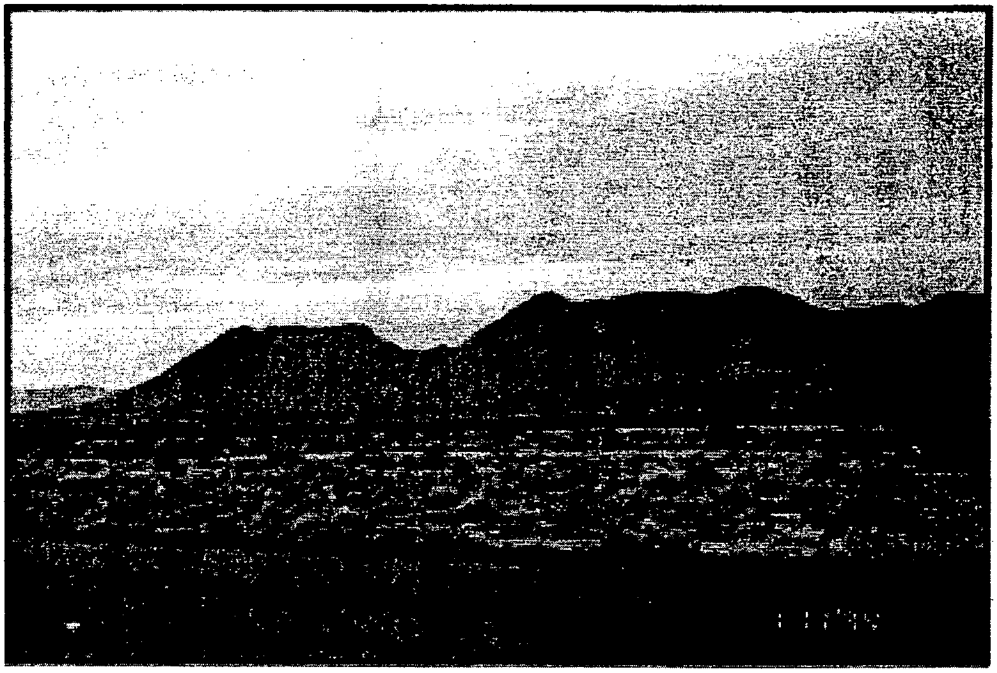
Potential impacts include physical contamination that would derive from an overturned truck along I-15, near Potato Woman. Physical contamination could occur from trucks parked in the I-15 rest area, located near her hair. Spiritual contamination could result from truck accidents, parking, and drive-bys (Site #2 photos).

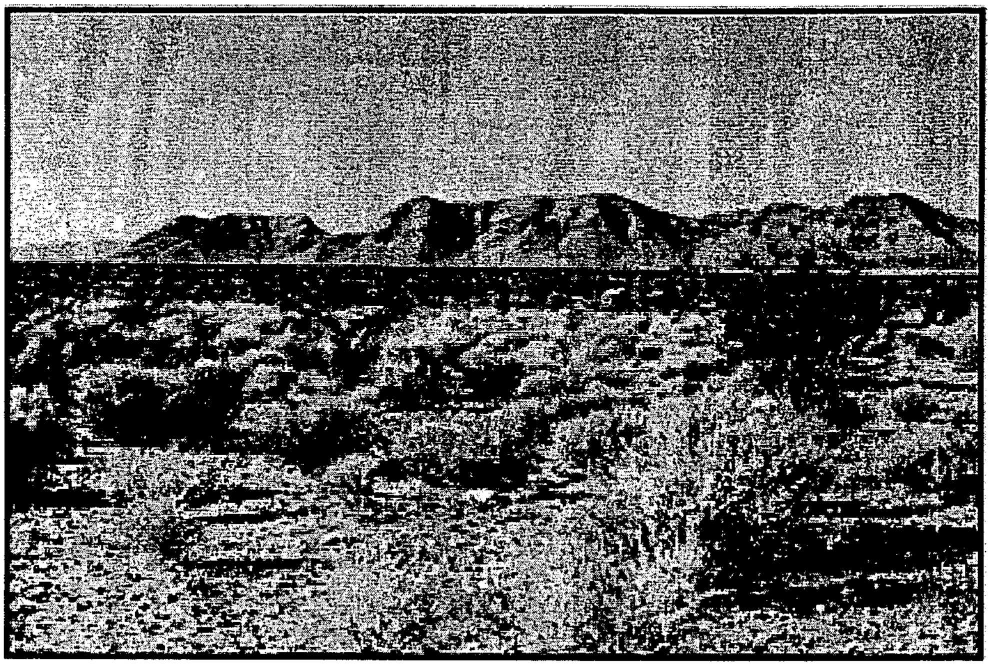
E.2.3 Indian Trails – Moapa to Sheep Range to Spring Mountains

The site of the Indian trail from Moapa to Sheep Range to Spring Mountains is located near the junction of US 93 and SR 168, and near the junction of the Muddy River and I-15. This special Indian trail connects the traditional Indian villages, located to the east in the Virgin Mountains, the Moapa villages along the Muddy River, and the Pahrump villages on both sides of the Spring Mountains. This trail also connects special natural and cultural places, such as the waters of the Virgin River and the Colorado River in the east, the Indian Salt Cave at Saint Thomas (currently under the waters of Lake Mead, a Ghost Dance site near Arrow Canyon), major sheep hunting areas in all local mountains, and religious paint sources at various locations (Site #3 photo).

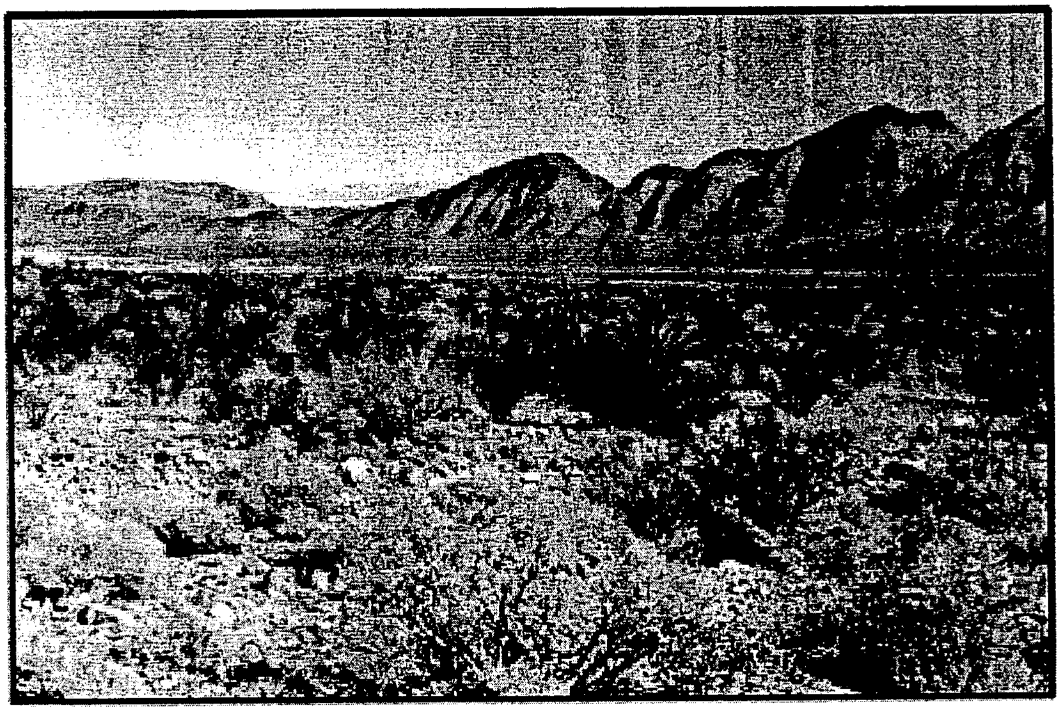
The trail to the Muddy River area was interpreted by the AITC as being traditionally used. One of the uses was an exchange of wives. Men from Pahrump Valley came to Moapa to acquire wives. In fact, the Pahrump Paiutes interpret the term Moapa to be a shortened form of "*Muh-ma'-pah*", which may be a play on words designed to leave the meaning "Woman Water."

In Indian culture, trails are sacred because they lead to places of power or spirit. Indian people physically travel trails, but they also travel through the media of song, prayer, and in their spiritual thoughts (Henningson, Durham & Richardson, 1980:81). Also the academic literature recognizes the importance of Native American trials, and describes them as the most enduring evidence of native land use (Norris and Carrico, 1978:5-11). Specifically, Norris and Carrico (1978) discuss the Mojave, the Cocomaricopa, the Yuma-Needles Trails, and other shorter and





Site #2. Potato Woman.
Showing the outline of the Creator Being Potato Woman, I-15, power lines, and various Indian food and medicinal plants.



Site #3. Moapa Reservation.
Showing the Indian Trails that criss-cross the Sheep and Spring Mountains, and the local flora.

less significant trails. These landform features possess significance to Native Americans and represent Native American land use methods and knowledge funds of the landscape. The Salt Song Trail, for instance, was and still is a landmark and sacred area to the Southern Paiutes and the Hualapais. Thus, trails are not just physical entities, but they are repositories of prayers, songs, and thoughts, as well.

If a trail is polluted at some point, the power at the other end of it may not accept you when you arrive or ever again accept anyone. Potential sources of pollution include truck accidents, parking, and drive-bys. Pollution of trails threatens the integrity and integration of cultural resources and places.

E.2.3.1 Pahranagat Valley Ecoscape

To the north and upstream of the Muddy River is the Pahranagat Valley and White River Valley-which is really one continuous watershed that has two names. The Pahranagat Valley portion of this watershed occupied a very special place in the cultural landscape that runs from Pahroc Valley to the Colorado River. In 1870, Major J.W. Powell recorded a Paiute song about this valley called "The Beautiful Valley" [MS 831-c] (Fowler and Fowler, 1971: 125).

Pa-ran'-i-gi yu-av'-i	The Paranagut Valley
Yu-av'-in-in	The Valley
Pa-ran'-i'gi yu-avai-I	The Paranagut Valley
Yu-av'-in-in	The Valley
U-ai'-in-in yu-av'-I	Is a Beautiful Valley
Yu-av'-in-in	The Valley

This song reflects the traditional views of the Indian people about this valley. A similar environmental perspective was recorded a decade earlier in 1864, when William Nye lived a winter in the valley. In his essay entitled "A Winter Among the Paiutes," Nye (1886: 194) noted that:

> *Pah-ranagat is purely an Indian name, and one which in the Piutes dialect signifies "shinining water" – the Valley of the Shining Water – a name which, at least, reflects no little poetic faculty of the Indian dwellers in this valley of the mountains. After all, it is a pleasant thought, that in the past that little strip of fertility with its grass-bordered streams, has been an Indian paradise.*

Nye's mining camp was located on a mountain side within view of Lower Pahranagat Lake. Below the camp was an Indian village whose inhabitants grew corn and melons. The Fowler and Sharrock (1973: 134) study of this valley, based on field archaeology and documents, indicated that from the protohistoric period until at least 1865, the "Southern Paiutes were farming with the use of irrigation ditches in the valley."

Although Nye noted the belief of his fellow Americans that native Indians and the white man are natural-born enemies, and that we are here only to fight and kill each other, it was Nye's experience that:

> *...Ours was an honest struggle to live in peace with our Indian neighbors; and we found them, in many respects, not very unlike what any community of two hundred white men would have been under the same circumstances...Their chief (Pah-Wichit) saw fit, at the outset, to remind us that the region was his domain. He said: "Me one great capitan," and with impressive gesture, he pointed down the valley...*

Despite the early efforts of Nye to forge a peaceful co-existence with the Indian villages of the valley, the State of Nevada was to establish the first county seat just up stream at Hiko. Before that could happen, however, there had to be a growth in local population. New settlers come to mine and farm. As a matter of policy and of image, the Indians had to be controlled. In the late1860s the members of two Indian villages, one located near the current town of Alamo and the other near Hiko, were surrounded and killed. By 1873, Powell and Ingalls recorded in their population survey of Indians, 171 Pahran-i-gats residents in the valley, headed by a chief called An-ti-av (Fowler and Fowler, 1971: 104). According to this report, the Pahran-i-gats were formerly three separate tribes, but their lands having been taken from them by white men, they have united in one tribe under An-ti-av (Fowler and Fowler, 1971: 107). All local Paiute Indians, including the Pahran-i-gats, were relocated to the new Moapa Indian Reservation in 1875.

The archeology of the Pahranagat Valley is not well known, however some important work has been accomplished. Henningson et al. (1980:388) estimates that there are 400 Native American sites in the Pahranagat Valley, of which 35 are presently known. The Fowler and Sharrock (1973: 103) study of 151 archaeology sites in the region indicated the presence of an historic Paiute site last lived in by Indian Pet is said by local non-Indian families to have died there and is still buried nearby.e and his family. The site is 200 meters north of the Hiko Post Office (Figure 4). Indian Pete

E.2.4 Maynard Lake – Red Tail Hawk Site

The Maynard Lake – Red Tail Hawk site is located at the mouth of the Pahranagat Valley on a wide sweeping S-curve on US 93. The site is within the boundary of Pahranagat National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service (USFWS) (Site #4 photo).

Maynard Lake was naturally formed in the geologic past. Although the natural dam has been breached in modern times, various past lake levels are indicated by white bands that ring the red cliffs surrounding the valley. The site is where the Kwi-nat'-sits (Red Tail Hawk, *Buteo jamaicensis*) received the white band on his tail feathers. This occurred because the red tail hawk used the canyon walls as his perch from which he protected the area. When the natural weather conditions became more arid and the lake water level lowered, it left a white band across the bottom of the tail feathers, just as it left its mark on the walls of the canyon. The red tail hawk existence and presence are tied to Maynard Lake.

The red tail hawk is one of the main animals that represents passage from this world to the other world or side. When an Indian person reaches the next life dimension (the other side) and the

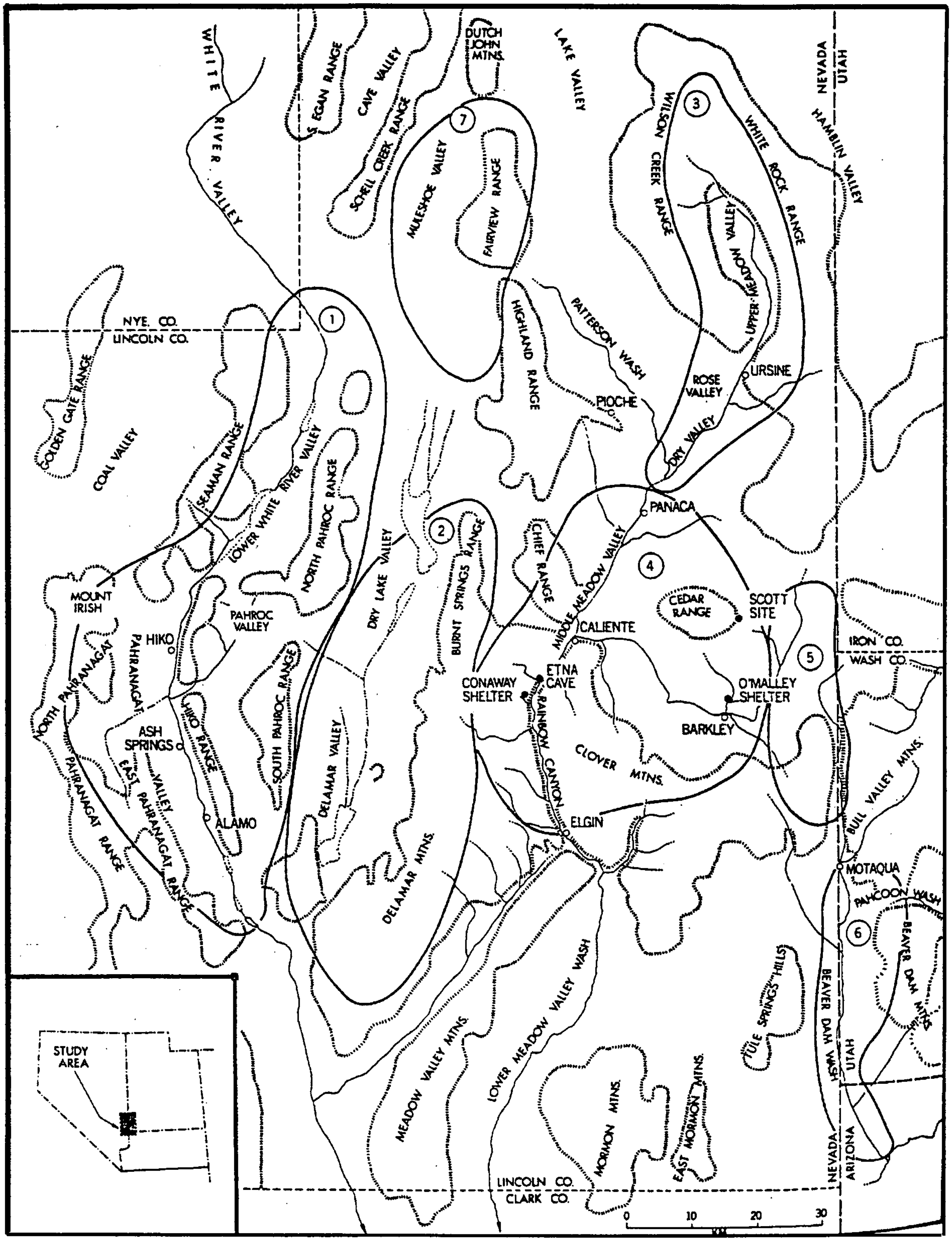
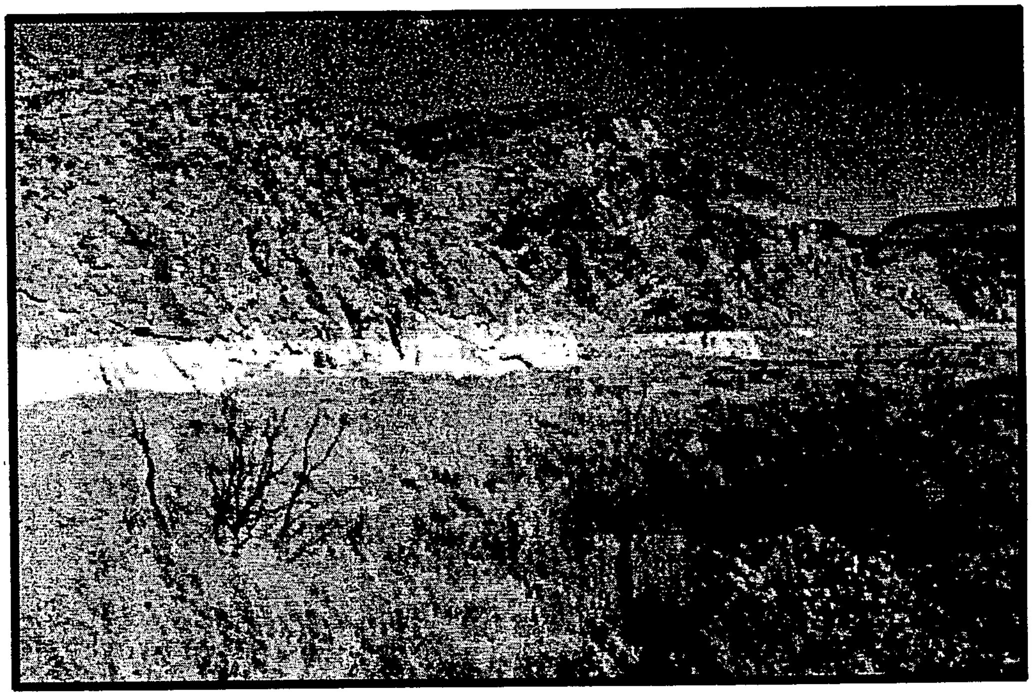


Figure 4. Archeological Areas Surveyed by Fowler and Sharrock (1973:98).



