DOE/EA-1140

Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico

March 1996

U.S. Department of Energy
Kirtland Area Office

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ACRONYMS AND ABBREVIATIONS

AAQS	Ambient Air Quality Standards
ACHP	Advisory Council on Historic Preservation
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CAMU	corrective action management unit
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curies
cm	centimeter(s)
CMI	corrective measures implementation
CMS	corrective measures study
CoC	contaminant of concern
CTA	Central Training Academy
°C	degree(s) Celsius
°F	degree(s) Fahrenheit
dBA	decibels
DOE	U.S. Department of Energy
DOE/AL	U.S. Department of Energy/Albuquerque Operations Office
DoL	U.S. Department of Labor
DU	depleted uranium (generally, 99.284% U-238, 0.711% U-235, 0.0053% U-234 by weight)
EA	environmental assessment
EOD	explosives ordnance disposal
EPA	Environmental Protection Agency
ER	environmental restoration
FR	Federal Register
FY	fiscal year(s)
HE	high explosive(s)
HEPA (filter)	high-efficiency particulate air (filter)
HSWA	Hazardous and Solid Waste Amendments
I-25	Interstate-25
I-40	Interstate-40
KAFB	Kirtland Air Force Base
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
km/hr	kilometer(s) per hour
LCF	latent cancer fatality
LDR	land disposal restriction
MDL	minimum detection limit

ACRONYMS AND ABBREVIATIONS (Concluded)

mg/kg	milligram per kilogram
mph	mile(s) per hour
mrem	millirem
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NFA	no further action
NM	New Mexico
NMAC	New Mexico Administrative Code
NMSA	New Mexico Statutory Authority
NOAEL	no observable action effect level
NRHP	National Register of Historic Places
NTS/EIS	Nevada Test Site Environmental Impact Statement
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PHC	petroleum hydrocarbon
ppm	part(s) per million
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
SARA	Superfund Amendments and Reauthorization Act
SHPO	State Historic Preservation Officer
SNL/NM	Sandia National Laboratories/New Mexico
S/S	solidification and stabilization
SVOC	semivolatile organic compound
SWMU	Solid waste management unit
TEVES	Thermally Enhanced Vapor Extraction System
TSD	Transportation Safeguards Division
TU	temporary unit
USAF	U.S. Air Force
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VCM	voluntary corrective measure
VOC	volatile organic compound
WIPP/SEIS	Waste Isolation Pilot Plant Supplemental Environmental Impact Statement
WM/PEIS	Waste Management Programmatic Environmental Impact Statement

GLOSSARY

Air Pollution: Any emission, excluding naturally occurring emissions, into the atmosphere of one or more air contaminants in quantities and/or of a duration that may with reasonable probability injure human health or animal or plant life or that may unreasonably interfere with the public welfare, visibility, or the reasonable use of property.

ALARA: As low as reasonably achievable. Radiation protection program for minimizing personnel exposures.

Alluvial Fan: A cone-shaped deposit of alluvium made by a stream where it runs out onto a level plain or meets a slower stream.

Ambient Air: That portion of the atmosphere, external to buildings, to which the general public has access.

Anion: A negatively charged ion (such as OH^-).

Anionic Exchange Media: A resin with a positively charged matrix and negative ions (anions), which exchange positions with negatively charged ions (contaminants, in this case) present in the solution being passed through it.

Arroyo: A drainage channel with ephemeral flow (the term is typically used in the arid and semiarid parts of the Southwest where surface runoff is restricted to brief periods following rainfall events).

Baghouse: A large filter housing filled with numerous long, cylindrical filter bags that remove particulates from an air stream.

Biodiversity: The complexity of a biotic community in terms of the number of species that comprise it and the relative evenness of their representation in abundance, weight, or other quantity.

Biological Process: Pertaining to treatment of waste, a treatment technology that stimulates microorganisms to consume contaminants and produce nontoxic byproducts such as water and carbon dioxide. Nutrients and oxygen are introduced to the contaminated media to encourage bioactivity.

Biotic Community: The naturally occurring plants and animals of a geographic area that is characterized by a distinctive vegetation type (e.g., grassland, scrubland, or woodland).

CAMU: Corrective Action Management Unit. An area within a facility that is designated by the U.S. Environmental Protection Agency (EPA) Regional Administrator under Title 40 Code of Federal Regulations (CFR) Part 264, Proposed Subpart S for the purpose of implementing corrective action requirements under 40 CFR 264.101 and the Resource Conservation and

Recovery Act (RCRA) Section 3008(h). A CAMU shall be used only for the management of remediation wastes pursuant to implementing such corrective action requirements at the facility.

Capping: The process of covering and sealing.

Carbon Dioxide Blasting: A physical process used to remove surface contamination from debris by blasting the surface with pelletized carbon dioxide.

Catalytic Converter: A device that uses a catalyst to facilitate chemical reactions that convert hazardous or undesirable compounds to nonhazardous compounds.

Cation: A positively charged ion (such as H^+).

Cationic Exchange Media: A resin with a negatively charged matrix and positive ions (cations, usually hydrogen ions), which exchange positions with positively charged ions (contaminants, in this case) present in the solution being passed through it.

Chemical Process: Pertaining to treatment of waste, a treatment technology that uses chemicals under controlled conditions to facilitate reactions that produce less hazardous or nonhazardous compounds.

Chronic Daily Intake: Exposure expressed as the mass of a substance contacted per unit body weight per unit time, averaged over a long period of time (as a Superfund program guideline, seven years to a lifetime).

Reference Dose (RfD): An estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are developed specifically to be protective for long-term exposure to a compound.

Component: Those artifacts and features at an archaeological site that display a similarity of style and temporal period, indicating the occupation of the site by a discrete cultural group.

Contact Rate: Amount of medium (soil) contacted per unit time or event (e.g., kilograms of soil ingested per day).

Contaminant of Concern (CoC): General type of chemical or radionuclide known to be present at waste sites based on site investigations and historical information about site use.

Corrective Action Management Unit: See CAMU.

GLOSSARY (Continued)

Criteria Pollutants: Combustion byproduct pollutants for which EPA has established criteria for protecting ambient air quality. These include carbon monoxide, nitrogen dioxide, sulfur dioxide, particulates, ozone, and lead.

Cultural Resource: Manmade sites, structures, artifacts, and other remains associated with historic or prehistoric cultures.

Cyclone: A vertical, conical vessel that separates particulate matter from an air stream using centrifugal force.

Desorbed Vapor/Off-gas Treatment: An integrated treatment system designed to abate (remove and/or destroy) contaminants in a vapor stream that is to be released to the atmosphere.