Site #4. Maynard Lake.
Showing the red tail hawk origin site.

red tail hawk appears, it means that the person is now whole and strong again. The hawk helps the person go across. The red tail hawk feathers are used in medicine fans because of the power of that animal. Red tails hawks are a good omen.

Physical impacts to this site could occur from truck accidents, parking, and drive-bys. Potential spiritual impacts are extensive. When a person passes on and you see a red tail hawk, then you know that the person has made it to the other side and is whole. If the red tail hawk becomes extinct, then you would never know whether the person has gone to the other side. If you pollute Maynard Lake, then there will be no more red tail hawks and Indian people never will know about the condition of those people who have died. The red tail hawk is both a symbol and a helper to the next dimension. The red tail hawk needs this place to live and die; its spirit returns to this place.

E.2.5 Lower Pahranagat - Storied Rocks

The Lower Pahranagat - Storied Rocks site is located just upstream (to the north of Maynard Lake) in the Pahranagat Valley on US 93. This site is within the boundary of the Pahranagat National Wildlife Refuge, administrated by USFWS.

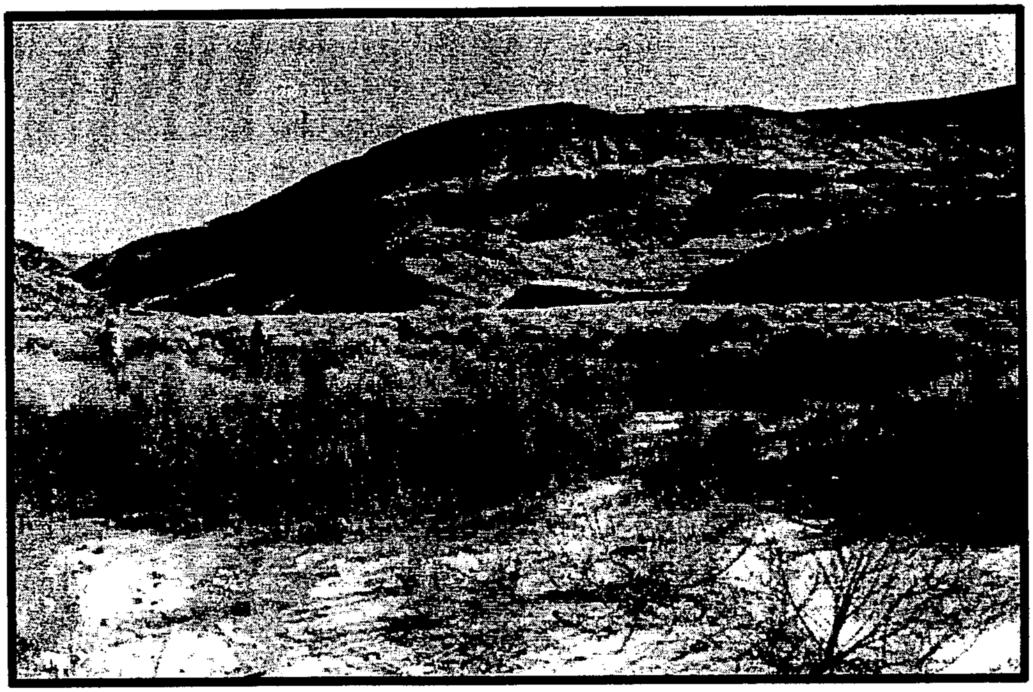
This site contains a number of rock paintings that are made with *ompi* (red paint). Red paint is used only in ceremony and is not just a source of either paint or paint color. The rock painting areas are associated with Koapi (Indian tobacco, *Nicotiana trigonophylla*), which is growing out of the cliff face. Koapi is used in ceremony and it conveys prayers to the Creator or other beings that are being talked with. Koapi seeds are given as offerings at places of ceremony and could have been a source of the Koapi plants that are now growing at the site. Another explanation is the Creator indicated the power of the site by placing the Koapi there and it still grows as a sign of a powerful place. A ka'-kwop (carved stick) is also at the site. It could have been used to stir the paint or as a physical connector between a person giving a prayer and the earth at the spot. Such a connector moves prayer into the earth and power into the person. Prayers and songs performed at this place serve to keep the earth in balance. These prayers and songs are part of a Creation-based responsibility to maintain harmony between people and all other elements of the earth.

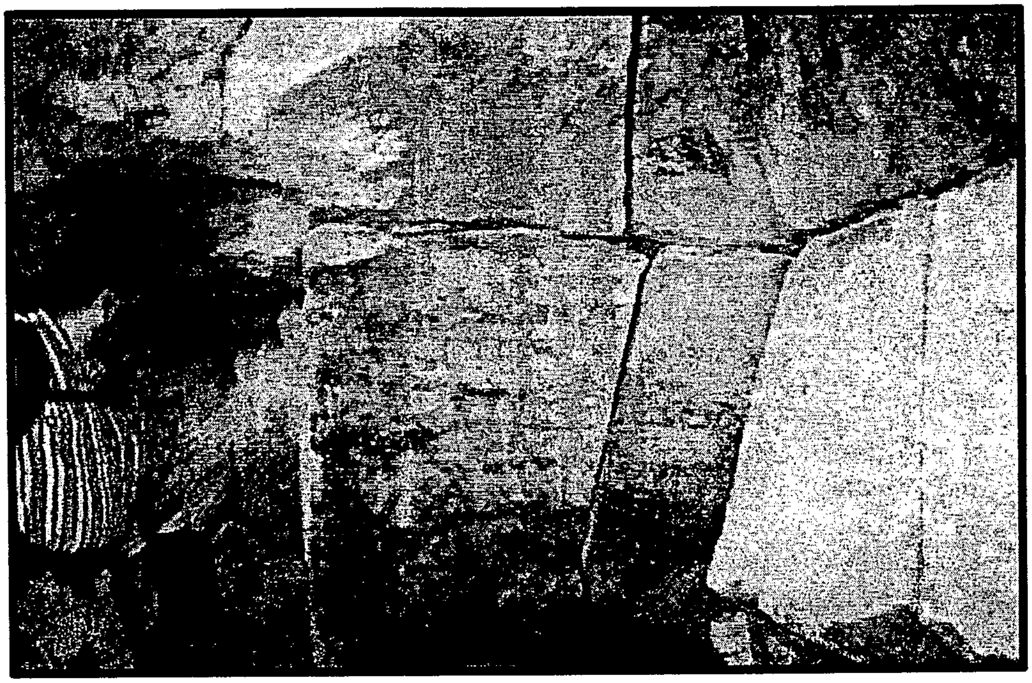
The site contains a number of Indian plants including special plants and foods such as Great Basin rye, salt brush, and Indian tobacco.

Physical impacts could derive from truck accidents, parking, and drive-bys. Spiritual impacts could include damage to the power of the place. Previous prayers and songs performed at the place could be neutralized by pollution, thus reversing the harmony and balance created by previous ceremony (Site #5 photos).

E.2.6 Upper Pahranagat - Black Canyon

The Upper Pahranagat - Black Canyon site is located in the upper portion of Pahranagat Valley within the Pahranagat National Wildlife Refuge, managed by the USFWS. The site is centered





Site #5. The Lower Pahranagat Valley.
Showing local flora and an AITC member investigating rock painting panels.

on a bend in the river where it passes through a resistant volcanic formation called Black Canyon. US 93 passes through the site.

Rock peckings have been placed by Indian people on many of the boulders and cliff faces in this volcanic formation. These rock peckings range from complete panels that are covered with interrelated figures and shapes to peckings on isolated boulders. On top of one prominent butte are a number of high-walled, circular structures. In the original riverbed are marshes filled with seed grasses. At any one time, according to the ranger, there are 250 species of birds living in the area. The site is on the Pacific Flyway for migratory birds, but it is also the permanent home for many species. A red tail hawk nest is located in a large cottonwood (*Populus spp.*) just below the butte. Mammals in the area include coyote (*Canis latrans*), bobcats (*Felis rufus*), mountain lions (*Felis concolor*), muskrats (*Ondatra zibethicus*), and deer (*Odocoileus hemionus*), some of whom sleep at night on a grassy area just below one of the large cliff-face panels high on the butte. Indian tobacco grows out of the cliff face below many of the panels. Pahranagat Valley is the place where the Pahranagat/Moapa people were created.

The AITC interpreted the site as a place to seek knowledge and power, to conduct ceremony, and to communicate with spiritual beings. The site contains medicines, food, and drink, but its power caused it to be exclusively used for ceremony. Living, farming, hunting, plant collecting, and social gathering areas were located elsewhere in the valley. The site is connected spiritually, physically, and via common ceremonial activities to other places in the valley including Maynard Lake, Lower Pahranagat pecking panel, and Crystal Springs to the north.

Physical impacts could derive from truck accidents, parking, and drive-bys. Spiritual impacts could include damage to the power of the place and a reversal of the harmony and balance created by previous ceremony (Site #6 & 6A photos).

E.2.7 Caliente – Downtown

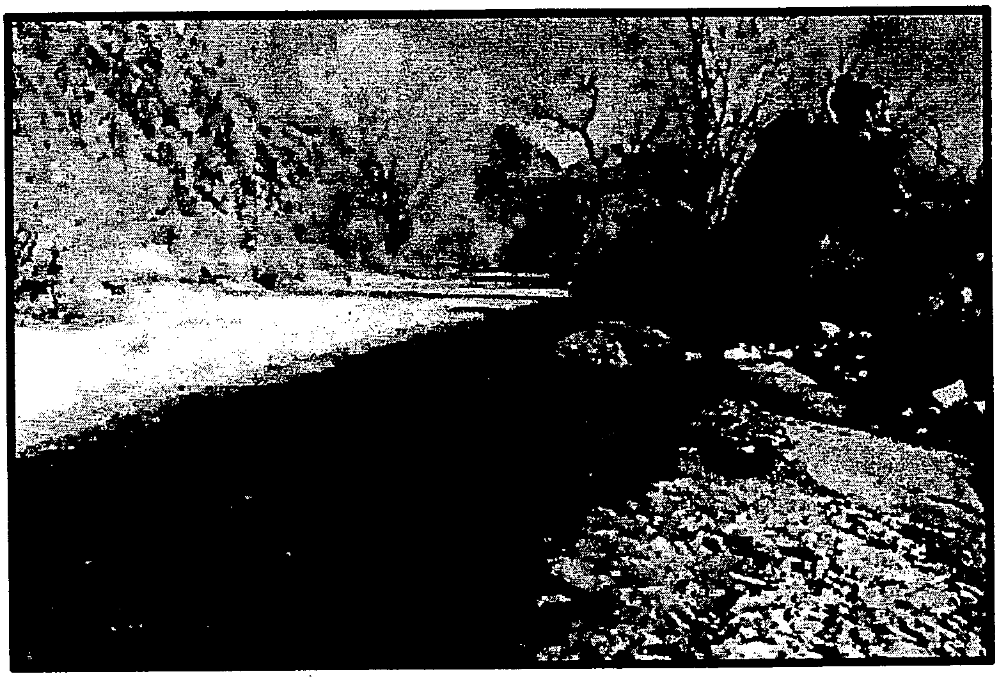
This site is located in downtown Caliente within an existing railroad yard. US 93 passes next to the site. The Union Pacific rail line enters the area from the east along Clover Creek and leaves the area through Meadow Valley Wash (Site #7 & 7A photos).

The site is near a hot spring (from which the town of Caliente derived its name), and is located near the junction of two permanent watercourses – Meadow Valley Creek and Clover Creek. The immediate area surrounding the site and along these watercourses contains 3 power caves that have been used by Indian people for thousands of years. Caliente was an area of dense Indian populations up to 1873 when Powell and Ingalls conducted their census. Henningson et al. (1980) estimates 13 presently known Native American sites in Clover Valley. The number of Native American sites in Delamar are estimated to be 247, of which 10 are presently known (Henningson, Durham & Richardson, 1980:388). A number of Southern Paiute men worked for ranches headquartered in the Caliente area. Delamar mine attracted many Indian men during the late 1800s. Eagles live all around the town.

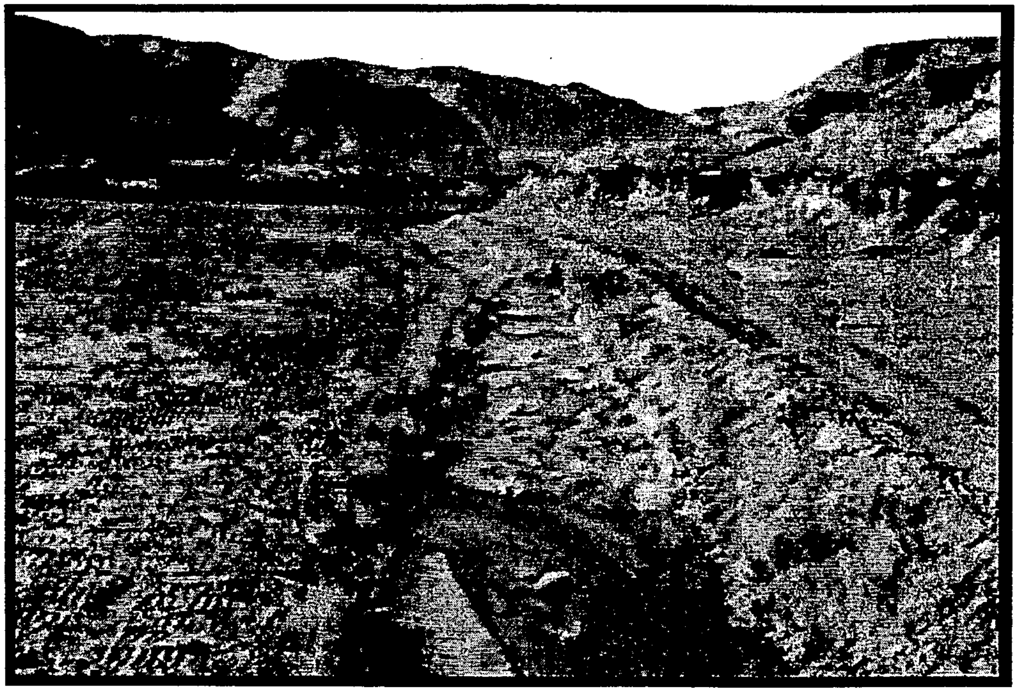
The AITC interpreted the site as a place for permanent living, hunting, and food gathering.

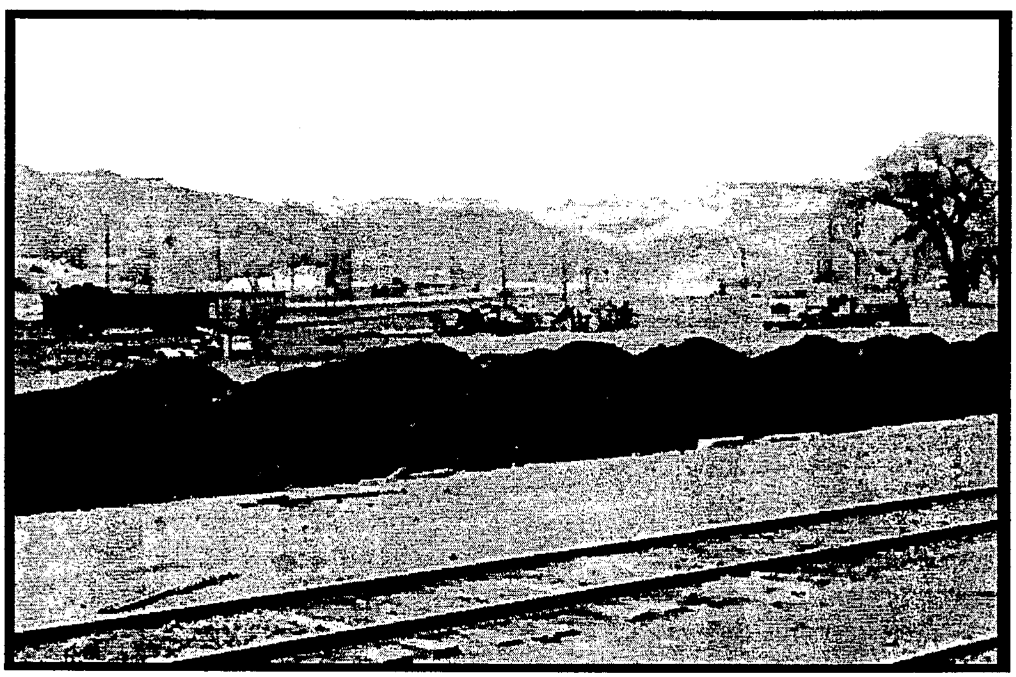
Site #6. The Upper Pahranagat Valley at Black Canyon.
Showing a marsh, a cottonwood tree, and Indian stone-walled structures.

**Site #6A. The Upper Pahranagat Valley at Black Canyon.
Showing rock pecking panels and Indian Tobacco growing below the panels.**



Site #7. Caliente – Downtown.
Showing the UP Station, railyard, and Clover Creek.





Site #7A. Caliente – Downtown.
Showing the UP railroad yard, wreckage from a recent accident, mounds of coal from the accident, and the Meadow Valley Creek.

Living sites and caves used for power are located along the Clover Creek and the Meadow Valley Wash. Three of these caves have been intensively studied (Fowler, Madsen, and Hattori, 1973). Additionally, an archaeology study of 151 sites in the White River Valley, Pahranagat Valley and Pahroc Ranges showed evidence of farming from the pueblo periods through the Shoshone periods (Fowler and Sharrock, 1973: 135). Evidence of farming also came from the Etna Cave study (Wheeler, 1973: 42).

The area has been altered, however, the nearby hot springs and watercourses are still fully functional. There once was a large Indian population in the area, and although this population has been reduced, two extended Indian families remain. Most of these families live near the site to the southeast of the train depot.

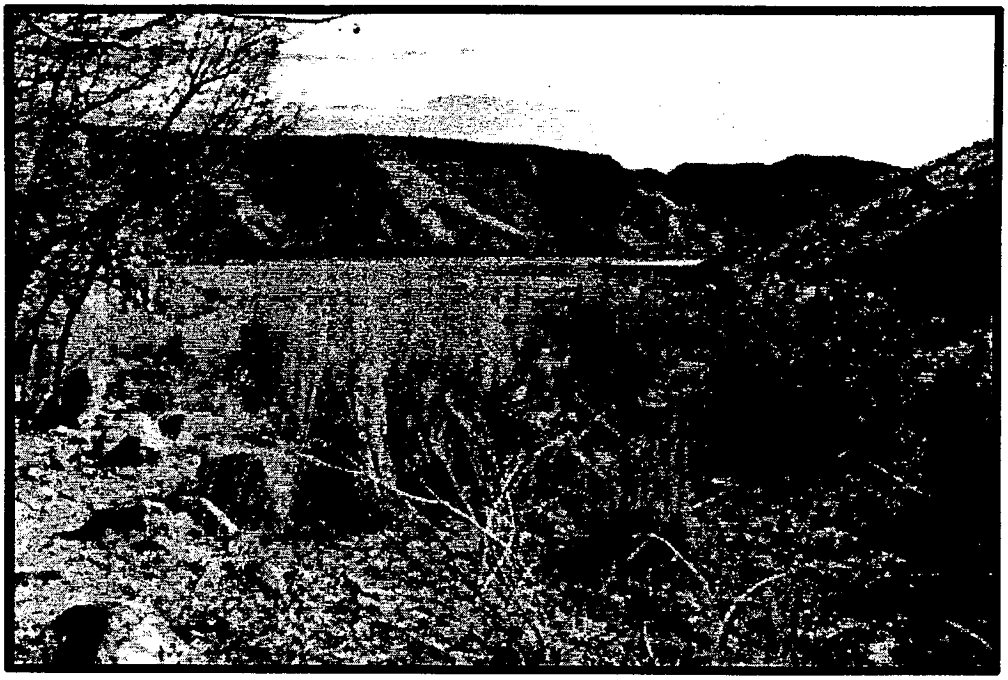
Potential impacts could derive from train accidents, rail yard accidents, and truck accidents. On December 24, 1998, a UP train left the tracks 4 miles up stream on Clover Creek from Caliente. This accident took out a railroad bridge and placed many of the cars and their loads in the water of Clover Creek. The haul was coal, so it was scooped up and disposed of in big piles in the UP railroad yard in Caliente. The site is subject to major flash and stream flooding. Highways and trail routes follow (or are near) water courses. Open range grazing is also practiced in the area. The health and lifestyles of Indian families living in the community could be effected. Spiritual impacts could also affect the food plants, the eagles, the water spirits and the power caves.

E.2.8 Caliente – South

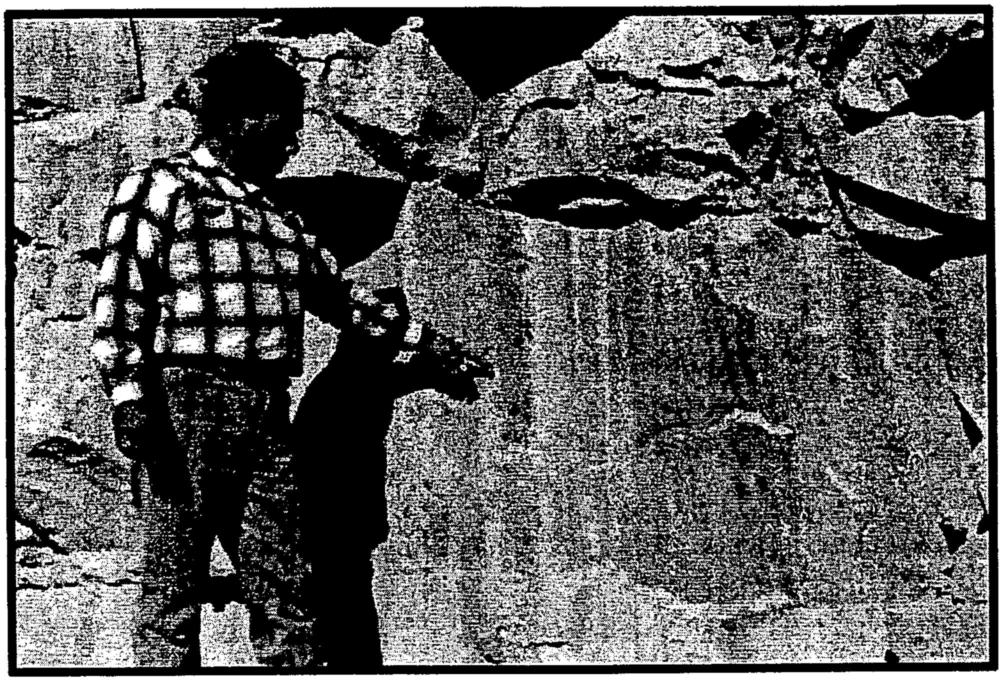
This site is located about 2 miles from downtown Caliente, south along the Meadow Valley Wash. The site is in the floodplain of the Meadow Valley Wash. The site is about ¼ mile from US 93.

This site is composed of a series of painted and pecked storied rocks. These occur high above the flood plain along vertical cliff faces and at the foot of sheltered cliff faces, which form the mouth of a side box canyon. This box canyon contains what appears to be a permanent stream that travels its full length creating a marsh at its mouth. The box canyon has a diverse ecology with oak trees (*Quercus spp.*, *Auive*), grapevines (*Vitus arizonica*), wild roses (*Rosa spp.)*, watercress (*Rorripa nasturtium-aquaticum*), Great Basin rye (*Elymus or Agropyron spp.*), and buck brush (*Ceanothus spp.*). The canyon contains many birds.

The AITC interpreted the site as being a place of ceremony and power. The acoustics of the upper portion of the box canyon are a unique cultural resource because they amplify and contribute to songs, prayers, and ceremonies. Birds of the canyon receive the songs, prayers, and ceremonies and carry them out of the canyon to other areas. The rock paintings at the mouth of the box canyon were interpreted as being where ceremonies were conducted to prepare people before they entered the canyon to conduct ceremonies. A large stone covering plant offerings exists near the painted panel. The box canyon has an aesthetically and strategically pleasing viewscape. There is a grinding stone near one paint panel, which was used to prepare medicine and not for food processing (Site #8 & 8A photos).



Site #8. Caliente-South.
Showing the floodplain and storied rock panels in the Meadow Valley Wash.



Site #8A. Caliente-South.
Showing a member of the AITC Team examining a rock painting,
and watercress (*Rorippa nasturtium-aquaticum*) in a side canyon spring.

The impacts to this site could derive from a number of sources. A nonliving Muupuitsi (owl, *Bubo virginianus*) was observed by the AITC in front of the mouth of box canyon. This was a sign that something bad is to come. It is like they are in an area where they should not be.

People are going into the area bringing in bad thoughts and plans. This is a powerful, lethal problem. This bad power will cause a spiritual imbalance that is as strong as the most deadly radiation.

The construction and operations of the IM facility would bring people, machinery, ground disturbance, and viewscape changes to the site. The use of the site will increase vibrations and possibly release the base of the rock panels. Possible pollution could derive from train, rail yard, and truck accidents. Spiritual impacts could nullify previous prayer and ceremony, and preclude the performance of such prayers in the future. Radiation could make the land, water, and the animals sick, and/or unwilling to give their power to Indian people. Indian access to the area would be precluded by developing an IM transfer yard here.

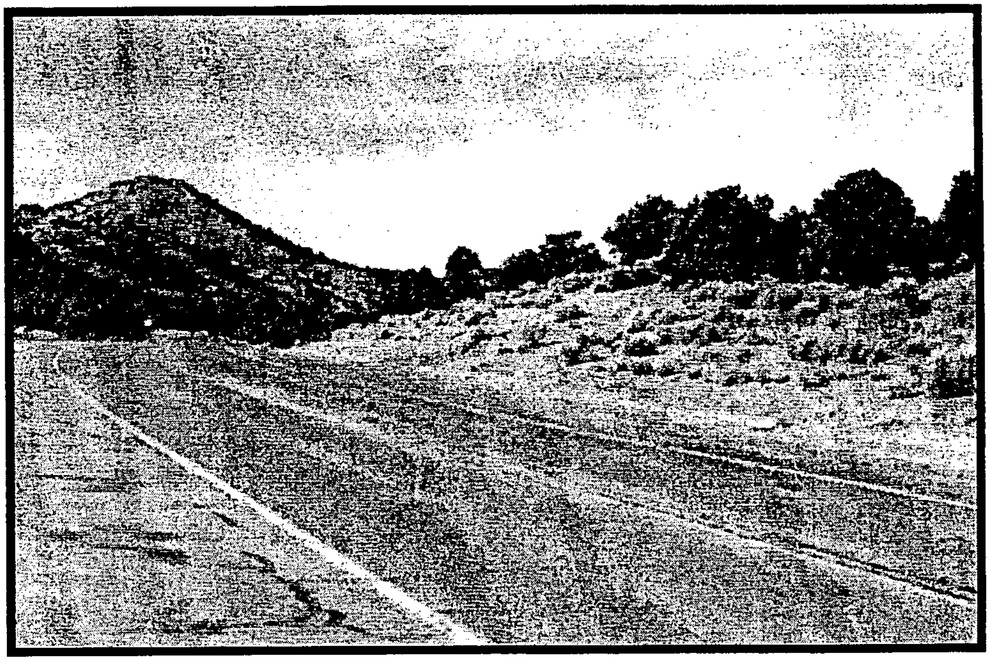
E.2.9 Oak Springs Summit

The Oak Springs Summit site is located along US 93 and extends on both sides of the road throughout the dense pinyon and juniper forest area for approximately 10 miles. The center of the site is approximately at the Oak Springs Summit, at an elevation of 6,234 feet.

The site is a prime high forest habitat. It thus supports rich stands of pine trees, cedars (*Juniperis spp.*), sage, Indian tea (*Ephedra nevadensis*), rabbit bush (*Chrysothamnus nauseosus*), and buck brush (*Ceanothus spp.*). Here there is Indian food in the form of pine nuts, medicine from the cedars (*Juniperis spp.*) and sage, and animals. The deer (*Odocoileus hemionus*) herds are extensive. The mammal population supports mountain lions (*Felis concolor*), bob cats (*Felis rufus*), foxes (*Vulpes spp.*), and coyotes (*Canis latrans*). The springs support all life (Site #9 photos).

The AITC interpreted the site as being central in the lives of Indian people from throughout the region. One AITC member collected pine nuts at Oak Springs Summit with a group of Indian people from Moapa just four years ago. The sage (*Artemisia tridentata*) in this forest is especially abundant and aromatic, and was collected at the time of the study. Sage and other plants, which grow in high forest habitats are more powerful.

Potential impacts derive from truck accident, parking, and drive-bys. Spiritual impacts involve reducing the willingness of the plants and animals to share their power. Radiation can kill the power that these plants and animals have. Open range grazing, dense deer herds, combine with narrow steep winding roads and frequent heavy snow storms to make this area known as dangerous to traffic.



Site #9. Oak Springs Summit.
Showing pinyon and cedar trees, and a member of the AITC Team standing before a productive pinyon tree.

E.2.10 Six Mile Flat – Pahroc Summit Pass - Eagle Habitat

The Six Mile Flat - Eagle Habitat site is located at an elevation of approximately 4,400 feet along US 93 between the Pahroc Summit Pass and the Hiko Range (Site #10 photos). This site is open grasslands and has a pair of nesting golden eagles (*Aguila chrysaetos*), which were observed during the AITC study sitting on the US 93 corridor fence line. The eagles are highly visible and a culturally important bird species. They also symbolize the great diversity of plant and animal species inhabiting this high valley grassland. The Pahroc area contains a number of Indian living areas. Many of these were documented by Fowler and Sharrock (1973).

Potential impacts included truck accidents, parking, and drive-bys. The area is largely fenced but there are sections such as in the Hiko Range Pass at the western end of the valley where there are grazing cows and no fences. The AITC observed a cow that had been killed just a few hours before. This cow was killed on a steep blind curve in a reduced speed zone having a 65 mph posted speed limit.

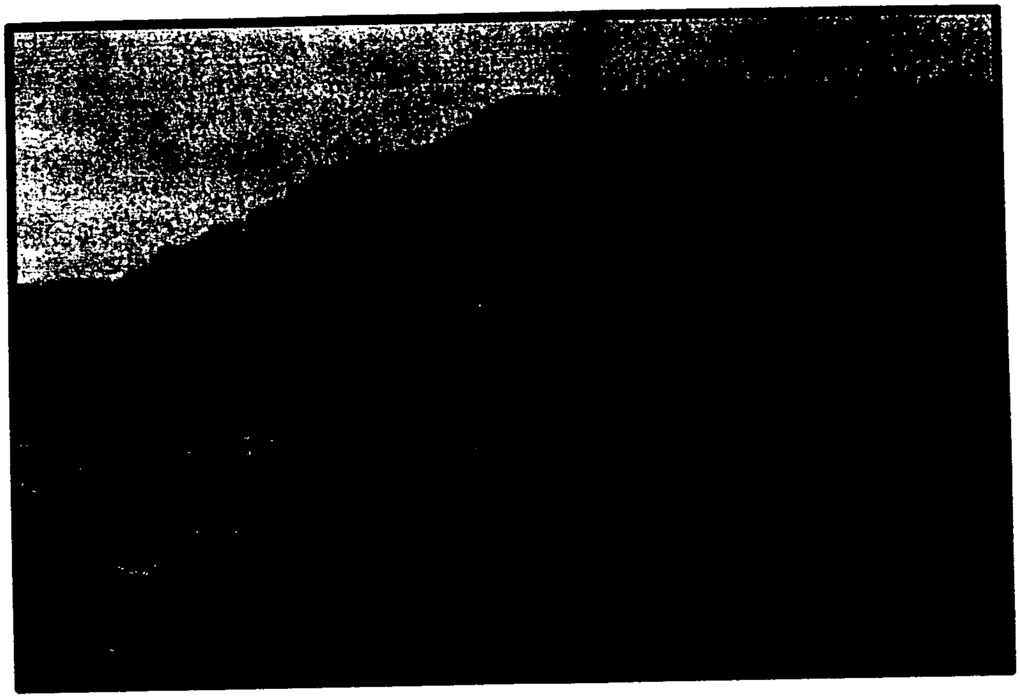
E.2.11 White River Narrows Archaeology District – BLM

The White River Narrows Archaeology District site is located on US 318, about 20 miles north of US 93 at Crystal Springs. The site is in the White River Narrows Archaeology District of the Bureau of Land Management (BLM). The site is divided by US 318.

This site is a place where a fairly large area of resistant stone has been dissected by the White River as it passes from it headwaters near the White Pine Range near Preston, Nevada, and then continues on its way to the Pahranagat Valley, through the Muddy River Valley, and finally joining the Colorado River. This site, therefore, is in the same hydrological system as many other sites in this study. The site contains a number of rock peckings and paintings. These tend to be on the cliffs facing the White River and at the upper reaches of side canyons (Site #11 & 11A photos).

The AITC interpreted this site as being a point of comparison with the two storied rocks sites in the Pahranagat Valley. The red paint represents the presence of a spiritual place and the conduct of ceremonies by Indian people. The power of the place derives in part from having a river narrowed by powerful resistant rocks. Ceremonies would be held near water. The site is similar to the two Pahranagat sites in that they all are at points along a winding water course that is constricted by rock cliffs. The side canyon pecking site is a place where Indian people would have prepared themselves before going into the main canyon narrows along the White River.

Potential impacts could derive from truck accidents, parking, and drive-bys. These could directly damage the storied rocks and could pollute the White River. The water here runs all the way to the Colorado River. Spiritual damages could occur by upsetting the balance and harmony of the place. It is a whole and coherent system. and if you damage a part of it, it is not a whole any more. Prior prayers and ceremonies that have maintained balance can be negated by damage from radioactive pollution.



Site #10. Six Mile Flat.
Showing the Pahroc Mountains and a dead cow on US 93 between the Pahroc Summit Pass and the Hiko Range.

Site #11. White River Narrows.
Showing the White River Wash and rock painting panels.

Site #11A. White River Narrows.
Showing a member of the AITC Team member
examining rock art panels, and a parked truck.

E.2.12 Hiko – Historic Massacre Site

The Hiko historic massacre site is located near the contemporary town of Hiko, Nevada, along US 318 and about 5 miles north of Crystal Springs on US 93 (Site #12 photo). The town of Hiko, the surrounding ranches, and the massacre site itself are defined as the site being identified in this study. The massacre site itself is located where the western Indian trail out of Hiko begins to enter a pass through the mountains.

The site is defined as where a local group of Indian people experienced hostile relationships with newcomer settlers. These hostilities resulted in an entire community of Paiute Indians being killed at one time. The Paiute Indians were surrounded by the White newcomers and then massacred. The massacre was documented by a local newspaper. More recently, oral history with longtime residents document the event itself explaining the White point of view; that the Indians had to be killed because they were stealing horses. These oral history interviews document that a cradle board with the skeletal remains of a child were found in later years stuck into a rock crevasse near the massacre site. The cradle board has subsequently been removed by unknown persons.

The area contains unsettled spirits. These can potentially be further disturbed by truck accidents, parking, and drive-bys. The area is extremely sensitive to Indian people today. It is like driving through a place, which has on-going spiritual turmoil. The massacre left the Paiute people without a burial so they never made their passage to the other side. The Indian people know that the local ranchers have collected some of the artifacts and bones from the massacre site. These artifacts and bones will have to be buried with a proper funeral in order to begin to restore balance to the area. The presence of radioactive materials can only further disturb the situation.

E.2.13 Crystal Springs

The Crystal Springs site is located on US 93, at the junction with US 318. The site consists of a series of major (slightly) warm springs. At this site, there are many trees and Indian foods like watercress. A red tail hawk was observed at the site, as well as, a number of other types of birds. Water babies are in the springs and in the water system. They can travel up and down throughout the hydrological system. The water babies in this area have been influenced by the Hiko massacre. As a result, there are more water babies in the local hydrological system and they are angry because of the massacre. It is possible that the water babies are now holding some of the spirits from the massacred people, especially the children. The parking areas near the springs are especially dangerous at night and should not be used (Site #13 photos).

Potential impacts can derive from truck accidents, parking, and drive-bys. Spiritual impacts could occur to water babies. Radiation can anger the water babies. They will respond with their own form of anger. They can travel anywhere in the hydrological system from the headwaters in the White Pine Mountains to the Colorado River.

Site #12. Hiko.
Showing a dead deer along NV 318.

Site #13. Crystal Springs.
Showing abundant warm spring water, poplar, cottonwood trees, and watercress.

E.2.14 Twin Springs, Twin Springs Slough, Echo Lakes

The area of Twin Springs, Twin Springs slough, Echo Lakes is located on US 93. The site consists of twin springs, the slough flowing to the east for a number of miles before entering Echo Lake (Site #14 photos). The site is a high elevation water source that supports a number of special Indian birds and animals. A red tail hawk was observed at the site. The site is on an old Indian trail connecting neighboring villages. Impacts to water include the danger of killing the water, the animals, and the plants.