Detection Limit: The lowest amount that can be distinguished from the normal "noise" of an analytical instrument or method.

Emission Inventory: A quantitative, detailed compilation of pollutants emitted into the atmosphere of a given community.

Emission Factor: The average emission of a pollutant per unit of use (gram/horse power-hour) for a category of equipment.

Equipment Equivalency Units: A multiplication factor that defines the number of individual heavy diesel equipment types needed to fulfill the excavation and/or backfill task in a given time frame.

Exposure Pathway: The course a chemical or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media (in cases of intermedia transfer) is also included.

Exposure Route: The manner in which a chemical or physical agent comes in contact with an organism (e.g., by ingestion, inhalation, dermal contact).

Exposure Point: A location of potential contact between an organism and a chemical or physical agent.

Exposure Event: An incident of contact with a chemical or physical agent. An exposure event can be defined by time (e.g., day, hour) or by the incident (e.g., eating a single meal of contaminated fish).

Exposure Assessment: A determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of exposure.

Exposure: Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., lungs, skin, and gut) and available for absorption.

Floodplain: The area adjacent to a drainage channel that would be inundated with water during a flood event.

Fugitive Dust: Particulate-matter emissions that are not ducted through exhaust systems and escape to the atmosphere because of leakage; material handling, transfer, or storage; travel over unpaved roads or parking areas; or other industrial activities.

Granular Activated-Carbon Column: A cylindrical vessel filled with granular activated carbon that adsorbs contaminants (generally organic compounds) from a vapor or liquid stream.

Grassland: Vegetation dominated by species of grass.

Habitat Quality: The physical and biological aspects of a habitat in relation to its ability to sustain a vigorous population of a species.

Habitat: The location or type of location where an organism lives.

Hazard Index: The sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways.

Hazard Quotient: The ratio of a single substance exposure level over a specified time period (e.g., subchronic) to a reference dose for that substance derived from a similar exposure period.

Hazardous Waste: Waste contaminated with chemical compounds as defined in 40 CFR Part 261, Subparts C and D.

High-Efficiency Particulate Air (HEPA) Filter: A sealed filter assembly that is designed to remove essentially all of the particulate matter from a vapor stream.

Historic: The chronology of human events that is marked in North America by the arrival of European expeditions (in the Southwest, the historic period begins in 1541).

Hydrogen Reclaimer: A porous platinum and/or palladium medium that adsorbs hydrogen gas (produced in the steam reformer) from the vapor stream.

GLOSSARY (Continued)

Incremental Cancer Risk: The incremental probability of an individual's developing cancer over a lifetime as a result of potential exposure to the carcinogen.

In Situ: In the natural or original position (at an Environmental Restoration [ER] Project site). In situ waste treatment means waste would not be transported from its ER Project site.

Indicator Chemicals: Selected chemicals that are potentially site-related and whose data are of sufficient quality for use in quantitative risk assessment.

Intake: A measure of exposure expressed as the mass of a substance in contact with the exchange boundary per unit body weight per unit time (e.g., milligram chemical/kilogram body weight-day). Also termed the normalized exposure rate; equivalent to administered dose.

Ion Exchange: The reversible interchange of ions between a solid and a liquid in which there is no permanent change in the structure of the solid that is the ion-exchange material. Ion-exchange materials contain ion-active sites throughout their structure, with a uniform distribution of activity.

Latent Cancer Fatalities: Cancer deaths that may be anticipated as a result of radiation exposure.

Mesa: A flat to moderately sloping topographic surface (used at Kirtland Air Force Base) to refer to the relatively flat surface of the alluvial fill between the base of the Manzano Mountains and the bluffs of the Rio Grande Valley).

Mixed Waste: Radioactive waste that is contaminated with RCRA-regulated hazardous wastes, as defined in 40 CFR Part 261, Subparts C and D.

National Ambient Air Quality Standards: Levels of air quality, with an adequate margin of safety, to protect the public health and welfare from any known or anticipated adverse effect of a pollutant.

No Further Action (NFA): NFA status means that the regulatory authority concludes that the site is not contaminated at levels that require further cleanup.

No-Observed-Adverse-Effect Level (NOAEL): In dose response experiments, an exposure level at which there are no statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control; some effects may be produced at this level, but they are considered neither to be adverse nor precursors to specific adverse effects. In an experiment with more than one NOAEL, the regulatory focus is primarily on the highest one, leading to the common usage of the term NOAEL to mean the highest exposure level without adverse effects.

No-Observed-Effect Level: In dose response experiments, an exposure level at which there are no statistically or biologically significant increases in frequency or severity of any effects between the exposed population and its appropriate control.

Off-Gas: Vapor produced from thermal desorption treatment process.

Physical Process: Pertaining to treatment of waste, a treatment technology that uses processes such as adsorption, abrasion, or elevated temperature to transfer contaminants from one media to another media for the purpose of facilitating further treatment.

Prehistoric: The period of past human events that occurred in North America prior to the arrival of European expeditions (in the Southwest, prior to 1541).

Process Control Instrumentation: Monitoring and control instrumentation used to maintain continuous treatment unit operation, optimize unit operations, and shut down system components when unacceptable conditions are encountered.

Pump-and-Treat System: A method of treating contaminated water through extraction by pumping and then treating to remove contaminants to a level that meets regulatory requirements. Actual treatment technologies vary according to site-specific conditions.

Radioactive Waste: Waste contaminated with radionuclides at a level detectable above background radioactivity levels.

Riparian: Of or located along a watercourse (e.g., riparian vegetation and riparian habitat).

Savannah: A woodland vegetation characterized by isolated, widely scattered trees and (typically) a grassland understory.

Scrubland: Vegetation dominated by species of shrubs.

Sensitive Habitat: A habitat type that is either granted special status by a state or federal agency (e.g., wetlands and floodplains) or a habitat that is known to support sensitive species.

Sensitive Species: A species or part of a species that is granted a special status designation by a state or federal agency due to (1) a recognized threat of extinction or extirpation in the foreseeable future (e.g., threatened or endangered species), (2) a current review of available information or ongoing studies to determine whether such a threat exists (e.g., candidate species), or (3) the need to monitor for potential future threats to a vulnerable species (e.g., rare species).

GLOSSARY (Continued)

Site Reclamation: A process to restore and reclaim an ER Project site to the natural condition that existed before corrective action activities. Reclamation activities would include backfilling excavations, topsoil application, reseeding, and establishment of plant growth.

Soil Vapor Extraction: An in situ remedial technology that involves application of a vacuum in order to reduce concentrations of volatile constituents adsorbed to soils in the unsaturated (vadose) zone.