E.2.15 Warm Springs, Hot Creek Valley

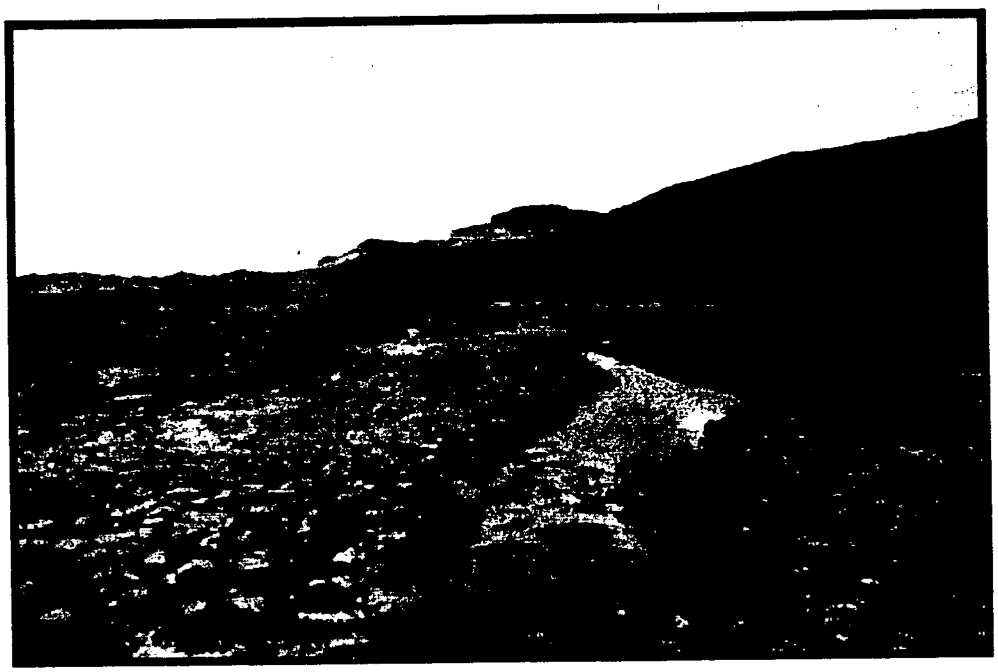
The Warm Springs and Hot Creek Valley area is located on US 93 where it joins Highway 6. The site consists of a very hot spring, a long flowage area to a lower elevation, and an historic bathing facility. Tribal representatives are interested in managing this area for ceremonial purposes as these hot springs were used by Indian people to conduct healing and purification ceremonies. The proximity of the hot springs to Hot Creek Valley is important and related to the First Mensus Site where Indian women would visit before participating in ceremonies. A member of the AITC used the hot springs on a regular basis while he was working at the Tonopah Test Range (TTR): Potential impacts are water pollution and on past ceremonies conducted at the site (Site #15 photo).

E.2.16 Death Valley Junction - Ash Meadows

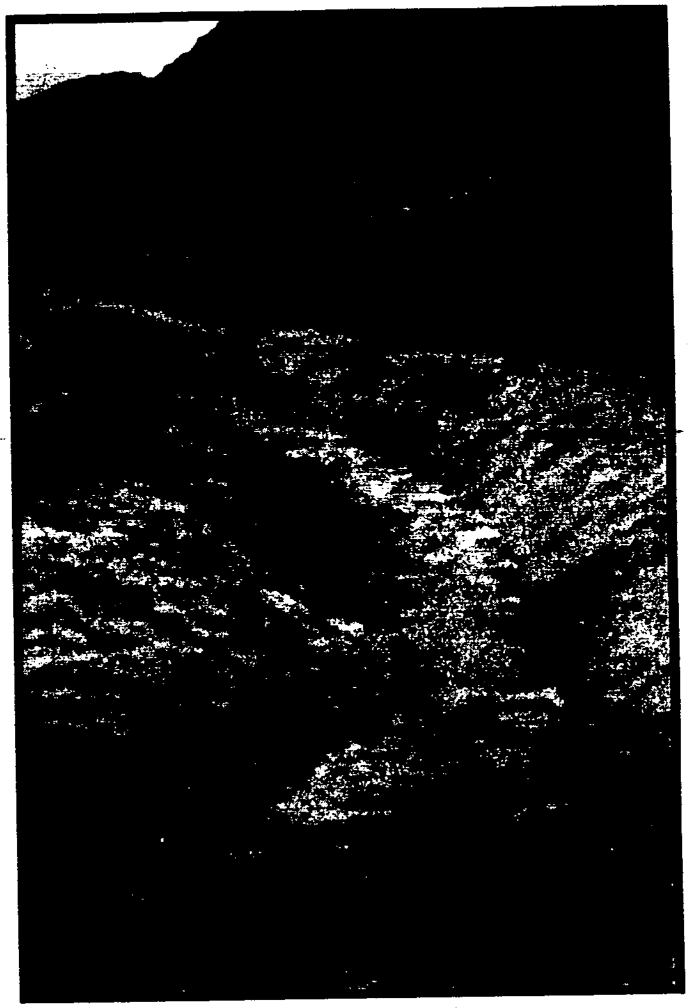
The Death Valley Junction - Ash Meadows area is located where SR 190 and SR 373 meet, west of the Amargosa River Valley. Death Valley Junction was an historic trading place for Indian people who brought in baskets and other items to trade for coffee and sugar. One pound of either was traded for 6 to 8 baskets. "My grandma used to go over there and trade those baskets," said a member of the AITC Team. This site is composed of physical and spiritual places that are traditionally important to Indian people. The area contains a number of human activity areas such as living, hunting, ceremonies, and trails.

Spiritually, it is the place of the giant birds and lizards, and where they lived and fought. These activities resulted in a number of physical places in the area including 3 little green hills near Death Valley Junction and a mountain with a dark shadow that, from one perspective, looks like an eagle, and from another perspective, looks like a lizard. Such places are used to receive spirit helpers. The giant eagles and lizards came from a hole in the sky to do their fighting. Ash Meadows is made by a giant spiritual being's foot that hit the land. When this foot hit the land it created the water in the valley.

The area is the center of a number of traditional trails, which exist both physically and spiritually. The Salt Song Trail comes through this area, arriving on the eastern side of the Spring Mountains near Indian Springs, goes through Pahrump to Ash Meadows, comes back south near Eagle Mountain, travels down the Amargosa River, past Shoshone, and turns at Dumont Dunes. It goes up through Baker and Soda Lake, then passes south to Providence Mountains. From there, it goes to 29 Palms then to the San Bernardino Mountains, turns east



Site #14. Echo Lakes – Twin Springs Slough. Showing frozen lake and water flowing along the slough into the lake from Twin Springs.



Site #15. Warm Springs.
Showing flowage of hot water into an abandoned bathing resort.

towards the Colorado River, and crosses into Arizona south of Blythe, completing the journey (south of Riverside Mountain).

All along this songscape, there are places of great cultural significance to Indian people. The medicine cane in the museum at Mitchell Caverns is so important that Indian people today make religious pilgrimages to see it and Mitchell Caverns. Currently, the Indian people who sing the Salt Song to send their people to heaven are retracing the route and stopping at special places along the route of the song. The whole Salt Song Trail is highly culturally significant and totally interconnected. The Fox Trail is a second spiritual trail that comes into the area. It moves in leaps from spring to spring, traveling south from the Whipple Mountains, to the north, past Chemehuevi Mountains, past the Dead Mountains, over Paiute Mountains, behind the Spring Mountains towards Shoshone territory bounded by the Funeral Mountains (called in Paiute Shoshone Mountains because it is a boundary area). The Funeral Mountains sit high above Death Valley serving as a gateway to the valley and as a transition from Paiute to Shoshone lands. If you look real close, the Funeral Mountains float in the air. That was his (Fox's) journey down to the southern end. He made the water holes with his arrow. They are in a straight line. Indians travel this route in ceremony through song to check on the water and bless the water and give thanks for the springs, and this keeps them alive. The Indian people go to these springs for special purposes because the springs are special areas.

In the Ash Meadows area, there is an historic cemetery that contains approximately 35 graves of Indian people including relatives of Chief Tecopa. The cemetery is located within lands managed by the USFWS and visited regularly by members of the Pahrump Paiute tribe.

The Ash Meadows area contains special plants that are needed for Indian ceremonies. This is one reason why Fox came here. There is also such a place over by Searchlight, Nevada. Here also, there is a woman lying down in the Spring Mountains (just to the north of Mt. Charleston) who watches over the area. If you do wrong in the area, she will punish you. There are water babies in the area who will do the same. The springs in the area were created when a giant who traveled through the area caused holes in the earth that water came from. Ash Meadows is on the Salt Song Trail and is described as it comes around Indian Springs on the east side of the Spring Mountains.

Ash Meadows was known as an area of great gatherings involving many local groups. Some of these gatherings were for social purposes, especially in the fall, while memorial gatherings were in the spring. Local clans came together for religious ceremonies and for doctoring. According to a Chemehuevi elder, whenever a big gathering was called by the *ha-ut-to-wen-tum*, (the real chief), runners were sent to distant villages to announce the ceremony. In later years, the ha-ut-to-owen-tum was Tecopa, who lived in the Ash Meadows area. He was the man. When a runner arrived at a distant village he would give the leader (*to-wen-tum*, a local or small chief) a knotted string. The leader would then know when to come with his village members to the designated location by untying a knot each day. *Tunop* is the name of the tied (knotted) string. They had runners and messengers who would run across the desert in one night -- distances so far that a normal person would have taken two days. That was all that the runners did. They were full-time runners. Senior runners were 40-50 years old.

Crystal Springs in Ash Meadows was especially known for doctoring. A noted Pahrump Paiute woman performed numerous doctoring ceremonies for Indian people near the Crystal Springs area. People would come from all over to get doctored. One of the medicines used was the chuckwalla (*Sauromalus obesus, sung-wada*), which was collected by doctor's helpers and then boiled up in a broth and given to really sick people who were being cured. The water at this location is very sacred as it is very clear and bubbles up from deep underground. Indian people used this water for ceremonies because it was so special. An AITC Team member said that his grandfather and father went to the area in 1933-34 for a big ceremony at Ash Meadows. Indian people have come to this area for thousands of years to get power and medicines that were not available anywhere else. After that time, the state and federal agencies took it away from the Indians and forced them out of the area. Then, they started damming it up to make livestock diversion canals. They dynamited the spring to make it come out more, according to one AITC Team member. Indian people have extensive knowledge about underground water systems that are connected to Devil's Hole. One such place is the water near Shoshone, California, where if you were not careful, the water babies would take you all the way underground to the Shoshone area. Of importance is the historical cemetery, a tourist stop, located 15 feet away from the road.

Potential impacts to the area can be derived from truck accidents, parking, and drive-bys. Our spirits will paint their faces and open up a can because they are disturbed by the presence of angry rocks. When we are out there now it is still and peaceful; it is like being in a church chamber. The harmony of the valley will be disturbed, and it will no longer be the same. It will be violated. All the previous songs and stories that have been shared in the area will be disturbed. Once a song is sung it continues to be there. When you sing a song you are on the trail – your spirit is making that trip. You are describing where you are at and what is happening. You tell in the song where you are and what you are doing. When people go to these areas today, a person can get a song. Previous songs live in the mountains and in the canyons. If you were a gifted person who was meant to be an owner of the song, you can actually hear it. The little people will come out of the side of the mountain and sing it to you. There are still areas today where you can go and hear the song. Some people hear the song and it scares them because they do not know what it is. Young people need to be told what it is they are hearing. The places need to be protected from damage so the songs continue to be there for future generations. It is like a delayed echo that never goes away and can come again and again to new people. A native person has the ability to go there and hear.

The prayers and songs were put in the walls by the animals who made the original trip. There were two sisters with a group of animals who made the Salt Song trip. The Bird Song trip was just made by the birds in their travel up the Colorado River. Some birds stayed along the route. They also traveled into the sky and became cold and lost their brother birds.

A place like this is powerful. The shaman knows how to use it. Each generation has its shaman who takes 20-30 years to be effective. The place is not changed because it shares its power, but repeatedly is used over generations, which makes the shaman and his people feel the place is more significant. You do not just take, you give back to the place. You give back prayer, honoring, and gifts to the place. Over generations of offerings, the place is both honored, but it also becomes adorned by the offerings – that is, it becomes prettier. So if you take the offerings away, the sacredness of the place is diminished. The power is still there, but you strip the place of its honor and beauty. If you put it back under the *Native American Graves Protection and Repatriation Act (NAGPRA)*, it restores the original intent of the offering, as well as, putting back the honor of the ceremony and the beauty of the place.

E.2.17 Eagle Mountain – Amargosa River Area

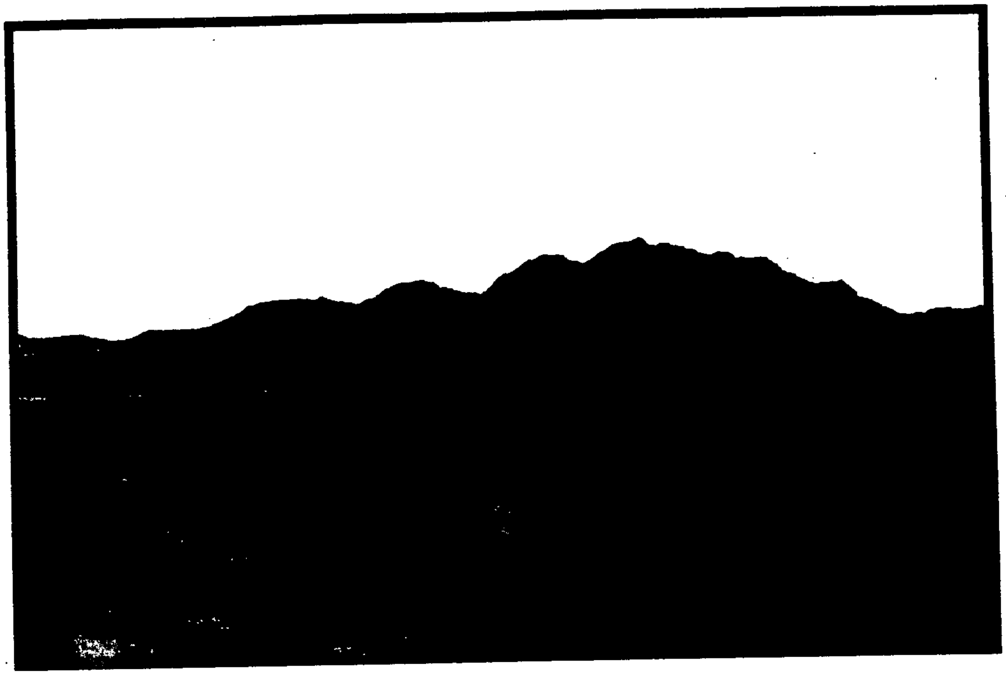
The Eagle Mountain – Amargosa River Area site is located on the Amargosa River, which is marked in this area as having 7 miles that are subject to flooding (Site #17 photos). This site consists of a landmark on the Salt Song Trail from the north to the south that indicated you are approaching the Funeral Mountains boundary for the Shoshone. Certain mountains are places of creation, are areas of spirit animals and visions, and therefore are sacred locations. Besides providing places of power and the emergence of the Indian people and the environment, mountain ranges contain powerful spirits and other creatures (Henningson et al., 1980; Kelly, 1939; Fowler and Fowler, 1971). One such location is Eagle Mountain, which is a symbol of many events that took place in the immediate area. An AITC member's great-grandfather was killed in Ash Meadows by some Shoshone who crossed over the boundary at night. It is also a place where a 49er group was passing through the area causing great concern by the Indian people. They were afraid of being caught so the Indians left a crying child on the trail. It is now considered to be a very important area by contemporary families of Pahrump Paiutes. It is the origin home of the eagles – that is where eagles are from. Just to the north of the Mountain is Devil's Hole. One Paiute person was pulled in there by the water babies and came up alive at the spring near Shoshone. This demonstrates the underwater movement of the Amargosa River.

Possible impacts to the area could derive from truck accidents, parking, or drive-bys. The presence of radioactivity materials in this area could physically pollute the Amargosa River and all downstream locations where it travels. Spiritually, the water babies both upstream and downstream could be angered by radioactive waste and they could pull the water back into the ground drying up the area or harming people and animals. The eagles on Eagle Mountain could be effected by radiation and would never be able to return to their place of origin.

E.2.18 Shoshone

In the town of Shoshone, there is a cemetery in the Dublin Hills. There are known Indian burials (and burials of non-Indians) in a graveyard right next (about 100 feet) to CA 127. These burials are actively visited by Indian people for ceremony and almost daily by tourists who stop there out of curiosity about this historic Indian and Anglo town. The pull-out near the cemetery was observed by the AITC as being used as a rest area for trucks traveling along CA 127. Nearby the cemetery are locations where Indian people used to place their baskets that were used for processing foods and medicines. Many of these baskets were blessed with prayers, both when they were made and placed in their locations.

The town of Shoshone is located on the southern route of the Salt Song Trail as it passes along the Amargosa River. The song describes the valley, the plants, the animals, and the people who occupy the area.



Site #17. Eagle Mountain.
Showing Eagle Mountain, flora, and the expansive Amargosa River floodplain along CA 127.

E.2.19 Tecopa Hot Springs - Amargosa Canyon Natural Area - Area of Critical Environmental Concern for BLM (American Indian Health Center – C. Harney)

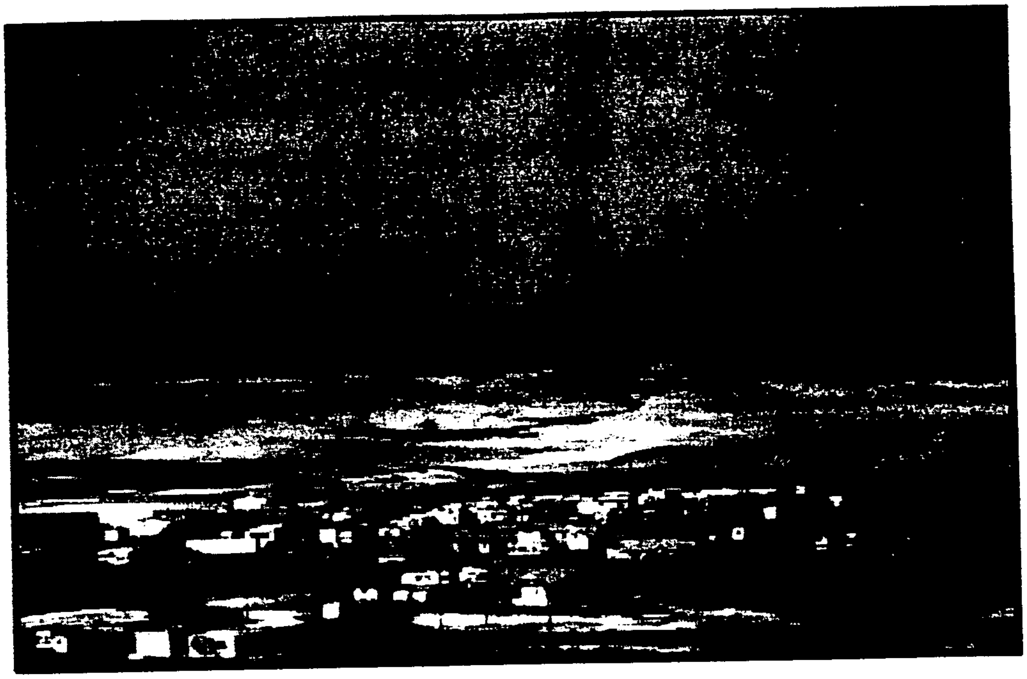
The site of Tecopa Hot Springs is part of the Amargosa Canyon Natural Area, an Area of Critical Environmental Concern (ACEC) for the BLM. Tecopa is located where CA 127 and the Old Spanish Trail meet. The settlement obtained its name from a high Paiute chief, Tecopa. Tecopa is known for its bathing hot springs. Considered a place of healing and doctoring, Tecopa is also surrounded by the Amargosa Canyon Natural Area (Site #19 & 19A photos). A member of the AITC Team said that his grandmother used to go there and they would use the area for doctoring. After they were done doctoring, they would cover the springs that came out of the rocks to hide it from people because of its sacred healing waters. After the arrival of Whites, the spring was converted into a bathing hole (the water temperature is 108 °F). Even today, Tecopa Hot Springs is recognized for its medicinal values. It is open to the public and managed by Inyo County.

Indian people still use it because of its medicinal and purification properties. Native peoples from all over the country make pilgrimages to Tecopa Hot Springs. Paiute songs and prayers are full of references to Tecopa Hot Springs.

In late 1998, the *Shundahuhai* Foundation purchased a house near Tecopa Hot Springs. This house is used today as Indian Health Center. One of the major Western Shoshone religious leaders currently resides in this house. His name is Corbin Harney, and he is from northwest Nevada, from the Battle Mountain Shoshone community of the Temoke Band of Western Shoshone (Harney, 1995). Mr. Harney is world-renown for having conducted and being invited to participate in healing ceremonies in many parts of North America, South America, and Europe. Also he was a member of the reburial committee representing 17 tribes and Indian organizations who are called to consolidate CGTO. This noted current religious leader is conducting religious ceremonies and free lectures at this Indian Health Center. A traditional settlement of the Southern Paiutes and a location engaged in a network of relationships with Western Shoshones, currently the community of Tecopa is home to some Paiute families.

The Amargosa Canyon Natural Area is immediately located south of Tecopa Hot Springs, along the Amargosa River. The Amargosa Canyon was designated as ACEC in 1980 by the California Desert Conservation Area Plan. It is recognized by Indian people as a " needed" oasis for its food plants and medical uses. The site has power because the canyon walls are located close to a major river. Such areas have been documented elsewhere as major ceremonial areas. Additionally, because of its proximity to the Hot Springs and doctoring locales, the area contains great power and the Salt Song Trail passes through the canyon.

Potential impacts can be derived from truck accidents, parking, and drive-bys. Physical pollution can adversely affect the lives of Indians living in this community because pollution can break the power and spirit of plants, rocks, and the surrounding environment. Indian people have spiritual bonds with their immediate surroundings. Plants, rocks, trees and rivers have power and they are spirited. Because of this spiritual friendship, any pollution of these elements can cause a break in the spiritual relations that Indian people have with the spirited elements and may reduce the strength that Indians obtain from the power inherent in the physical properties of the environment.



Site #19. Tecopa.
Showing the trailer park and a crane in the Grimshaw National Wildlife Refuge.

Site #19A. The Amargosa River floodplain overshadowed by Eagle Mountain and the Amargosa Canyon Natural Area south of Tecopa.

Physical pollution of Tecopa Hot Springs can derive from effects on the hydrological system entering the Amargosa River. On the cultural side, pollution would upset the water babies who control the flow and temperature of that water. Pollution would also cause great harm to the ecosystem, which in turn might initiate irreversible damage to the flora and fauna of the Tecopa valley, as well as, that of the Amargosa Canyon Natural Area.

E.2.20 Dumont and Ripple Sand Dunes

The Dumont and Ripple Sand Dunes site consists of the Amargosa River and sand dunes. A member of the AITC Team said that the sand dunes were like the mother because the children were playing on her. Her patience was enduring and she was very peaceful. She was laying across the desert floor, graceful as she can be. It is a conversion place, sand dunes were built from the wind and the elements, from the four directions and they created sand dunes. They are ever changing and not static; we call them copycat changing mountains. Mountains change for the shamans (as we believe) in the Paiute tradition, and they are never the same. The explorers who came before, documented the ever-changing nature of sand dunes. They change to look beautiful and if they don't want you in the area, they change to fool you. Certain mountains play tricks on you and sand dunes certainly do. Their power is elusive and it can fly away at will. In a sense, the sand dunes and the mountain peaks trade places so it is a highly complex system ever evolving. It probably has water babies and the Amargosa River flows by there and the other one that comes from the Silurian Valley. At this place, it has, we feel, a hidden entity. Everything there is controlled and its voice is imperative and a mystical place. I will go a step further and say its soul belongs to the Southern Paiute. The mountain ranges encase, care, and give its will to these people. The area is important because it is a boundary that separates the traditional peoples and tribes in the Southwest. This is the Pacific area and Arizona is the Southwest and the boundary goes to both places. The wind always blows there and goes to that region; winds come from all directions to form a windy place. The little people live in the sand dunes.

Other Indian tribes inhabit the area and it held migratory tribes like the Pueblos and it is a trading route. The Amargosa River supports the ecosystem (Site #20 photos).

Potential impacts can derive from truck accidents, parking, and drive-bys. Physical pollution could result in radiation contaminating the area. Little people in the Sand Dunes will become angry. The anger of Little People will take back their gifts causing irreparable damage to the area. If you misuse their gifts, they become angry. Gifts such as water, rivers, trees, mountains, wind and rain can be taken away. Some of the Little People are night people and whistling is avoided at night. Paiute tradition stresses that children come home before dark. These sand dunes form peaks and everything comes to a peak, and the wind from both directions protects sand dunes from rolling way. A member of the AITC Team said that the Sand Dunes resemble or look like a cat. They are unique because winds come from all angles. Because of wind effects, motorized recreation vehicles will not hurt it. Despite the fact that some of the dunes are not on the highway proper, accidents upstream from this location can cause damage to the Amargosa River. Additionally, the Sand Dunes are traversed by the Salt Song Trail.

Site #20. Dumont Sand Dunes and the nearby Amargosa River.

E.2.21 Silurian Valley – Salt Creek Hills Protected Area: ACEC, for BLM

Located to the south of Dumont and Ripple Sand Dunes, the Silurian Valley is the meeting place of the Salt Creek and the Amargosa River. To the south of this site, there is the Salt Creek Hills Protected Area, another ACEC for the BLM, sustained by water from the Salt Spring Hills (Site #21 & 21A photos below). This area is managed by the Bureau of Land Management.

The Salt Spring Hills support a diverse oasis of plants, trees, and shrubs. The dominant trees are mesquite. Because of the mesquite trees and location, I believe Indians gathered there for ceremonies. The mountains constrict the stream and the acoustics of the place make it a desired site for various activities. It is a charming location.

Indians use mesquite for food, shelter, and fire (fuel). Roots are used for making cradle boards; we use roots for handles of the musical instruments, and handles for the gourds. In terms of medicinal usage, people chew mesquite leaves to treat bee stings. It is an essential item for the Paiutes, Mojaves, and the Chemehuevis.

This site also has abundant water. Water runs year-round and it is a permanent source of water. On top of the Salt Spring Hills, you get good views of the surrounding area. A good view is used for communicating with supernatural beings and conducting prayers. The acoustics also play an important role in the significance and interpretation of the site.

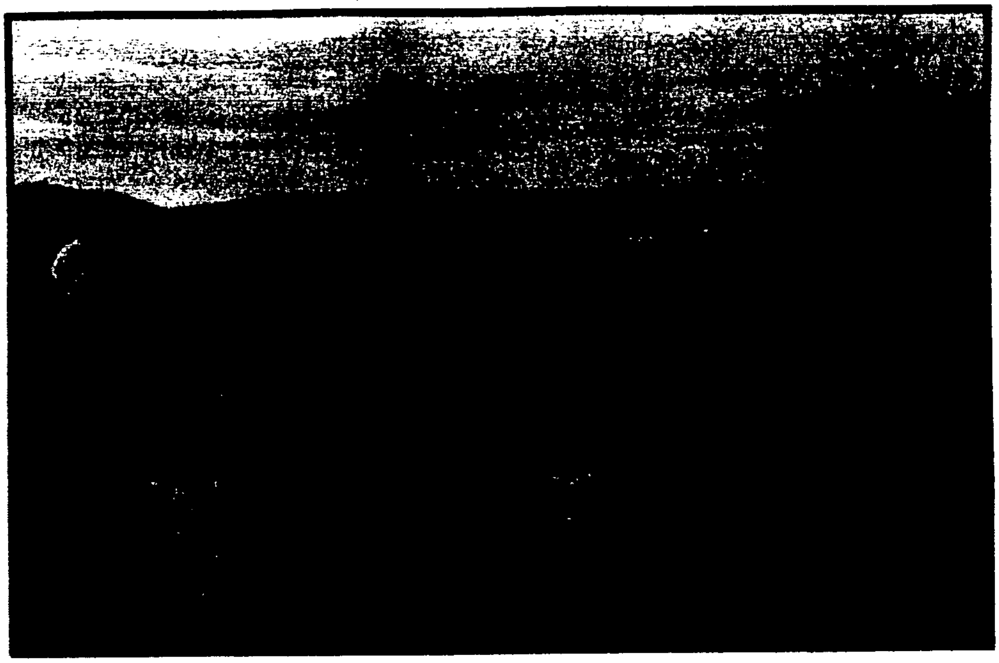
A member of the AITC Team was greeted by a poor-will bringing a message. The poor-will (*Phalaenoptilus nuttallii*) was acting out of character, which is unusual in Paiute. This out of character behavior is called an omen. Chemhuevis have a phrase when they see something like that it is time to take out your gourd and start singing a song. It is usually a messenger. If it was a disturbed spirit, it is an owl. You have to talk to it. Another member of the AITC Team said,

> *"I see the area as a refuge, an area where people go to renew themselves and cleanse themselves. Someone will climb on a hill and look out for intruders because the person cleansing themselves and talking to the Mountain could not be disturbed and would need privacy. The presence of that bird (poor-will) re-enforces the significance of the site. Things that come to the Indian are real heart."*

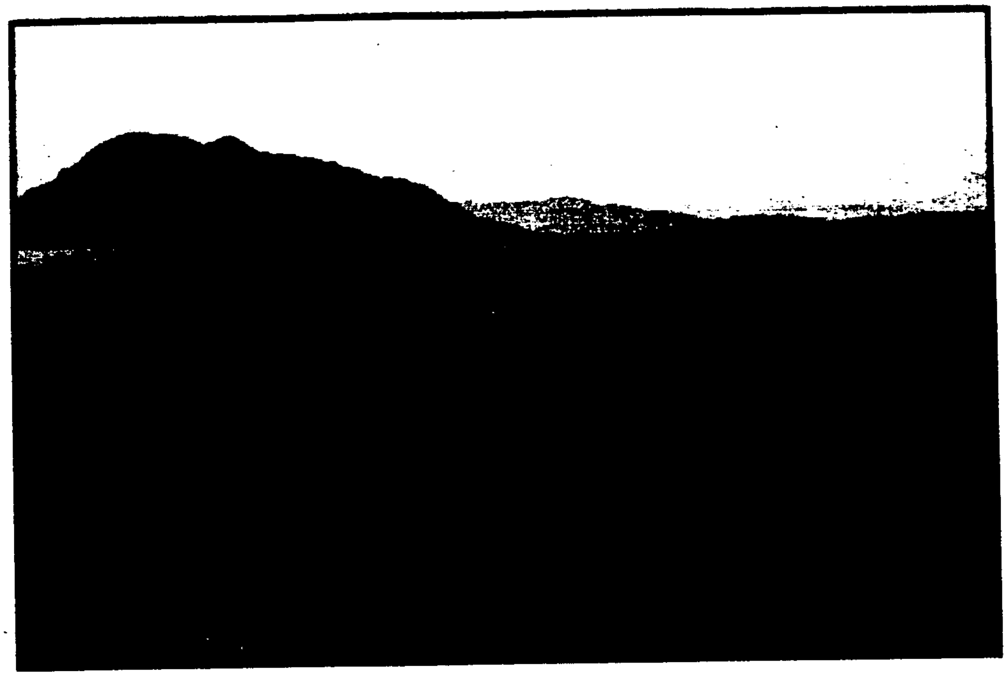
Potential impacts can derive from truck accidents, drive-bys, and parking. Physical pollution can get into the water, the land, the animals and the plants. Because of its location on a sharp curve, it is susceptible to damage. Accidents will upset the spirits and the power of that area leading to irreparable damage.

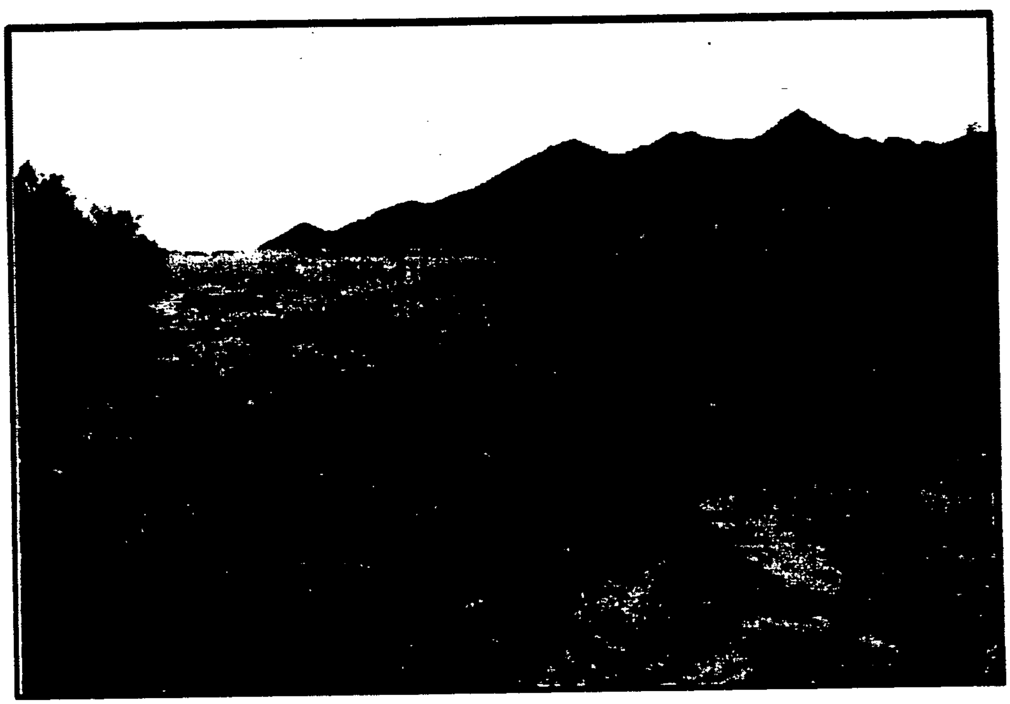
E.2.22 Avawatz Mountains

The Avawatz Mountains site was pointed out as a traditional landmark between Southern Paiutes and the Kaweets. According to one AITC member, twenty years ago, he went down there with a Paiute elder (RA). The Kaweets no longer reside in the area and he thought they had died out.



Site #21. The Silurian Valley, and the Salt Creek Hills Protected Area. Showing the Salt Creek Stream and the Avawatz Mountains.





Site #21A. The Salt Creek Hills Protected Area and Salt Spring Hills. Showing burned trees and a variety of trees and plants.

The Avawatz is a boundary mark and traditionally sought out for vision quests. In the way of the Chemehuevis, if a shaman performs a ceremony, he would go to the river, smoke himself, refrain from eating salt, and cleanse himself. When shamans went into their healing they put themselves into a trance and start singing those songs without knowing it. He would even sing songs he did not know. He talks as if possessed by the spirit. The doctor does not have the power. The power is given to him through this creative force, and the doctor knows how to call it to him at the time of the curing. The curing power could be an animal, rock, or something in the air, but your fingers can feel it and it goes through you, it is called "laying of hands."

After a shaman has conducted a ceremony, he takes away inside of himself the sickness of the patient and so he has to go somewhere and cleanses himself. He may go to a river or a place of refuge like the Salt Spring Hills. There, he spends a few days cleansing himself.

The Avawatz is a place where a person could go to find a spirit helper. He would use the Salt Spring Hills site to clean himself before going into the hills. The mountains contain spirit helpers who live on the mountain – each doctor has a different animal or natural force that helps him (like the wind, rain, or clouds). The doctor would call upon the mountain from time to time to help him find the proper medicine for a ceremony and the power to heal during a ceremony. These ceremonies could include individual sickness as well as group problems like drought, eclipse, or other unusual problems that the whole group faces. These doctors could call the rain – they would travel spiritually on top of their mountain and look for the rain. Avawatz would be one of those high mountains that the doctor could get up on and find the rain. Another local mountain is Mountain Baldy (that is Mountain San Antonio in the San Gabriel Mountains); this is a 29 Palms folks mountain. The springs on the mountain would be especially important because of their proximity to that place.

Power spots usually are in the center of a people's territory. But this powerful mountain is at the boundary of three ethnic groups (Shoshone, Kaweets, and Southern Paiutes). Maybe it was a jointly used powerful mountain like Spirit Mountain (possibly the Kawaiisui). The current name of the mountain, Avawatz, suggests a meaning of a place of many spirits. In Chemehuevi, the word Avawatz means "many" or "many spirits." This may further refer to the many spirits there and reflect the Mountain being used by these three Indian ethnic groups.

Potential impacts to this place could come from truck accidents, parking, or drive-bys. The presence of radiation could have physical effects. Radiation could spiritually impact the many prayers at this mountain. It could separate the mountain from the spring if the road between them was polluted. It will upset the balance of the spirits in the area and undo the prayers and the songs of the past. The anger could be so great that it would go down from the mountain to the Salt Spring and, because of the echo at the spring, anger will bounce to other areas. The anger from this spiritual place could influence the dreams of Indian people many miles away. Dreams are important because they guide the life of people. Also, some believe that a bad dream undoes previous good dreams. So in dreams, like in past ceremonies and songs conducted at a place, future events can retrospectively influence the past.

E.2.23 Mohave River

At one time the Mohave River was a full flowing river. Indian people were here then. The Chemehuevi have a story about when the Mohave was a big river and there was a forest everywhere here. A chief wanted a monument made for him when he died. For that end he put his whole tribe out there to make his monument. He worked them like slaves and made them cut down trees to build the monument. He even put his two children out there. One day his son sat down but his father whipped him and tried to make him work then the son threw down his load. Then his sister threw down her load and left too. Then all the tribal members threw down their loads too. All of the tribal members went away and died in the desert. His monument was never made. Then as a punishment for the Chief because he drove all of his people away, the gods took away all of the trees and water. So eventually, the Chief died as the land died. That monument remained half finished, but sometimes you can still see it as a mirage in the desert. This is why the Chemehuevis never punish their kids. Their chiefs have to be firm and just, and in control without physical abuse. Otherwise the spirits will go against him, and he will loose his followers and they will go elsewhere. This is why the Mohave River is mostly dry now.

Indian people lived along the Mohave River for thousands of years. So all along it are many places where Indian people lived. For example, the early Indian site at Calico Hills is near the river. In addition, the Mojave people lived in the desert once. They (the Mountain Mojaves, *Avi makav*) had a village at the lower portions of Mohave River near the Soda Mountains and Cady Mountains and also had a village later near Barstow on the Mohave River. The Chemehuevi people have always lived along this river. They continued to defend it from intruders who were traveling what they now call the Mohave Road. Newberry Springs was an Indian community at one time. It was a place where Indians came to camp or gather food or hunt.