Soil-Washing: A process using vibratory screens, gravity separators, and a cyclone to segregate various-sized soil particles, allowing the contaminants to adhere to the silt and clay particles. Chemicals can be added to the wash water to extract metals from the soil.

Solidification and Stabilization: Solidification refers to processes that reduce the mobility of contaminants by production of a monolithic block composed of cement, water, additives, and contaminated media. Stabilization refers to processes that limit the solubility of contaminants by changing the pH of the solution or detoxifying the contaminants by chemical reaction. Stabilization uses additives to achieve desired waste form characteristics.

Steam-Reforming: A process that uses high-temperature steam to decompose organic compounds to carbon dioxide, carbon monoxide, water, methane, and hydrogen in a pressurized reactor vessel.

Succession: The natural process of change in a biotic community toward a more stable ("climax") community, typically following a disturbance or natural perturbation of the community.

Temporary Unit: See TU.

TEVES: Thermal Enhanced Vapor Extraction System; a sampling and analysis plan to characterize the physical and chemical conditions of the subsurface through the collection of soil and soil gas. A method for collecting organic vapor from soils through use of thermal electrodes inserted into ground and pressure gradients causing their mitigation to an enclosed surface collection system.

Thermal Desorption: A physical process that uses increased temperature to separate contaminants from a solid matrix through volatilization and, in some cases, decomposition.

Treatment Train: A series of integrated treatment technologies that are employed in sequence to effectively remove the contamination from contaminated media.

TU: Temporary Unit. Container storage areas used for treatment or storage of hazardous remediation wastes with a life span of one year and an option for one additional year of use.

GLOSSARY (Concluded)

Understory: A community of low-growing plants beneath the tree canopy of a forest or woodland.

Vadose Zone Vapor Extraction: See Soil Vapor Extraction.

VCM: See Voluntary Corrective Measure.

Vegetation: The plant community of an area, with emphasis on the relative abundances of the species comprising the community.

Voluntary Corrective Measure (VCM): Partial or complete cleanups undertaken at the initiative of the permittee rather than in response to permit compliance schedules.

Wetland: An area of permanently or periodically saturated soil that possesses resulting modifications in soil and/or vegetation.

Woodland: Vegetation characterized by the presence of trees but not to the extent of forming a closed canopy of foliage.

NOTE: Throughout this document, a scientific shorthand notation for expressing risks is used in all tables estimating risks. For example, the number 0.00000111 can be expressed as 1.11×10^{-6} which would correspond to a 1.11-in-a-million risk.

EXECUTIVE SUMMARY

Environmental Assessment for the Environmental Restoration Project at Sandia National Laboratories/New Mexico

The U.S. Department of Energy (DOE) is proposing to conduct Environmental Restoration (ER) site characterization and waste cleanup (corrective action) activities at the currently estimated 157 ER Project sites (also known as solid waste management units or SWMUs) at Sandia National Laboratories/New Mexico (SNL/NM) (see Figures S-1 and S-2). Site characterization and cleanup would be performed using a range of treatment options. The corrective measures selected for this cleanup and analyzed in this environmental assessment are those reasonable, feasible, and implementable technologies that DOE believes would achieve U.S. Environmental Protection Agency (EPA) corrective action objectives and meet EPA technology selection criteria. These actions will be implemented in compliance with the Resource Conservation and Recovery Act (RCRA), the Hazardous and Solid Waste Amendments (HSWA) of 1984, other applicable laws and regulations, and applicable DOE Orders.

Purpose of and Need for Action

DOE, through the Kirtland Area Office of the DOE Albuquerque Operations Office, proposes to conduct ER Project site corrective action (site characterization and cleanup) activities at SNL/NM. Site characterization and cleanup would be implemented in compliance with RCRA, as amended by HSWA in 1984, and other applicable regulations.

The overall purpose and need for site characterization and cleanup is to reduce risk to human health and the environment posed by potential releases of contaminants of concern (CoCs) at ER Project sites. It is the mission of the DOE Office of Environmental Management to achieve and maintain full compliance with applicable federal, state, and local environmental laws and regulations pertaining to current waste management practices and cleanup of previously contaminated sites and facilities. The proposed action would start in fiscal year 1996 and continue for approximately 10 years.

This environmental assessment contains: a statement of the purpose of and need for the ER Project (Chapter 1.0); a description of the proposed action and the alternatives (Chapter 2.0); a description of the affected environment (Chapter 3.0); an analysis of potential environmental consequences (Chapter 4.0); a discussion of applicable environmental regulations, permits, and DOE Orders (Chapter 5.0); and a list of agencies and persons contacted (Chapter 6.0). Supporting analysis and information on methodology are provided in the appendices.