The Colorado River Indian Tribes (CRIT) and Chemehuevi Tribes are part of a long-term monitoring arrangement with the BLM and others who currently manage these sites. They also have similar co-stewardship relationships with the National Park Service (NPS) in the Providence Mountains and on the NTS. CRIT, and perhaps Chemehuevi, are working with the BLM also at Soda Lake and the Cady Lake area.

E.2.24 Dagget Mountain, Newberry Mountains - Newberry Springs

The Dagget and Newberry Mountains are located south of I-40, and immediately southeast of Barstow. Newberry Springs is about 16 miles east of Barstow, and it is bordered by I-40 to the north and the Newberry Mountains to the south.

Newberry Spring was an Indian community at one time. It was a place where Indians came to camp or gather food or hunt. The CRIT and Chemehuevi Tribes are part of a long-term monitoring arrangement with the BLM and others who currently manage these sites. They also have similar co-stewardship relationships with the NPS in the Providence Mountains and on the NTS.

E.2.25 Barstow and Vicinity

A Laguna Pueblo man, who moved to Barstow, California in 1941, shared his knowledge of American Indian life, which follows, with the AITC during the RCA. He lived at the Laguna Indian Colony in Barstow with approximately 25-30 families for 20 years. During the construction and maintenance of the Santa Fe Railroad System in the 1930s, arrangements were made with various tribal communities that were impacted by the railroad. Two effected communities were the Laguna and Acoma Pueblos, both of New Mexico (personnel communication, Paiute and Laguna, December 11, 1998).

In the 1930s, the Santa Fe Railroad made agreements with the Laguna and the Acoma people to provide free travel passes for employees and their families to ride the train at any time. This policy was acknowledged until the merger between Burlington and Santa Fe, when these arrangements ceased because the agreement was not written (personnel communication, Paiute and Laguna, December 11, 1998).

Barstow had a Laguna Colony and a separate Acoma Colony. In addition to these two groups there were Navajo who lived on the outskirts and had built hogans along the rail lines. Around 1939-41 there was a Confinement Camp for Japanese Americans in Barstow (personnel communication, Paiute and Laguna, December 11, 1998).

The Laguna Colony was south of the roundhouse and next to the railroad tracks between 6th and 7th Streets. It consisted of about 5 old box cars that were converted to living quarters and were in the place in a u-shape. There were about twenty 3-bedroom bungalows with a kitchen and a living room. The box car in the middle was converted into a restroom with the men's on the south side and the women's on the north. One box car was used as a laundry area and meeting hall. Those buildings were condemned by the County in the late 1960s or early 1970s and gone by 1975 (personnel communication, Paiute and Laguna, December 11, 1998).

The Laguna Pueblo man described some of the traditional dances that occurred when he was there including others that happened in the 1960s. When the dances were held, canvases were placed on the fences so no one could see inside. Only Laguna people could enter. He remembered the Acoma doing the same for their people. He described Kachina Dances that occurred regularly and Deer Dances that happened around Christmas time (personnel communication, Paiute and Laguna, December 11, 1998).

When deaths occurred, sometimes the bodies would be shipped back to New Mexico as part of the agreement with the Santa Fe Railroad. Other times, people would be buried in the Mountain View Cemetery in Barstow, California (personnel communication, Paiute and Laguna, December 11, 1998).

Today, there are about 1,500 Indian people that live in the Barstow area. The Laguna Colony has been working on a language retention program and have produced audio tapes. The current Governor, Joseph (Larry) Garcia, lives in Barstow, California. The Colony is recognized by the Laguna Tribe in New Mexico, and receives minutes and other related information (personnel communication, Paiute and Laguna, December 11, 1998).

The Acoma Colony was fewer in numbers and was located on the east side of the old Barstow Ice Plant near 7th Street. They had about 15-16 bungalows and fewer box cars. Traditional ceremonies were conducted on a regular basis with access restricted to Acoma people only. Their area was completely condemned by the county at the same time as the Laguna Colony. It is unknown how many Acoma people are in Barstow today (personnel communication, Paiute and Laguna, December 11, 1998).

The Navajos did not have an area set aside like the Lagunas and Acomas. They lived on the outskirts near the rail lines in hogans along the tracks. It is known that there are Navajo families living in the Barstow area (personnel communication, Paiute and Laguna, December 11, 1998).

No specific information was provided nor asked about the Japanese people. It is unknown as to the number of individuals or interactions with the Indian people living in the Barstow area (personnel communication, Paiute and Laguna, December 11, 1998).

E.3 SECTION THREE - AITC RECOMMENDED *ADDITIONS* TO THE CURRENT TEXT IN THE U.S. DOE PREAPROVAL DRAFT ENVIRONMENTAL ASSESSMENT OF INTERMODAL TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE, SEPTEMBER, 1998

E.3.1 Section 3.1, Transportation

The 29 American Indian tribes involved in this study know all transportation of radioactive waste materials should be subject to Tribal ordinances regarding nuclear-free zones and the transportation of radioactive materials through tribal lands. The DOE, and others, need to integrate these considerations into their policies.

E.3.2 Section 3.7, Water Resources

The 29 American Indian tribes involved in this study know that even if the current actions and proposed alternative actions do not directly use water, all of these actions potentially impact water and waterways. The 29 American Indian tribes involved in this study would like to see a more detailed discussion of potential water impacts. Especially important are water routes that directly feed Indian people and support tribal enterprises.

E.3.3 Section 3.9, Biological Resources

The 29 American Indian tribes involved in this study know all animal species have a critical ceremonial and life-preserving role within ecosystems and Indian cultures. Animal species are critical links in the Indian (human) ecosystem. We are all in this thing together and if pollution gets into the plants along the road, it will get into animals, and then into humans.

The 29 American Indian tribes involved in this study know the ROI for evaluating potential impacts on biological resources should be expanded to include the hunting territories of animals who would collect their prey, living or dead, along the highway. Accidentally released materials will remain on or very close to the road only if hunting animals do not remove contaminated materials or food sources to distant dens or other portions of their hunting territories.

The 29 American Indian tribes involved in this study know that concentrated amounts of water runoff from highways creates green strips adjacent to the highways. These green strips are special ecosystems used by a wide variety of animals. Animals' territories that should be especially considered are eagles, hawks, ravens, and other raptors; coyotes *(Canis latrans)*, foxes (*Vulpes spp.)*, and other canines; and bobcats *(Felis rufus)*, lions, and other felines. Other species include badgers (*Taxidea taxus)*, roadrunners that hunt lizards along highways; magpies, birds who feed on seeds from plants that are concentrated along highways due to increased water runoff from the highways; and migratory herd animals such as elk (*Cervus elaphus)*, deer (*Odoicoileus hemionus*), antelope (*Antilocapra americana*), wild horses (*Equus caballus*), burros (*Equus asinus)*, and cattle that are attracted to and use plants along highways and waterways. It also should be pointed out that desert tortoises have a range of up to 6 miles, which greatly exceeds the proposed biological resources' ROI.

The 29 American Indian tribes involved in this study know that stream crossings are not the only water areas that can be contaminated. Spillage potentially will be carried outside of the 400-foot ROI and affect plants, animals, and people far from the highways in the same ways as mentioned above. Animal species that should be considered are those who live in and along the streams and lineal ecosystems such as rabbits, ducks, Great Blue Herons, and fish. There also are many dry washes the highways cross and these potentially will carry contamination far from the highways when water flows in them.

E.3.4 Section 3.10, Cultural Resources

The 29 American Indian tribes involved in this study know of cultural resources including things central to the lives of Indian people today. American Indian cultural resources are spiritual and thus include more than physical natural resources and archaeological remains. Only American Indian people can divine the cultural importance of their resources and these are not therefore defined by their scientific importance. The full spectrum of significant cultural resources can only be identified by living Indian people since many roadways to sacred sites are known only to them.

The 29 American Indian tribes involved in this study know there are a number of additional regulations, guidelines, laws, and ordinances, which are applicable to the identification, evaluation, and management of cultural resources. These include among others, all pertinent regulations enacted by all of the 29 American Indian tribes involved in the American Indian Transportation Study titled "Native Americans Respond to the Transportation of Low Level Radioactive Waste to the Nevada Test Site" (Austin, 1998).

E.3.5 Section 3.10.1, *Barstow*

The 29 American Indian tribes involved in this study recommend an EA identify all archaeological sites found within an appropriate ROI along the routes and the intermodal transfer points being considered. A great amount of archaeological field work has been done by the U.S.

Department of the Interior (DOI). BLM and the CRIT Museum. An AITC member is one of the contacts for this work. The BLM and the CRIT Museum have done some preservation of archaeological sites in the Barstow area. All of their previous projects in this area should be referenced and become part of this assessment. The CRIT currently has monitoring and restoration agreements with the BLM in the Barstow area. It is recommended that further archaeological assessments associated with this project involve Indian archaeological teams from the CRIT tribal government.

The 29 American Indian tribes involved in this study know Barstow contains a great number of physical and spiritual resources (Bean and Vane, 1979). For example, one of the earliest Native American sites is within 12 miles from this location, therefore the entire area was used by Indian people for over 12,000 years. Aboriginally, Barstow was occupied and used by both Southern Paiute and Mojave people. The waters of the Mohave River are today and have always been central in the lives of Indian people. During the historic period, studies have shown that Navajo families associated with the construction of the railroad built and constructed sacred hogans and sweat lodges along the railroad that have been deemed protected under the National Historic Preservation Act (NHPA) (16 U.S.C. § 470 et seq.) (Drover, 1985). Today, many of these Navajo families reside in Barstow. Also living in Barstow are people from Laguna and Acoma Pueblos in New Mexico who, like the local Navajo residents, came during the early construction and operation of the railroad and have remained as a local resident Indian population. The Navajo, Laguna Pueblo and Acoma Pueblo people who live in Barstow should become a part of this study being defined as Indian people who are culturally affiliated to the study area with historic ties.

American Indian people know that previous ground disturbances occurred without EAs. Contemporary proposals for alternative uses of those sites need to assess both past and present cultural resource impacts. Previously existing American Indian cultural resources and cultural significance of American Indians are not necessarily eliminated by the construction or development of a site. Archaeological assessments of potential impacts should be extended beyond the footprint of the project so that a holistic view of the immediate area is provided.

E.3.6 Section 3.10.2, *Caliente*

The 29 American Indian tribes involved in this study know that there are many cultural resources in and around the Caliente sites. These cultural resources include physical things such as plants, animals, water, petroglyphs, and landscapes; spiritual things such as water babies; and historical things such as massacre sites.

As a result of the RCA conducted in January 1999, the AITC interpreted the proposed in-town intermodal transfer site as a place of permanent living, hunting, and food gathering. Cultural resources in the area of this site include a hot spring (from which the town of Caliente derived its name), the junction of two permanent watercourses – Meadow Valley Creek and Clover Creek, and 3 power caves that have been used by Indian people for thousands of years. Eagles, which are of great importance to Indian people, live all around the town. A modern Indian cemetery also exists here.

Caliente was an area of dense Indian populations up to the 1873 when Powell and Ingalls (1874) conducted their census. The Delamar mine attracted many Indian men during the late 1800s. Although this once large Indian population has been reduced greatly, two extended Indian families remain. Most of these families live near the site to the southeast of the train depot. The nearby hot springs and watercourses are still fully functional even though the area has been altered substantially.

The AITC interpreted the proposed south intermodal transfer site as being a place of ceremony and power. This site is composed of a series of painted and pecked storied rocks that are associated with a variety of ceremonial uses. These occur high above the flood plain along vertical cliff faces and at the foot of sheltered cliff faces, which form the mouth of a side box canyon. This box canyon is an area with a high level of biodiversity and unique cultural resources such as the acoustics of the upper portion of the box canyon, which amplify and contribute to songs, prayers, and ceremonies.

American Indian people know that previous development, alternative uses, and disturbances in and around these sites need to assess both past and present cultural resource impacts. Archaeological assessments of potential impacts should be extended beyond the footprint of the project so that a holistic view of the area is provided.

E.3.7 Section 3.10.3, *Yermo*

The 29 American Indian tribes involved in this study know Yermo contains a great number of physical and spiritual resources. For example, one of the earliest Native American sites is within 4 miles of this location and, therefore, the entire area was used by Indian people for over 12,000 years. Aboriginally, Yermo was occupied and used by both Southern Paiute and Mojave people. The waters of the Mohave River are today and have always been central in the lives of Indian people. During the historic period, studies have shown that Navajo families associated with the construction of the railroad, built and constructed sacred hogans and sweat lodges along the railroad that have been deemed protected under the NHPA (16 U.S.C. § 470 et seq.) (Drover, 1985).

American Indian people know that previous ground disturbances occurred without EAs. Contemporary proposals for alternative uses of those sites need to assess both past and present cultural resource impacts. The presence of construction and/or development of a site does not mean cultural resources are not present. Archaeologists should move beyond the footprint of the project to assess the broader ROI.

E.3.8 Section 3.12, *Socioeconomics*

The 29 American Indian tribes involved in this study would like to recommend that the socio-economic section address issues previously raised in the EIS for the NTS, specifically, Section "G.3.5 *An Outline of Social and Economic Issues*", which is included below for reference (pp. G29-31). It is important that the intermodal EA address potential social and economic impacts to Native American enterprises, education, mining, and community cohesion. American Indians also recommend that such assessments be made for rural, non-Indian citizens living along the transportation routes but outside of the three currently considered cities of Barstow, Caliente, and Yermo.

"G.3.5 Outline of Social and Economic Issues

"G.3.5.1 American Indian Region of Influence. *Within this ROI, there also are several Indian reservations, tribal enterprises, tribally controlled schools, tribal police departments, and tribal emergency response units. The following reservations are located within the designated ROI: Duckwater Shoshone Tribe, Las Vegas Paiute Tribe, Moapa Paiute Tribe, and the Yomba Shoshone Tribe. In addition, there are tribes, which are located geographically outside of the ROI, but are potentially impacted by NTS activities. One of these tribes is the Timbisha Shoshone Tribe, based in Death Valley, California. This tribe is actually located closer to the NTS than many towns in northern Nye County. As a consequence of this proximity, people from the Timbisha Shoshone Tribe are a part of the social and economic ROI of the NTS. For example, students from the Timbisha Shoshone Tribe attend public school in Beatty, Nevada, whereas many Shoshone students from Tacopa, California, attend school in Pahrump, Nevada. Timbisha tribal members work and shop in Clark and Nye counties.*

"The Pahrump Paiute Tribe, located in Pahrump Valley, is composed of Indian people who have been historically recognized by state and federal agencies as qualified to receive services as Indian people, and who as a group are currently seeking federal acknowledgment.

"G.3.5.2 American Indian Education. *Under federal and tribal law, American Indian children can be educated in tribally controlled and federally certified schools located on Indian reservations. Federal funds are available through the Indian Education Act for the education of Indian children. Compensation from the federal government is provided to any school district that has entered into a cooperative agreement with federally recognized tribes, whether it be public, private, or an Indian-controlled school.*

"One tribally controlled elementary school is in Nye County. It is operated by the Duckwater Shoshone Tribe. In 1995, the school had 32 students enrolled from preschool to 8th grade, who were taught by 3 full-time certified teachers; these included 2 certified elementary teachers, 2 teaching assistants, 1 preschool teacher, and 1 teacher under Chapter I Program. Using these numbers, the student-to-teacher ratio was 10.66:1 (Duckwater Shoshone Tribe, 1996).

"A tribally operated Headstart Program is located on the Moapa Paiute Indian reservation. The program is open to all eligible preschool students. Both included Indian students and non-Indian students from nearby communities. This program is funded through the Inter-Tribal Council of Nevada, which operates Headstart sites elsewhere in Nevada. Indian students also attend non-Indian public schools.

*"G.3.5.3 **Farming and Ranching.** The NTS contains valuable resources for American Indian economy that were lost not only to Euro-American encroachment but also to land withdrawal, pollution, and radioactive contamination. The NTS is in a desert region where water is the most crucial source. Springs located within the NTS and in its immediate vicinity were the place of Indian settlement and traditional farming until the first half of this century. Although much of the well-watered land in the aboriginal territory was lost to Euro-American settlers, by the turn of the century American Indian families owned small farms in the area both for their own consumption and for commercial purposes. Livestock was also a part of the Indian economy. Foodstuffs and stock forage were grown and sold by Indian people to supplement wage labor (Stoffle et al., 1990). With decreased access to springs and agricultural fields, and with some pollution of land and water, traditional Indian farming was seriously impacted.*

*"G.3.5.4 **Mining.** American Indian people played a major role in the development of mining in the region of the NTS. Many local American Indians were active prospectors on their own behalf, locating their own mining claims. Many of the producing mines in southern Nye County, for example, were located by local American Indian people, whose knowledge of minerals had been developed throughout centuries of mineral collecting. The NTS was one of the areas where Indian people conducted their mining activities. Several American Indian people guided Euro-American prospectors to valuable ore deposits, providing them with transportation, food and lodging, and teaching them about minerals, water resources and trails. Yet, American Indians were not made equal partners in mineral development as they may have expected and may have been promised (Stoffle et al., 1990). Perhaps because mining was seen as a primarily Euro-American economic activity, the rights of American Indians to claim mines was never made explicit. Mining was further precluded when the NTS land was withdrawn. Thus, Euro-American settlers began a process that was continued by the withdrawal of NTS lands.*

*"G.3.5.5 **Political Integration and Community Cohesion.** The process of fragmentation of Indian nations into small, increasingly isolated communities began with Euro-American settlement and continued with the withdrawal of NTS lands. The loss of cohesion has lowered the ability of Indian people to (1) negotiate, (2) resolve conflicts, (3) keep peace, and (4) share resources. The White Rock Spring area was traditionally where all activities promoting community cohesion and political integration took place. When Indian people were denied access to White Rock Spring, they lost a central place shared by the three ethnic groups. Without this central place, the three ethnic groups did not meet as often. Eventually, the lack of contact weakened interethnic relationships and, to some extent, caused an overall loss of political power and skills among the groups. The political strength of the three ethnic groups, to some extent, has been restored with the NTS American Indian consultation program, which has*

provided the opportunity for the three ethnic groups to meet on a regular basis, work together, find common ground, and speak with one voice.

"G.3.5.6 ***Waste Transportation and Tribal Enterprises.*** *Other major concerns of the CGTO are the impact and cumulative effects of NTS operations on the tribal economy, particularly regarding the issue of radioactive waste being transported across reservation lands. To date, only minimal efforts have been made to investigate socioeconomic impacts of NTS actions on Indian tribes and organizations. Ongoing research by the AIWS on such effects suggests, for example, that continued or increased transportation is detrimental to the economic success of tribal-owned businesses and may increase the value of insurance policies. Currently, there are no compensation measures planned or mitigation efforts taken by the federal government to improve the socioeconomic problems of tribes and organizations directly affected by NTS operations. Similarly, no efforts have been made to distribute equally the benefits and losses caused by NTS operations among Indian and non-Indian populations."*

The 29 American Indian tribes involved in this study know that the Current Route environment through Moapa and Las Vegas affects tribal enterprises now. The potential exists for accidents and/or spillages to contaminate agricultural fields, to keep people from getting to work, and to prevent people from stopping for tourism and other economic purposes. The potential for spillage is also a threat to the enterprises along the Mohave River and the White River in the Pahranagat Valley.