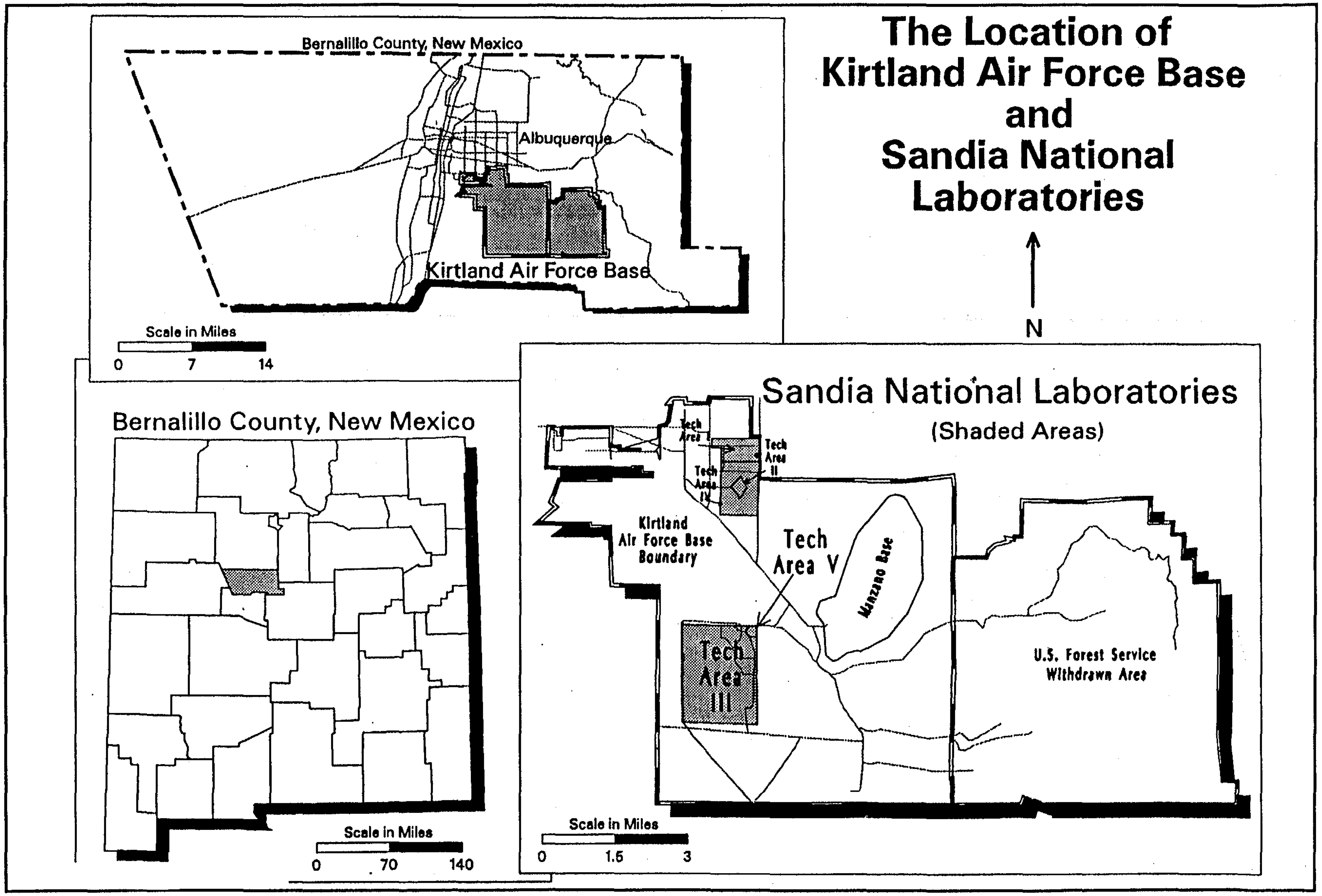

Figure S-1
The Location of Kirtland Air Force Base and Sandia National Laboratories

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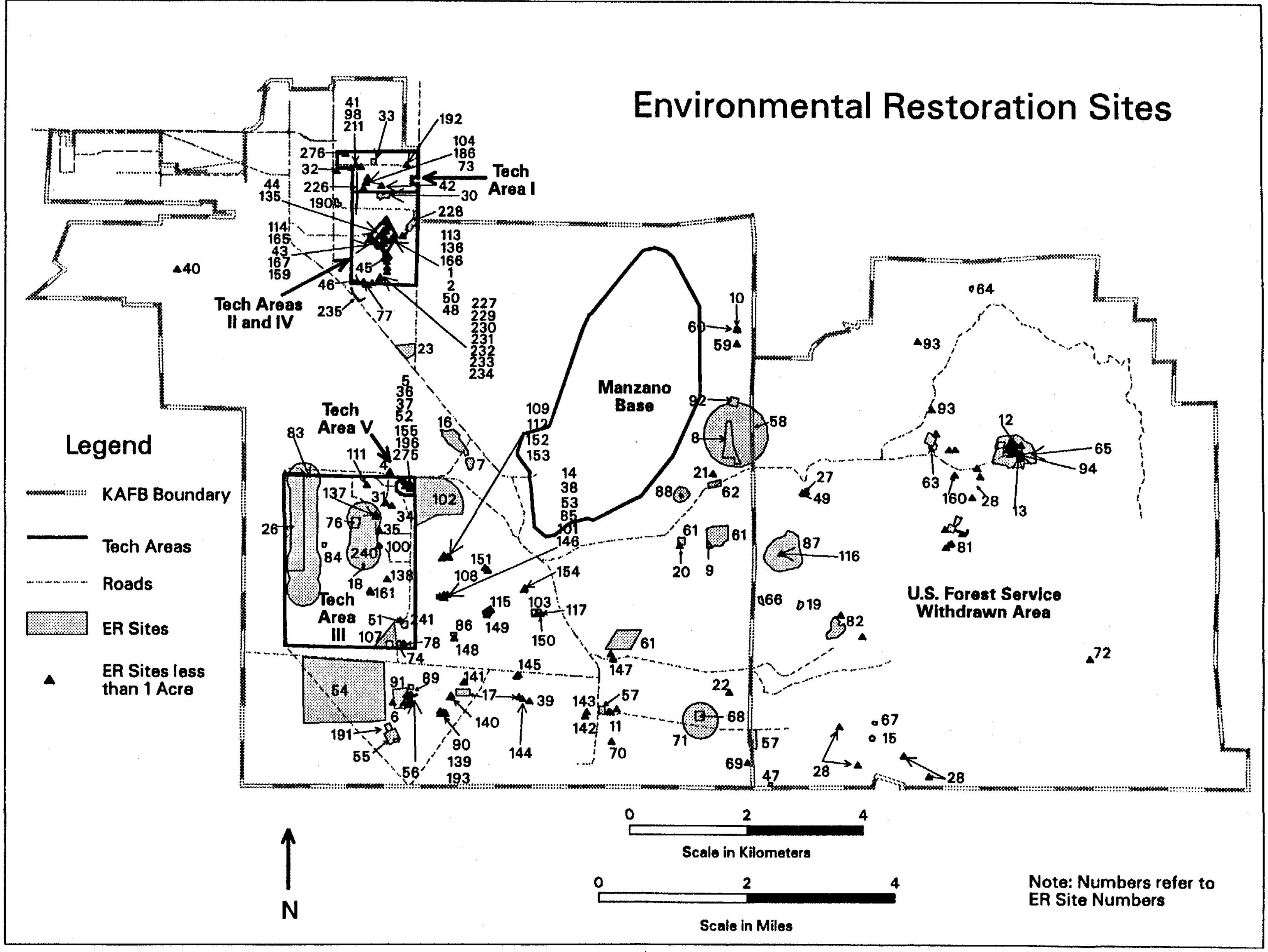

Figure S-2
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Proposed Action

What is DOE's proposed action? The proposed action is for DOE, through SNL/NM, to perform site characterization activities and site cleanup at a currently estimated 157 SNL/NM ER Project sites. An overview of the key steps in the proposed project is presented in Figure S-3. The first step would be to identify those sites that may have been contaminated because of past SNL/NM activities. Once this has been done, the next step is to evaluate the nature and extent of the contamination and to determine the CoCs. After this evaluation, it would be determined whether the site is contaminated at a level requiring cleanup. If a site is not contaminated at a level that would require cleanup based on regulatory cleanup thresholds, the site would be proposed to regulatory authorities for no further action (NFA) status.