E.3.9 Section 3.13, *Environmental Justice*

The29 American Indian tribes involved in this study would like to comment on the process by which the environmental justice text was developed. If we follow Wilkinson (1998), environmental justice impact assessments should include demographic assessment, impact assessment, and community involvement. The current text focuses exclusively on demographics. It is important also to understand the cultural and health issues that have been previously raised by American Indian people in the NTS EIS. Finally, both the Council on Environmental Quality (CEQ) and the Environmental Protection Agency (EPA) guidelines recommend the direct community involvement throughout the process of assessing environmental justice issues and potential impacts. It is unclear at this time the extent to which community involvement has occurred.

The population figures for American Indian reservations and American Indian tribes in the following analysis do not reflect the current tribal enrolled membership. Tribal members who live off the reservations frequently come to the reservations for specific cultural events. These tribal members reflect additional American Indians who would be affected by the potential social and economic impacts.

The 29 American Indian tribes involved in this study know that holy land, health, and cultural survival issues are pertinent to discussions of the current route environment, the three community environments, the transportation routes, and the all-truck routes.

The 29 American Indian tribes involved in this study would like to include text prepared for the NTS EIS found in Section G.3.4, specifically sections G.3.4.1, G.3.4.2, and G.3.4.3, which are included below for reference (pp. G27-28).

"G.3.4 Environmental Justice and Equity. *"Federal agencies are directed by Executive Order 12898 to detect and mitigate potentially disproportionately high and adverse human health or environmental effects of its planned programs, policies, and activities to promote nondiscrimination among various populations in the United States. The CGTO knows of three violations of this act that have derived from past NTS programs, policies, and activities. These are (1) holy land violations, (2) health violations, and (3) cultural survival-access violations. Evidence for each of these violations varies. There is no question that only the holy lands of Indian peoples have been, continue to be, and will be impacted by NTS actions. There is no question that only Indian people have lost cultural traditions because they have been denied access to places on the NTS where ceremonies need to occur, where plants need to be gathered, and where animals need to be hunted in a traditional way. There is no scientific evidence, and there never will be, to completely document the physical health risks of Indian people deriving from NTS-produced radioactivity. Indian people have such poor health care and there are so few of them that it is difficult, if not impossible, to establish the collective health impacts of radiation. Studies of how Indian people perceive themselves to be at risk from radioactivity and what social and cultural impacts derived from these risk perceptions can be conducted, but these have not been conducted.*

"G.3.4.1 Holy Land Violations. *American Indian people who belong to the CGTO consider the NTS lands to be central in their lives today as these lands have been since the creation of these people. The NTS lands are part of the holy lands of Owens Valley Paiute, Western Shoshone, and Southern Paiute peoples. These holy lands have been polluted and their resources damaged by long-term activities involving radioactive materials. The CGTO perceives that the past, present, and future pollution of these holy lands constitutes both environmental justice and equity violations. No other people have had their holy lands impacted by NTS-related environmental pollution and damage.*

"G.3.4.2 Health Violations. *The lives and health of Indian people who have occupied this area since their creation have been seriously threatened by continued exposure to radioactivity. This threat is not limited to Indian people who live in the immediate vicinity of the NTS and use its resources on a regular basis, but extends to those Indian people who share resources that have been collected on the NTS region. Indian people fear the continuous invisible peril of radioactive contamination and its cumulative effects on future Indian generations. These Indian people have experienced, and will continue to experience, health effects and perceived risks from NTS radioactivity.*

*"**G.3.4.3 Cultural Survival - Access Violations.** One of the most detrimental consequences of NTS operations for the survival of American Indian culture, religion, and society has been the denial of access to their traditional lands and resources. Loss of access to traditional foodstuffs and medicine have greatly contributed to undermining the cultural well-being of Indian people. These Indian people have experienced, and will continue to experience, breakdowns in the process of cultural transmission due to lack of access to NTS lands and resources. No other people have experienced similar cultural survival impacts due to lack of access to the NTS. Recently, the DOE has accepted a CGTO recommendation to open access for American Indians who must conduct their traditional ceremonies and obtain resources within NTS lands, provided that these lands are not contaminated; areas set aside for Indian use would be cleaned up. Unfortunately, land disturbance and irreparable contamination of the soil and underground water may render many locations unusable.*

"To date, a systematic evaluation of traditional places within the NTS has not been made by Indian people; therefore, no specific statements about access to particular locations can be made at this time. An important exception is the recommendation of the CGTO that the Gold Meadows area be set aside for exclusive Indian use because it contains a concentration of important cultural resources. The DOE NV has acknowledged the importance of this area to Indian people and will make every effort to protect it.

"American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival, especially access, violations.

"These concerns are discussed in Section 4.1.10, Cultural Resources, and Section 4.1.11, Occupational and Public Health and Safety/Radiation.

"There has not been a systematic study of these issues for any of the areas examined in this EIS. The CGTO maintains that past, present and future activities on the NTS have, are, or will disproportionately impact the American Indian people. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study, before new activities are approved."

E.3.10 Section 3.14, *American Indians*

The 29 American Indian tribes involved in this study view the areas through which radioactive waste will be transported as contiguous landscapes that are important to American Indian culture and life. One Paiute man (AITC Meeting Notes, 1998) described this perception and how radioactive materials threaten American Indian culture and life:

"Willow is very important...how a native person sees how the water is not coming down from the mountains, so there's no willows, we can't make baskets, and the

water is no good. Environmental warmth and the hydrologic cycle (are broken), feedback to the land isn't taking place, so it's funny willow."

A Paiute woman (AITC Meeting Notes, 1998) added,

> *"Everything needs water, water is the life, the blood of mother earth. From the Native American level, the powers you can't see, the regulatory effects, the power of the moon affects water, we're 80 to 90 percent water, it affects women's' cycles, man comes along and changes that, it's not an earthly issue, it's a spatial issue, water comes in contact to where we live, if no water is coming down from the mountain then there is something definitely wrong with that. And this is something, native people see but other people don't see. Why don't they wake up?"* She related the following story also: *"The donkey and zebra were walking along. Zebra is egotistic and says, 'I'm faster and can do things better.' Donkey says that's not so, that he can do things better too. Zebra says 'No, you're too slow.' Donkey says he is fast too. Zebra says, 'Okay show me.' Donkey says, "Okay, but first you have to take off your ugly pajamas.' This is how native peoples see things. They have a lot to offer too."*

The 29 American Indian tribes involved in the study have selected some quotes from their elders that reflect how they feel about radiation, its affects up to now, and the future effects of bringing more of it into their land. The AITC selected the following quotes from the American Indian Transportation Study (Austin, 1998) "...because this report contains the thoughts of American Indian elders and it is really a powerful thing to read" (AITC Meeting Notes, 1998).

> "[the mountains] *Nowadays they got no snow ...I don't know...maybe that bomb, maybe, that bomb shooting off, that's why...the willow is dry now...it's funny willow, too, it's no good, this year's no good, everything's no good...you can't split it good, either..."* (p. 169)

> *"I noticed the weather's been changing, it don't snow or get cold like it used to...less snow, less rain, drier...some places you see the willow's been dry...deer population is less now, they moved or died off or something, there isn't that many anymore. Used to see them right here in the field, does come down here, little fawns, see them walking around in the fields...there ain't much deer, I don't know what happened to the sage hens, they're less...maybe it's the atomic boom or whatever, with them eggs...the shaking of the ground will kill those chicks...the air...you find...shorten your breath sometimes...used to run around those mountains, couldn't do that after they were blasting...probably* [change] *the nature of the air in the mountains, sometimes it stays kind of high, the fallout or whatever it is..."* (p. 170)

One Indian man (AITC Meeting Notes, 1998) said,

> *"If you look at the whole thing from an Indian point of view, it's hard for us to make sense of how they look at things: they can look at the animals without*

looking at the rocks. They obviously don't do it the way Indian people do. People talk about why we're losing so much; road crews go out and destroy things; no one talks about prayers that need to be done before these things happen; our culture has to be first and foremost. That's why we're here. Other people can look at this and may be afraid of radiation or not afraid of it and let the shipments go through. It will never affect them the way it affects us. It affects our medicines, our stories, and affects, changes all our things, our lives. We need to make things better, keep it in balance."

Another Indian man selected the following quote from the American Indian Transportation Study (Austin, 1998) because the animals know that they are affected. He added, *"I am especially impressed by the idea that the animals are more sensitive to these things than us and that they would leave and it would create dead zones."*

"I can envision the animals standing back once it goes through for the first time and they recognize that there's a danger that they would move away because of fear. That they would no longer be there and that there's something bad coming down the road and they disperse and move away into different corridors. Kind of like a dust storm, they disperse and move further and further away. I see it from the animals' standpoint, they're a lot smarter than us and they've been doing this for longer than us and their senses are more keen and I think the animals would get back and it would create dead zones throughout the country. Through these corridors or transportation routes of course at the site there will be those that are curious who want to go see but they, in turn, they would be the ones that would die because of contamination of some sort. The ones who are in tune to the community and the environment will stay away." (p. 173)

An Indian man selected the following quote from the American Indian Transportation Study (Austin, 1998) because it is similar to how the Cowlitz tribes in Washington State think. The quote is from a Chemehuevi man as he spoke of the Chemehuevi "storied landscape."

"Back in the old days when the animals were people, the animals used to have to sneak out at night because the sun was so mean; he threw sparks at them or he burned them...one day these animals decided that they were gonna put a stop to this, so they decided and they took a vote and they decided that the rabbit, he was the one that was going to, the cottontail, because of his quickness and his movements, he was the one that was gonna go out there and fight the sun. So, this old rabbit, he goes out there at sundown or before the sun came up every morning when they gather their water, well he would go and ask the trees, he says, "Do you burn?" and they'd say "Yeah, I...", well he finally came to this one bush and he said "Do you burn?" and he said "No, I don't burn." And he said "OK, well I'm gonna dig a hole under you right here, by your roots," he said, "and tomorrow morning when the sun comes up I'm gonna come over here and I'm gonna bombard him and I'm gonna run and duck back in this, underneath this tree," under there because he don't burn So that was the plan, so they went back the next day, they all came out, the rabbit went back out there and he went, sure

enough, he went under this tree, and the old mean old sun came up looking for somebody to scorch and hit again, so, looking around, the rabbit gets his rocks, he runs out there real fast and he bombards him, he scares him all over. And the sun has swollen spots here and swollen spots there, and he just ticks the rabbit on the back of his head, and ...the rabbit he runs back underneath this tree, underneath this yucca tree, and he hides down in there and sure enough, all the weeds and everything burns around him except that little bush, and when it all comes down, he runs out ant he goes back into his cave. But a spark hit the cottontail on the back of his head, and today you'll see where the cottontail has a speck on his back, that's where he got it, from the sun...That is the story of how the rabbit declared war on the sun and he bombarded him... (p. 175)

"When I was out there I asked this ranger "Is there a brush, a tree around here that doesn't burn?" and he said, "Oh yeah, that's the Mojave yucca, that grows around here, the Mojave yucca, he says it's very resistant to fire, everything'll burn but that one won't...that was in the rabbit story...there is such a tree that is resistant to fire... (p. 175)

"...it does mention that they were in a cave, and this is where they had to hide, in this cave, to keep so the sun wouldn't see them or bomb them with the heat...that story related to the Chemehuevis when they came from the north and down into the hot desert, it took them a long time to get used to the heat, and this is how that story came up that the sun was mean and it burned them or bombed them or whatever, because it took them a while to overcome and get used to living out there in the hot desert, although up there in the Providence Mountains it doesn't because that's pinon trees and water holes and stuff up there it doesn't appear to be a place that would get that hot...I realized that that story was told about that little area right there..." (p. 175)

E.3.11 Section 3.14.1, *Current Route Environment*

The 29 American Indian tribes involved in the study know that the Current Route Environment through Moapa and Las Vegas potentially threatens tribal enterprises now. In the event of an accident, agricultural fields could be contaminated, people could be kept from getting to work and tourists and others would not want to stop. The potential threat also exists for spills that would get into the water and affect the health of the people downstream in the Pahranagat Valley. These points are voiced also in the American Indian Transportation Study (Austin, 1998) under socio-economic concerns (p. 112).

The 29 American Indian tribes involved in this study believe that the transportation of radioactive waste, an accident involving or release of radioactive materials, and the mere existence of the trucks hauling radioactive waste on the roads will damage the economic prospects of their communities, including agriculture, wildlife, and tourism, or harm anything connected to personal revenue. Some of the tribes participating in the American Indian Transportation Study (Austin, 1998) and in this study have begun to develop tourism industries and have expressed concern that people might be afraid to come to their communities or travel on the highways where radioactive waste is hauled. Two of the respondents from the American Indian Transportation Study (Austin, 1998) expressed the following concerns:

> *"I use this, our land, as a way of life for me. I use the animals to the dead trees and the grasses. The cattle takes care of my family, that's another portion of my income, and , if they're not healthy, we're not healthy, or wealthy."* (p. 112)

> *"And if anything happens, how is it going to economically impact everybody up and down the river that depend on tourism?" (p. 112)*

E.3.12 Section 3.14.2, *Barstow*

The 29 American Indian tribes involved in the study know that the Barstow area and the area along the route from Barstow to NTS has many culturally significant sites of diverse affiliation including Laguna, Acoma, Navajo, and Japanese people. Their concerns for those sites are expressed in Section 2.25 of this Appendix.

Cumulative Impacts - places themselves are being modified and the access to places is changing and the imagery of the land is changing.

E.3.13 Section 3.14.2.1, *Intermodal Facility*

The 29 American Indian tribes involved in this study know that the Barstow area is in the middle of a traditional cultural landscape. This landscape involves the Newberry Mountains on the south, the Calico Mountains on the north, and the Mohave River in the center. Indian people have acknowledged the cultural importance of this area forever and shared their thoughts about that importance in 1979 in one of the Allen-Warner Valley study, an early environmental assessment of the region (Bean and Vane, 1979). For example, one Mojave person at that time had some concern that burial sites of Mojave people, known to be in the Barstow area, not be disturbed (p. 7-15). Mojave people frequented this area not only in prehistoric times, but have lived here at least in small numbers through much, if not all, of the historic period. Some Mojave people presently live near Barstow. There is also a Laguna Pueblo community in Barstow.

The Calico Early Man site documents what Indian people know; that they have always been here. Recent archaeology field work conducted by the CRIT at Newberry Spring and north of Soda Lake has further documented the continued centrality of this area for Indian people over tens of thousands of years. Using the western term "cultural landscape" helps to convey the Indian beliefs and ideas that the land is all integrated and related. Especially related at this spot are the Newberry and Calico Mountains with their special springs, and the Mohave River, which was both a spiritual and physical trail for the people of this area. The idea of cultural landscape further conveys the sense that if a part of this whole is affected, other parts are inevitably changed. Even though the area has been affected by development activities, its cultural importance and centrality in the lives of Indian people remains.

The Allen-Warner Valley study (Bean and Vane, 1979) further indicates:

- that the Calico Mountains were used for burials. *"The Calico and Oro Grande sites were the only ones respondents knew about but the respondents believed that wherever people lived or camped temporarily, there were probably burials."* (7-16)

- that the Mohave River is *"a historic, and possibly an archaeological, resource,"* that *"respondents spontaneously expressed great concern for the protection of hunting areas along the river,"* and that *"...the river has been important to humans for its water resources, and also for the plant and animal resources that depend on the river. The archaeological data suggest that it may have been important to humans as far back in time as any stream in America...* [and] *archaeological sites along the general course of the river are abundant...* [and include human] *artifactual markers, up to and including the proto-historical and historical periods."* (7-22)

- the historic resources of the Mojave Trail are of great concern. *"One said, It's in our hearts; we sing about it. He said that construction should avoid it if possible; and that if not, it should be spanned.* [Other respondents said the trail] *was sacred because it was used by and named for the Mojave... The Mojave Trail can be separated only partially from the Mohave River. The river made the trail possible by providing a source of water. The eastern part of the trail... was probably not just one trail, but several. Each trail was a way of getting through a vast arid expanse by making the most of every spring along the way..."* (7-23)

- that Newberry Mountain was *"a gathering site of some significance. This area contains several well-known recorded archaeological sites, as well as others less well known. It is likely that a careful survey would reveal many more. Among the recorded sites is that of Newberry Cave, a landmark case in California archaeology because of the fiber materials preserved there. These included woven figurines. A site at Newberry Spring at the northern base of the mountains may be very important. Near it...is a site a mile wide, where projectile points and other tools were found".* (7-25)

- that there are highly significant *"petroglyphs and pictographs in the Newberry Spring area. One urban Barstow respondent expressed some spontaneous concern for the area as a place to hunt. A rich archaeological site... is recorded for Newberry Spring, which has perhaps been a source of water for thousands of years. This is an oasis with abundant plant resources."* (7-25, 26)

The findings of the RCA conducted by the AITC in January 1999, reveal the enduring importance of this area for American Indian people. The history of this area reveals the traditional cultural landscape that is comprised of the Mohave River, Newberry Mountains. Calico Mountains, Soda and Cady Mountains. The findings of the assessment are presented in Sections 2.23 and 2.24 of this Appendix.

E.3.14 Section 3.14.2.2, *Route to NTS*

The 29 American Indian tribes involved in the study know that the area along the route to NTS has many culturally significant sites.

In addition to the sites identified previously by the AITC, specific cultural resource data was collected during a RCA in January 1999, in specific areas along this route including Death Valley Junction, Ash Meadows, Eagle Mountain, the Amargosa River Area, the town of Shoshone, Tecopa Hot Springs, the Amargosa Canyon Natural Area, Dumont and Ripple Sand Dunes, the Silurian Valley, and the Salt Creek Hills Protected Area. The data are presented in Sections 2.16 through 2.24 of this Appendix.

E.3.15 Section 3.14.3, *Caliente*

The 29 American Indian tribes involved in the study know that throughout the Caliente, Nevada area are important American Indian cultural resources and sacred sites in addition to several historic sites. Many of the American Indian resources contain important foods and medicines that are gathered in specific areas. Other areas include places of ceremonial worship.

The 29 American Indian tribes involved in the study know that throughout the Caliente and Alamo areas are areas that were used by Indian people for farming and ranching activities. Many of the areas located at nearby Caliente, Nevada contain valuable resources for American Indian economy that were lost not only to Euro-American encroachment but also to land withdrawal, pollution, and radioactive contamination.

The Caliente area is in a desert region where water is the most crucial source. Springs located in the area and other nearby places were the place of Indian settlements and traditional farming until the first half of the century. Although much of the well-watered land in the aboriginal territory was lost to Euro-American settlers, by the turn of the century, American Indian families owned small farms in the area both for their own consumption and for commercial purpose. Livestock was also a part of the Indian economy. Foodstuffs and stock forage were grown and sold by Indian people to supplement wage labor (Stoffle et al., 1990). With decreased access to spring and agricultural fields, and some pollution of the land and water, traditional Indian farming was seriously impacted.