Under the HSWA Part B process, the SNL/NM ER Project may propose sites for removal from the cleanup action list. After a rigorous permit modification process with significant public input, EPA will make a determination on the request. However, if the contamination at a site exceeds regulatory cleanup thresholds, other choices would follow. One choice could be to immediately remove an existing hazard (e.g., surface debris), reducing the risk to human health and the environment, by performing a voluntary corrective measure (VCM). If a VCM is not warranted or sufficient for cleanup, the SNL/NM ER Project could proceed with further site characterization to identify and determine the range of treatment options appropriate for site cleanup.

Once the site characterization is complete, actual treatment options would be identified and implemented to clean up the sites. The treatment options considered as part of the proposed action include, but are not limited to, the following two general approaches:

1. Excavation followed by treatment and disposal of contaminated soils (see Sections 2.1.4.1 through 2.1.4.8). This could include the following:

   - Excavation, waste segregation, and site reclamation.
   - Thermal desorption.
   - Off-gas treatment.
   - Soil-washing.
   - Carbon dioxide blasting.
   - Solidification and stabilization.
   - Off-site treatment and disposal.

2. Treatment or site control at individual ER Project sites (see Sections 2.1.4.9 through 2.1.4.11). This could include the following:

   - In situ bioremediation.
   - Thermally enhanced vapor extraction.
   - Capping.
   - Institutional controls.

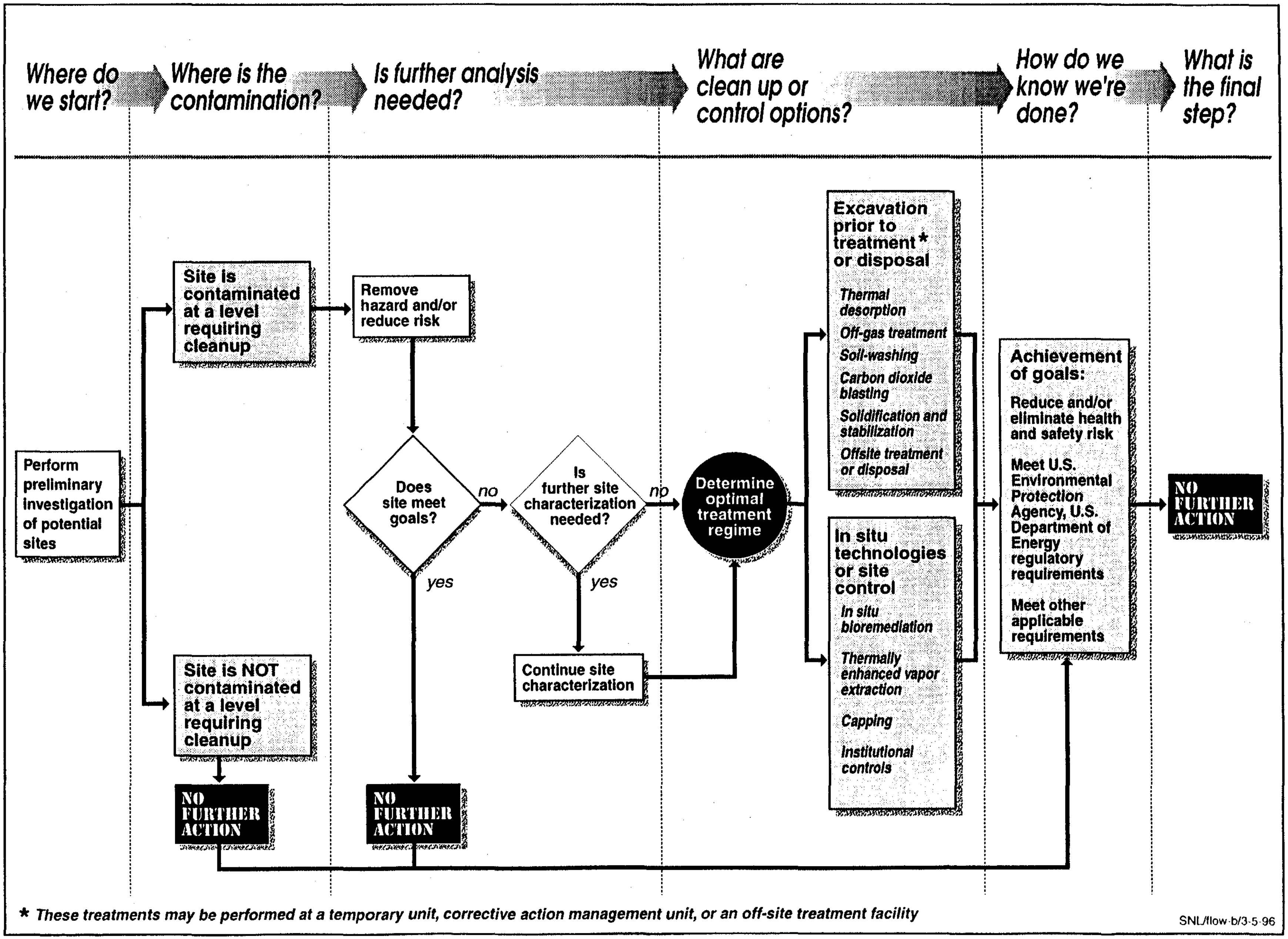

Figure S-3
Simplified Flow Process of the Proposed Action

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All activities requiring excavation followed by treatment and disposal of contaminated soils, could be performed at a centralized treatment area called a temporary unit (TU) and/or corrective action management unit (CAMU), if approved by the regulatory agencies.

What is involved with ER Project site characterization? As part of the proposed action, site characterization activities (see Section 2.1.1) would include, but not be limited to, the following:

- Installing and operating groundwater monitoring wells.
- Sampling and analysis of air, soil, surface-water, and groundwater.
- Performing aquifer tests.
- Extracting and analyzing soil-gas samples to determine the nature and extent of organic vapor contamination within the soil.
- Installing and maintaining site monitoring instrumentation.

What is known about the CoCs? Past and interim investigations and subsequent field investigations currently in progress provide information on site conditions. This information includes evidence of spills and releases, determination of radiological contamination and background conditions, and the existence of potential unexploded ordnance (UXO) hazards at the ER Project sites. Based on this information, some broad categories of contaminants have been identified for each of the ER Project sites. These broad categories of contaminants and hazards include:

- Radioactive materials such as depleted uranium.
- Metals such as lead, copper, mercury.
- Polychlorinated biphenyls (PCBs).
- Petroleum hydrocarbons (PHCs).
- Volatile organic compounds (VOCs) such as acetone, alcohol, carbon tetrachloride, and toluene.
- Semivolatile organic compounds (SVOCs) such as ethylene glycol.
- High-explosive compounds and residues, such as ammonium nitrate, rocket propellant, and black powder.
- Inorganic chemicals such as acetic acid, sulfides, and sulfuric acid.