The 29 American Indian tribes involved in the study know that throughout the Caliente and Alamo areas are areas that were used by Indian people and known for important minerals. American Indian people played a major role in the development of mining in the region of Caliente, Nevada. Many local American Indians were active prospectors on their own behalf and located their own mining claims. Many of the producing mines in southern Nye County, for example, were located by local American Indian people, whose knowledge of minerals had been developed through centuries of mineral collecting. The NTS, along with mining activities in Caliente, Nevada, is where Indian people conducted their mining activities. Several American Indian people guided Euro-American prospectors to valuable ore deposits, provided them with transportation, food, and lodging, and taught them about minerals, water resources, and trails. Yet, American Indians were not made equal partners in mineral development as they may have expected and may have been promised (Stoffle et al., 1990). Perhaps because mining was seen as a primarily Euro-American economic activity, the rights of American Indians to claim mines were never made explicit. Indian mining was further precluded when the NTS land was withdrawn and other land was obtained through Euro-American encroachment.

E.3.16 Section 3.14.3.1, *In-town*

The AITC collected specific cultural resource data on the Caliente In-town site during a RCA in January 1999. The data are presented in Section 2.7 of this Appendix.

E.3.17 Section 3.14.3.2, *South*

The AITC collected specific cultural resource data on the Caliente South site during a RCA in January 1999. The data are presented in Section 2.8 of this Appendix.

E.3.18 Section 3.14.3.3, *Caliente Route to NTS*

The 29 American Indian tribes involved in the study know that the area along the route to NTS has many culturally significant sites.

In addition to the sites identified previously by the AITC, specific cultural resource data on the Caliente route to the NTS was collected during a RCA in January 1999. The data are presented in Sections 2.9 through 2.15 of this Appendix.

E.3.19 Section 3.14.4, *Yermo*

Yermo is viewed as being a part of the same cultural landscapes that give meaning to the Barstow Intermodal Facility, therefore the Barstow text should be used in understanding the Yermo facility and the route to the NTS.

E.3.20 Section 3.14.5, *All-truck Routes*

Many of the cultural resources identified by the AITC during the RCA in January 1999, as previously discussed, are in the ROI for the All-truck routes. These cultural resources and potential impacts are discussed below by route sections.

E.3.21 Section 3.14.5.1, *Kingman to Barstow to the NTS*

The 29 American Indian tribes involved in the study know that I-40, from Kingman to Barstow, is a timeline of history and the cultural resources along its path are determined by the past, present, and futures of culturally affiliated people of the Southern Paiute, Chemehuevi, and Patayan/Mojave cultures. This cultural landscape is important to permanent residents, traveling human populations, and commerce. The protection of this region's ecosystem is essential to the health and safety of the ecosystem and its people. The 29 American Indian tribes involved in this study believe they must protect all elements in this region by conducting field surveys, ethnographic studies, and other permanent measures including:

- Properties nominated for the National Register of Historic Places (NRHP). Spirit Mountain (Avikwame), for example, is a proposed Traditional Cultural Property (TCP) in the Newberry Range, which, according to native traditions, has no boundaries.

- Ward Valley, springs, burials, Mojave Trail, Route 66, archaeology sites, animals, plants, aquifers, mountain ranges, trails.
- Places where the Salt songs, Bird songs, and other songs pass through the mountain regions.

The 29 American Indian tribes involved in the study feel that these measures will help to minimize the potential impacts in this region of influence. Other areas of concern are within the area and need further study. Human and natural impacts are rooted deep in history and are important to the contemporary tribes. It is important that each generation establishes the roots for future generations. Past generations established the roots for the present generations. Establishing roots is important because a root goes deep into the ground and can not be dug out. Several previously discussed sites of cultural resources that potentially could be affected along this route are addressed below since they, potentially, would be affected similarly by this alternative.

The results of the RCA of this route are presented in Sections 2.21 through 2.25 of this Appendix.

E.3.22 Section 3.14.5.2, *Mesquite, Nevada to Tonopah to the NTS*

The 29 American Indian tribes involved in the study know that the area along the Mesquite-to-Tonopah route to NTS has many culturally significant sites. The AITC collected specific cultural resource data on the portion of this route that runs from Mesquite, Nevada to US 93 and from US 93 to Hiko during a RCA in January 1999. The portion of this route that includes NV 375 and Highway 6 to Tonopah was assessed also and that data is addressed under Sections 2.9 through 2.15 of this Appendix.

E.3.23 Section 3.14.5.2.1, *Mesquite, Nevada to US 93*

The portion of the route that runs from Mesquite to US 93 passes by a number of cultural areas that are highly significant to Indian people. These include the following:

- South of the highway for the turnoff near NV 170, is a cave, which was a traditional source of paint. Nearby is another cave with writings. These are near the Gold Butte Back Country Byway. A study was conducted on these sites by the BLM in the 1980s.
- Southeast of I-15, in the general vicinity of Halfway Wash, is a culturally significant meadow with its own natural seep.
- Meadow Valley Wash is at the edge of the Moapa Indian Reservation and crosses the highway at Glendale.
- Near Crystal on I-15 on the Moapa Indian Reservation there are culturally significant archaeological sites.

The importance of these sites is supported by the findings of the AITC's RCA of this portion of the route, particularly the Warm Springs-Glendale and Potato Woman areas. The findings are presented in Sections 2.1 and 2.2 of this Appendix.

E.3.24 Section 3.14.5.2.2, *US 93 to Hiko*

The portion of the route that runs from US 93 to Hiko passes by a number of cultural areas that are highly significant to Indian people. These include the following:

- Arrow Canyon Range is spiritual and culturally significant and is connected to Potato Woman through the creation of mountain sheep.
- There is an outline of an eagle imbedded in Arrow Canyon Range.
- US 93 generally follows the Pahranagat Valley to Hiko and this is an area of traditional villages and especially permanent agricultural villages.
- Near Coyote Springs there are a series of rock art sites associated with an east-west trail that runs from the Indian communities in the Moapa Valley to the hunting and pine nut picking area in the Sheep range. It is hypothesized that this trail generally continues west and southwest and connects the Moapa Paiutes with the Pahrump Paiutes. The men from Pahrump would come to get their wives at Moapa and take them back to their new homes in Pahrump. This trail, therefore, is the Indian equivalent of the Mormon Honeymoon Trail, which is a historically protected trail.
- The place where the Moapa people were created.
- Pahranagat was where a very powerful medicine man lived. He wore a robe of coyote *(Canis latrans)* pelts and he was able to communicate with the coyote *(Canis latrans)*, which is very important to Paiute creation stories.
- The powerful medicine men from the Hiko and Pahranagat areas would travel to a mineral deposit near Panaca. There they would mine a green, highly siliceous mineral, which they used to make arrows, knives, and surgical tools. They also made sharp instruments, which appear to be hafted knives and arrowheads.
- Pahranagat Valley contains many medicine plants not found anywhere else and medicine animals. The whole length of the Pahranagat Valley is a natural oasis for wildlife.
- Delamar represents a significant Indian community associated with mining activities. Indian people from this community traveled back and forth from their home communities along the White River.
- Many other significant American Indian resources in the Pahranagat Valley are cited in the Intermountain Power Project report (Stoffle and Dobyns, 1983) and Kelly (1939).

The importance of these sites is supported by the findings of the AITC's RCA of this portion of the route, particularly the Pahranagat Valley Ecoscape and areas associated with it such as the Indian Trail, Maynard Lake, Lower and Upper Pahranagat Valley, and Hiko. The findings are presented in Sections 2.3 through 2.6 and 2.12 of this Appendix.

E.3.25 Section 4.1.13, Environmental Justice

The 29 American Indian tribes involved in this study know that they have experienced and will continue to experience adverse personal, social, and cultural affects that are identifiable under the issue of environmental justice. These affects, included in Section 3.13 of this Appendix, have been identified in the analysis of environmental justice in Appendix G of the NTS EIS and include holy land violations, health violations, perceived risks from radiation, and cultural survival. The federal boundary recognized by the tribes and the federal government requires serious consideration of the impact on the tribe. Environmental justice issues cannot be adequately addressed or understood without going out to the reservations and talking to the Indian people there.

E.3.26 Section 4.1.7, *Water Resources*

The 29 American Indian tribes involved in this study know that critical Indian water resources exist at various points next to both the facilities and the existing and proposed transportation routes. These include at a minimum the Mohave River, Colorado River, the Meadow Valley Wash, the White River in the Pahranagat Valley, the Virgin River, and the Muddy River. The 29 American Indian tribes involved in this study recommend that these rivers, other water sources such as hot springs, and other waterways be assessed with special attention to the potential for radioactive waste spills that can endanger these waters. Among the other water sources are Warm Springs in Hot Creek Valley, Tacopa Hot Springs, springs at Beatty, Goldstrike Canyon near Hoover dam, Ash Springs, and Caliente.

E.3.27 Section 4.1.9, *Biological Resources*

The 29 American Indian tribes involved in this study know that a wide range of biological resources exists at the existing facilities and along the transportation routes. They recommend that this wider range of biological resources be assessed especially looking at the potential for radioactive waste spills that can endanger aquatic and highway greenstrips, which are essential animal habitats.

E.3.28 Section 4.1.10, *Cultural Resources*

The 29 American Indian tribes involved in this study know that physical, spiritual, and cultural resources important to their people exist at both the proposed intermodal transfer points and along the existing and proposed transportation routes. American Indian-defined cultural resources include physical things such as plants, animals, water, petroglyphs, landscapes; spiritual beings such as water babies; and historical places such as massacre sites. Therefore, they recommend that a more extensive cultural analysis be completed.

E.3.29 Section 4.1.14, *American Indians*

The 29 American Indian tribes involved in this study are concerned that the transportation of LLRW and the proposed intermodal transfer points will negatively affect their lands and cultures. They already have witnessed the creation of "dead zones," where plants and animals are sick, can not support life, or have left the area. These zones may expand with new transportation activities. American Indians must find a way to counter those affects so that their culture is not changed as a result of activities involving radioactive waste.

American Indians are connected to the land in ways that are difficult for others to understand. They can not relocate away from the "dead zones" and other contaminated areas because of this connection to the land. As one Paiute man (AITC Meeting Notes, 1998) said,

> *"The dead zone; if there isn't any immediate action taken there will be no more plant life or animal life. The spirit of the rocks are angry because they altered the state of the rocks to make the nuclear stuff. The spirit is mad and killing. That spirit is being shipped around and being used without permission."*

Another Paiute man (AITC Meeting Notes, 1998) summarized the common sentiment:

> *"The magnitude of the impact is more than we can put into words. You can impact the whole earth. They just look at, 'Well, we're just going to put this thing here,' ...they look at it through a microscope and say we're just going to put it here. We look at the whole thing and have to travel farther off the road for medicine and animals... driving us away from where our land is at."*

These ideas have been expressed also by respondents in the American Indian Transportation Study (Austin, 1998). According to a Chemehuevi man,

> *"...the rocks are angry, yes, they're striking out saying "don't do this to me, don't touch me, don't let this happen." In a sense you look at it from a spirituality standpoint, it's the spirits of Mother Earth telling us don't mess with Mother Earth. As far as the transportation of waste there's a lot of unknowns and we don't know what the consequences are. We know there are many sicknesses that come out form people that have been contaminated by nuclear waste and as far as Indian people go, we show respect to the land, show respect to other people, for the animals, the plants, the rocks. The power of the rock—just looking at Chemehuevi Mountain, it's a very spiritual mountain from this perspective right here. When I look out towards the mountains and I don't just see a mountain, I see a place of power, I see a place where I can go and meditate and speak with the Creator directly and ask for prayers and blessings for people directly."* (p. 173)

Indian people have direct experience with radioactive waste and it has come from a wide range of events especially the impacts of nuclear fallout from the above ground testing of atomic bombs. A Western Shoshone woman from Ely, Nevada related in the American Indian

Transportation Study (Austin, 1998) the following experience of her and her family when one of the first atomic clouds fell on their community in Duckwater, Nevada:

> *"And I stood in the doorway of the house, we had a well about from here to about that table from the house, and I stood in the doorway and watched these little birds. Just three little birds laying down, and they spread their wings out, just like a fan. And I was watching these little birds and they did not get up. And I watched them for quite a while. And I went out and I picked them up, and they were just little birds, they had just died. And they were eating out there, picking up sand, the gravel. And after that we went out, I told my dad that the little birds had died out there. And I took him out there and showed him, and he took them away with the shovel. I don't know where he took them, but he took them away somewhere... there has been a lot of seizure death out there. (p. 170-171)*
>
> *"And one day my dad and I were irrigating. And there was a very little sprinkle coming down, just a very little bit, and it splattered my arm. And I had a short sleeved shirt on...and it started to blister. And then all the horses laid down and couldn't get up from eating this wilted alfalfa. That had almost turned it black, real dark green. And then, I guess, it is no wonder the mice had this disease, which is called hanta virus, because it soaked down into the ground...I remember that one boy was riding a horse, and he was going across this rocky trail, and he had a seizure and come up an died. And I remember another place where a man got off at the gate and got out, and he had a seizure, and he up and died. And another girl, she had a seizure and she died. And then there is another man out at Duckwater and he had brain surgery. And there is another woman out there, her brain is kind of drying up and shrinking or something. We moved...*(p. 171)
>
> *"...a lot of us have died. There is my aunt, she died of cancer, she was a captain in the army. There is my brother, he was in the army, too, and he died of cancer. But we can't do nothing, we can't get any money or nothing from it. So, and my husband he died of that lung disease, and can't do nothing about that either...You know that valley down to Duckwater down to that other range of mountains, it was all full of dust, all full. One day we took a ride down there, and the whole valley was all full of dust, covered with dust. And then when we got home we would play with these things, and my brother got blind from doing that. From playing with this radioactive thing."* (p. 171)

A Western Shoshone man (AITC Meeting Notes, 1998) explained that there are places today where Indian women will not pick pine nuts because they perceive that radiation has contaminated them. Indian people will not hunt along the corridors of the test site for the same reason. He knows of one man who likes to hunt deer for the weird racks that occur but not for the meat. He also has a relative who used to hunt ground squirrels (*gümbi*) along the highway with a shotgun. The ground squirrels live along the roads in and out of Tonopah (US 95, Highway 6) and were a major food source for the Shoshone people. He added,

> *"But I won't eat them* [guhm-be, Citellus sp.] *today if they come from south and east of Tonopah because of pollution. I go way up north to hunt those. This is the southern most area for them...* [he continued with a discussion of picking plants and said, that because of pollution] *I travel at least a mile off the road to pick medicine creosote (yatumbi, Larrea tridentata) for my wife and my mother -- it only grows from Goldfield on to the south so we have to come down here to get it.*

E.3.30 Sections 4.x.x.14, *American Indians*

The 29 American Indian tribes involved in this study know that physical, spiritual, and cultural resources important to their people exist at both the proposed intermodal transfer points and along the existing and proposed transportation routes. American Indian-defined cultural resources include physical things such as plants, animals, water, petroglyphs, landscapes; spiritual beings such as water babies; and historical places such as massacre sites. Therefore, they recommend that a more extensive cultural analysis be completed.

E.3.31 Section 5.1.1, *Option 1 - Barstow*

The 29 American Indian tribes involved in this study have gone on record as believing there are significant cumulative affects associated with the production, transportation, and isolation (dumping) of radioactive materials in this region. Comments from respondents in the American Indian Transportation Study provide an American Indian perspective of the impacts of nuclear fallout from above-ground testing on the people and resources of Duckwater, Nevada. Given her history of exposure to radioactive fallout, this Western Shoshone woman's response to continued radioactive waste transport was:

> *"Well, how would you feel if you were in my spot and you saw a truck go right through here and stop at the motel, how would you feel if you saw that sign with the skull's head and the bones that cross? I wouldn't want it...I believe* [there is radioactivity in the land from the bombs], *it is never going away...I believe, myself, and there are a few other people who believe it too, that once that thing comes down to the earth then it is not going to go. It is not going to go anyplace, it is going to settle in the ground...These things I see fall down from the sky, now I am giving them from first hand. These things fall from the sky and just settle in the dirt and the rain on top of it, and it snows on top of it. Where do you think it goes? When the alfalfa turns black, almost black, kind of wilted, the horses can't get up...No container can contain it."* (p. 171)

Increased transportation leads to an increased number in the size and number of roads and is a potential cumulative impact. In the long history of perceived mistreatment of land and resources—all integral, synergistically associated parts of cultural landscapes once under the sovereign control of Indian people—the development, production, use, transportation and storage of radioactive materials, whether high-level or low-level, on or near Indian lands is seen as another disrespectful action by non-Indian people, the consequences of which could be grave for both humans and the environments on which they depend. As one Paiute man said, *"The U.S. government, since they started, have always tried to get rid of tribal people. This is just another form of getting rid of tribal people that we can't see or smell. All the shipments going through there now, how long can we live there? Are they going to give us another reservation? We suffer because of the things they push on us and say it's the best thing for us but they're supposed to protect us."*

In 1863, the Western Shoshone and the federal government reached an agreement about the limits of encroachment on Indian land, which was embodied in the *Treaty of Ruby Valley* (Crum, 1994:32-33; Harney, 1995:193-197). Today, the amount of this encroachment has certainly exceeded any Indian or U.S. government expectation as these might have been discussed at the treaty table. Since that time this encroachment has largely continued without consultation with Shoshone people. This encroachment has certainly exceeded any expectation on the table at the treaty. Today, the land is crisscrossed with every kind of road imaginable.

In the 1800s, little of the land was physically disturbed and they told about in the treaty of disturbing the ground in some ways but no one could imagine that there would be a time when people would dig into every square foot of the earth seeking gold and placing bombs. Today, the scraping of Mother Earth has reached such extremes that gold miners literally grind up entire mountains and mix it with toxic chemicals in order to extract microscopic amounts of precious materials. While radiation has always been known by Indian people to exist, it was in places that were rarely or never visited and it was never disturbed. Unconsidered in the *Treaty of Ruby Valley* or other previous agreements with Indian people was the idea that radiation would be released upon the land in such magnitude as to be a threat to all living things, which include from an Indian perspective all things. The selection of these traditional lands for the release of this enormous quantity of radiation constitutes a violation of the land and the people that exceeds anyone's understanding. The magnitude of the impact is more than can be put into words. They have to travel farther off the road for medicine plants and animals and are being slowly moved away from their land.

E.3.32 Section 5.1.1.14, *American Indians*

The 29 American Indian tribes involved in this study know that physical, spiritual, and cultural resources important to their people exist at both the proposed intermodal transfer points and along the existing and proposed transportation routes. American Indian-defined cultural resources include physical things such as plants, animals, water, petroglyphs, landscapes; spiritual beings such as water babies; and historical places such as massacre sites. Therefore, they recommend that a more extensive cultural analysis be completed.
Cumulative Impacts - places themselves are being modified and the access to places is changing and the imagery of the land is changing.

- Existing hazardous toxic dumping – California quote on that Map …
- Accidents dumping – (1) train, (2) truck
- Wells have dried up – because of de-watering, water diversion, and spiritual impacts
- Mine
- Loss of medicine sites

- Loss of ceremonial sites
- Stigmatizing of the desert
- Military use –
- Grazing
- Urbanization –
- Off-road vehicle recreation
- Potential Land disturbances:
- Removal of the ITT Line
- Land Managers (Department of Defense [DoD], BLM, NPS, and State, Where are the Indians?) and California Desert Cooperative Management Group (Gore's initiative)
- Future growth demands (oil pipe to Las Vegas from L.A., running through the National Mojave Preserve).
- Military plans not to be compromised by future development
- Train accidents through the National Mojave Desert
- Need for identifying cultural landscapes of the Indians.

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