- Unexploded ordnance (UXO) hazards.

- Miscellaneous contaminants, such as asbestos and hydrazine.

What are VCMs and how are they regulated? VCMs are partial or complete cleanups undertaken at the initiative of the permittee rather than in response to permit compliance schedules. VCMs are intended to reduce or eliminate immediate human health or environmental risks, as well as save time and money by quickly cleaning up sites for which a remedy is obvious. The SNL/NM RCRA Part B permit contains a specific section on the use of VCMs. Many cleanup actions at SNL/NM are performed as VCMs. Prior to performing a VCM, DOE and SNL/NM presents the planned work to the public, requests temporary authorization from EPA to begin the field work, and requests that EPA begin the permit modification process necessary for an eventual decision on the adequacy of the cleanup.

What is a TU and/or CAMU? A TU and/or CAMU (see Section 2.1.4.7) is a centralized facility for managing, treating and disposing of remediation generated wastes. A TU is an area where wastes can be stored or treated. It is regulated and approved by EPA and requires a modification of the SNL/NM RCRA Part B permit. The life of a TU is limited to one year with the potential for a one-year extension. Once it is no longer needed to store or treat wastes, a TU is clean closed. However, if it is needed to treat or to store wastes, it could become permitted as part of a CAMU. The lifespan of the CAMU would be the remaining term of the SNL/NM RCRA Part B Permit and any subsequent renewals.

A CAMU is an area within a facility that is designated for the management of remediation wastes. A single proposed CAMU would be capable of storing and treating loose soils and debris contaminated with organics, metals, or both. The CAMU would be designed with the flexibility to store and treat additional hazardous waste streams and larger waste volumes. Soils treated to remove contamination could be proposed for disposal at a CAMU. The proposed action would be to return decontaminated soils to the ER Project sites of origin. However, if EPA or other regulatory agencies do not approve this option, these soils would be placed in the TU and/or CAMU. Concentrated waste streams from TUs, as well as from debris that could not be decontaminated, would most likely be shipped off site for final treatment and disposal.

What are "institutional controls"? Institutional controls include administrative actions, such as deed restrictions, and access controls (e.g., fences) around ER Project sites to allow for sufficient time for natural processes, such as degradation or radioactive decay, to occur and to render waste less hazardous. The use of this option would depend upon future land-use plans for the individual ER Project sites and for SNL/NM in general.

What does NFA mean? A NFA determination (see Section 2.1.6) is made by EPA with regard to levels of contamination at a site. An NFA status means that EPA determines that the ER Project site is not contaminated at levels that require cleanup. An NFA designation requires that EPA approve a requested modification of the SNL/NM Part B permit for those sites regulated under RCRA corrective action. There may be other comparable processes under other applicable regulations.

No Action Alternative

Are there other alternatives to the proposed action? The no action alternative is the only alternative action considered in addition to the proposed action for this environmental assessment. DOE is required by EPA through the SNL/NM RCRA Part B permit to perform ER site characterization and cleanup. Under the no action alternative, existing contamination would be left in place at the currently estimated 157 SNL/NM ER Project sites. Corrective action, in the form of the specific corrective measures and treatment options described in Sections 2.1.4.1 through 2.1.4.11, would not be undertaken at those sites where releases of contamination currently occur or where there is a threat of future release of hazardous wastes or constituents. There would be no excavation of contaminated soils and no transport of contaminated media for treatment and/or disposal.

Under the no action alternative, DOE and SNL/NM would not comply with the requirements of the SNL/NM RCRA Part B permit, which became effective August 26, 1993. Nor would SNL/NM activities comply with the requirements of Sections 3004(u) and (v) of RCRA or other applicable regulations. The no action alternative does not meet the purpose and need for the proposed action.

Affected Environment

What is the affected environment? Aspects of the environment that could be affected by the proposed action are described in detail in Chapter 3.0. Topics discussed include the physical setting, land use, geology and soils, surface-water and groundwater hydrology, air quality, biologic resources, cultural resources, noise, and socioeconomics.

Environmental Consequences of the Proposed Action

What are the environmental consequences? The consequences of site characterization and cleanup are evaluated in Chapter 4.0. The issues identified, which have either beneficial or potential adverse environmental effects, include land use, surface-water and groundwater quality, geology and soils, air quality, biological resources, cultural resources, noise, and socioeconomic consequences or effects. The potential environmental effects of the various treatment options of the proposed action are summarized in Table S-1.

The no action alternative could result in environmental consequences at SNL/NM because no site characterization or remediation (cleanup) activities would be initiated. The consequences of the no action alternative are summarized in Table S-1.

Human Health Effects

What are the human health effects? Human health risks were estimated for four types of ER Project sites for which sufficient site characterization data exists: waste disposal sites/landfills, firing sites (explosives areas), burn pits, and septic systems. The risk assessment portion of the environmental consequences analysis predicted potential human health effects for individuals exposed to carcinogens and noncarcinogens in three population groups:

Table S-1
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil-Washing/ Stabilization	Carbon-Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Land Use	Land use options would increase when contamination has been removed and excavations have been properly backfilled.	Land use options would increase when treated clean soils are returned to ER Project sites of origin or disposed of at a CAMU.	Land use options would increase when treated clean soils are returned to ER Project sites of origin or disposed of at a CAMU.	Land use options would increase when debris is removed and treated.	The total area where contaminants are present would be reduced through consolidation; a greater range of land use options would become available for more sites. Land use at TU and/or CAMU site would be limited to uses where public access is controlled.	Land use options would increase when excavated contaminated soil has been removed off site and replaced with clean backfill.	Land use options would increase at sites where treatment has been completed.	Land use with unrestricted public access may be restricted at capped sites. Institutional controls could allow limited access for recreational purposes.	No effect. NFA sites would have demonstrated low risk levels.	Land use restricted to current uses or other industrial application and limited access.
Geology and Soils	Contaminated soils would be removed and replaced with clean backfill. Soil composition and texture could be altered. *Some short-term* soil erosion may occur during excavation.	Soils would be remediated. Soil composition and texture may be altered.	Soils would be remediated. Soil composition and texture may be altered.	No effect.	Soil disturbance and some short-term erosion would result from construction of the TU and/or CAMU.	Contaminated soils would be removed and replaced with clean backfill.	Soils would be remediated.	Soil composition and texture may be altered.	No effect. NFA sites would have demonstrated low risk levels.	Contaminated soils would remain in place.
Surface Water	Temporary erosion would increase from runoff. Possible local runoff *would decrease*, due to ponding.	No effect. Surface-water runoff controls would prevent migration of *contaminants* from treatment facility.	No effect. Surface-water runoff controls would prevent migration of *contaminants* from treatment facility.	No effect. Surface-water runoff controls would prevent migration of *contaminants* from treatment facility.	No effect. Surface-water runoff controls would be part of design to prevent *migration of* contaminants to surface water features (e.g., arroyos).	No effect. Contaminated soils would be shielded from moisture by *being placed in* metal containment boxes during transport.	No effect. The in situ bioremediation system would be designed to *mitigate surface-* water infiltration.	Capping would be designed to prevent surface-water runoff from contacting *contaminated* areas.	No effect. NFA sites would have demonstrated low risk levels.	Surface water could come into contact with contaminants.

Table S-1 (Continued)
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil Washing/ Stabilization	Carbon-Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Groundwater	Source removal would have beneficial effect.	Source removal would have beneficial effect.	Excavation for soil-washing would remove contaminant sources. Stabilization would have a beneficial effect.	Contaminant removal would have a beneficial effect.	No effect.	Source removal would have a beneficial effect.	Source removal would have a beneficial effect.	Capping would have a beneficial effect, reducing likelihood of contaminant migration into groundwater.	No effect. NFA sites would have demonstrated low risk levels.	Contaminants could potentially migrate downward into groundwater.
Air Quality	Possible impacts from dispersion of contaminants released from ER Project sites during dirt-moving. Impacts would be mitigated by use of fugitive dust controls, such as soil-wetting. Emissions from diesel engine combustion products would result. Emissions would be well below air quality control limits.	VOCs would be removed without release. Carbon monoxide release would be well below regulatory standards. VOCs available for release from contaminated sites would be destroyed.	Metals and radionuclides available for release, either by air emission or by airborne fugitive dust, would be removed and immobilized.	Removal of contaminants would prevent their release to air. Carbon-dioxide blasting decontamination process would be carried out in enclosed space with air filters to eliminate emissions.	The TU and/or CAMU design would incorporate controls to mitigate potential air emissions; therefore operation of the TU and/or CAMU would have no effect. Construction of the TU and/or CAMU would have similar impacts as for excavation.	Transport vehicle engine emissions would result. Treatment emissions would be relocated to off-site location.	VOC contaminants would not be available for release from contaminated sites.	Contaminants could not be blown from the surface once it is capped. VOC emissions would be mitigated.	NFA designation would only be available for sites with low demonstrated health risks from exposure to contaminant emissions through air pathway.	Natural wind dispersion of contaminants could degrade air quality.
Biologic Resources	Existing biota would be disturbed, moved, or possibly destroyed. Revegetation would be performed to mitigate habitat impacts.	After clean soils are returned to ER Project sites, revegetation would be performed to mitigate habitat impacts.	After clean soils are returned to ER Project sites, revegetation would be performed to mitigate habitat impacts.	Removal of debris for treatment may disturb or destroy existing biota. Revegetation would be performed.	Existing biota would be disturbed, moved, or destroyed. Revegetation would be performed after TU and/or CAMU closure to mitigate habitat impacts.	Excavation impacts would still occur.	Existing biota may be disturbed or moved. Revegetation would be performed to mitigate habitat impacts.	Existing biota would be disturbed, moved, or destroyed. Capping would include revegetation to mitigate habitat impacts.	No effect.	Contaminants may negatively impact biota in long term.

Table S-1 (Continued)
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil-Washing/ Stabilization	Carbon Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Cultural Resources	Subsurface resources may be disturbed. Cultural resources sites would be avoided, if possible, and ground-disturbing activities would be monitored.	No effect.	No effect.	Removal of debris may disturb subsurface resources. Cultural resource sites would be avoided, if possible, and ground-disturbing activities would be monitored.	Subsurface resources may be disturbed or destroyed. Cultural resource sites would be avoided, if possible, and ground-disturbing activities would be monitored.	No effect, other than excavation impacts.	No effect, because no ER Project sites with surface resources have been identified and because ground disturbing activities would be monitored.	No effect, because no ER Project sites with surface resources have been identified and because subsurface resources would not be disturbed.	No effect.	No effect.
Noise	Excavation equipment would create noise on site.	Low to no effect.	Low to no effect.	Low to no effect.	Earth-moving equipment would create noise on site.	Transport vehicles would create noise off site.	No effect.	Earth-moving equipment would create noise on site.	No effect.	No effect.
Socioeconomic Effects	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	No effect.	No effect.
Transportation	Excavation/ earth-moving equipment would be required. Vehicle accident probability would increase.	Soil transport to treatment area would be required. Vehicle accident probability would increase.	Soil transport to treatment area would be required. Vehicle accident probability would increase.	Soil transport to treatment area would be required. Vehicle accident probability would increase.	Earth-moving equipment and transport trailers would be required. Vehicle accident probability would increase.	Off-site incident free transportation risks and impacts, which are small, would be bounded by existing DOE risk analyses. Off-site transportation accident impacts are consistent with the SNL/NM on-site transportation accident analysis.	Equipment for system would need to be transported to site. On-site transportation accident probability would increase.	Earth-moving equipment would be required. Vehicle accident probability increases.	No effect.	No effect.

Table S-1 (Concluded)
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil-Washing/ Stabilization	Carbon-Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Human Health Effects from Releases	Impacts could occur from dispersion of contaminants during excavation. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	There would be an increased possibility of injury or fatality from vehicle accident during transport. There would be an extremely low probability of adverse effect from releases.	Workers could be impacted by exposure to contaminants during ER efforts. There would be a very low probability of adverse effect due to health and safety protection measures.	Workers could be impacted by exposure to contaminants during ER efforts. There would be a very low probability of adverse effect due to health and safety protection measures.	No effect. NFA sites would have demonstrated low risk levels.	Impacts would remain at present levels, with a low probability increased cancer, but greater potential for long-term exposures from contaminant migration.

CAMU Corrective action management unit
ER Environmental restoration
NFA No further action
TU Temporary unit
VOC Volatile organic compound

- Members of the general public residing or present outside the Kirtland Air Force Base (KAFB) boundary.
- Workers involved in implementing corrective measures at the ER Project sites.
- SNL/NM workers present at the facility but not involved with corrective measures.

The total lifetime incremental cancer risks from routine operations for all three population groups were estimated to be 4.2 in 100,000 (4.2×10^{-5}). EPA guidelines list the accepted cancer risk range to be one in 10,000 (10^{-4}) to one in 1,000,000 (10^{-6}). Risks from exposures to noncarcinogens, expressed as a hazard index, totaled 0.30 for all three population groups. Any number lower than the value of 1.0 indicates that human populations can be exposed without appreciable risks of deleterious health effects over a lifetime (see Section 4.3).

Total incremental cancer risks resulting from accidents and abnormal events for all three population groups were estimated at 1.8 in 100,000 (1.8×10^{-5}). The hazard index associated with accidental releases was estimated at 7.4×10^{-6}. The overall cumulative incremental cancer risks for both routine operations and accidents were estimated as 1.0 in 10,000 (1.0×10^{-4}). The cumulative hazard index was estimated at less than 1.0 for all three exposure groups.

The above risk may be compared to an estimated baseline of 0.00047 (4.7×10^{-4}) incremental cancer risk to both SNL/NM workers and the public from general levels of contaminants existing on site and in the Albuquerque metropolitan area without undertaking proposed ER Project actions. This estimate was based on levels of soil contaminants on and near KAFB and locations in the greater Albuquerque metropolitan area (Culp et al., 1994). Contamination from ongoing operations and existing ER Project sites does contribute to this risk; however, the relative contribution is unknown. Therefore, the baseline provides an upper estimate of the risk associated with the no action alternative.

Nevertheless, if the long-term potential for risks from releases to groundwater at unremediated ER Project sites is considered, the no action alternative would likely result in increased risks.

Airborne concentrations of contaminants were compared with ecological benchmark toxicity values. Airborne releases of either hazardous chemicals or radionuclides would be within EPA limits (see Section 4.1.4).

Land Use Effects

What are the land use effects? The same or similar activities are anticipated to be conducted at the SNL/NM location and KAFB and are not expected to change substantially over the next 100 years, during which time institutional controls will be in effect. After 100 years, alternative land-use scenarios may be considered by whatever regulatory authorities exist at that time. It is further assumed that cleanup levels imposed by EPA or the State of New Mexico would achieve a minimum lifetime excess cancer risk no greater than 1 in 10,000 (10^{-4}), which is consistent with industrial uses where exposures to contaminant releases can be documented and controlled. It is also assumed that a regulatory risk level of 1 in 100,000 (10^{-5}) would be imposed and maintained for areas open to public recreation. For reasons given in Section 4.1.1, there is no current conflict between the proposed action and federal, regional, state, local, or tribal land-use plans, policies, and controls. No national state parks, wilderness areas, or national monuments are in the vicinity of the ER Project sites. A major recreation resource, Cibola National Forest, would not be adversely impacted.

Effects on Geology and Soils

What are the effects on the geology and soils? The principal impacts to geology and soils would result from excavation activities associated with corrective measures. Excavation would have minor, temporary effects on local topographic expression. Soils would be stored and piled for site reclamation activities. Soil disturbances would also result in small increases in local erosion potential, which would be mitigated by recontouring and revegetating disturbed sites. A beneficial effect of soil-profile alteration (a decrease in fine-grained material during treatment) would be a potential increase in infiltration rates and an accompanying decrease in water erosion. No cumulative impacts were projected.

Surface-Water and Groundwater Quality Effects

What are the effects on surface-water and groundwater quality? No major adverse impacts to surface-water or groundwater resources would result from construction or operation of corrective measures. Any increases in surface-water runoff from excavation or construction would be temporary (see Section 3.3). In general, surface-water quality would not be adversely affected because it is present only during and following intense precipitation events when it is predominantly confined to the channels of two major arroyos. There would be slight adverse impacts for short durations where ER Project sites are located in or adjacent to the arroyo channels. Groundwater contamination associated with corrective measures (e.g., excavation) is unlikely because of the depth to ground-water (generally, 350 feet [107 meters] or more) and low annual precipitation.

Three ER Project sites (7, 16, and 23) are located within or adjacent to the main channel of Arroyo del Coyote (see Figure 3-7 and Figure 3-8), which is subject to flooding during major precipitation events (see Section 3.4.1). Small-scale excavation of contaminated soils and debris at these sites would have no short- or long-term adverse effects on the floodplain. The proposed excavations, which would be reclaimed within a short time period, would not affect human life or property or natural and beneficial floodplain values. Of the natural wetlands remaining at KAFB (Coyote Springs, Sol de Mete Spring, and G Spring) (see Figure 3-9), only Coyote Springs (ER Site 62) might be affected. However, this site is proposed for a determination of NFA based on a determination that the site is not contaminated at a level exceeding regulatory cleanup thresholds.

Air Quality Effects

What are the air quality effects? Prior to any excavation or remediation activities, each ER Project site would undergo an evaluation for the applicability of the National Emissions Standards for Hazardous Air Pollutants (NESHAPS) and of other potentially applicable regulations.

An estimated 7,650 tons (6.94 million kilograms) of regulated criteria air pollutants would be emitted over the assumed ten-year ER Project activity period (emissions of toxic pollutants not subject to regulatory limits for mobile sources were also estimated). Ambient air concentrations resulting from these emissions were estimated using the EPA ISC2 model (see Section 4.1.4) and were compared to the National Ambient Air Quality (NAAQ) Standards and the Albuquerque/Bernalillo County Ambient Air Quality (AAQ) Standards. All air emissions associated with ER Project site excavation and transportation to the TU and/or CAMU would be well below both the national and the local AAQ standards. Carbon monoxide emissions are estimated to be 4.3 tons (3,900 kilograms) per year and would be below the Albuquerque Environmental Health Department Air Pollution Control Division "General Conformity" standards for carbon monoxide emissions of 100 tons (91,000 kilograms) per year for any local source. Because of the contaminant destruction effectiveness of the proposed off-gas treatment system for the thermal desorber, the only significant pollutant emission from the TU and/or CAMU treatment facility would be carbon dioxide, which is estimated to be 0.03 tons (27 kilograms) per year. There are no NAAQ or local AAQ standards for to carbon dioxide emissions.

The only potential routine releases of hazardous air pollutants from the proposed treatment facility would be radionuclides. Emissions of radionuclides, controlled by high efficiency particulate air filters with a minimum 99.9 percent removal efficiency, would not exceed the National Emission Standards for Hazardous Air Pollutants (NESHAPS) criteria that radiation doses to the public not exceed 10 millirems (mrem) per year. Corrective measure-related doses at KAFB site boundary were estimated at below 0.005 mrem per year. Radionuclide emissions would be monitored and reported according to NESHAPS and SNL/NM air monitoring requirements.

Effects on Biological Resources

What are the effects on the biological resources? Sensitive species potentially located at ER Project sites include plant and animal species that are listed under the federal Endangered Species Act (see Section 3.6.2) as well as those protected by the State of New Mexico. Three state-listed endangered plant species (List 1: grama grass cactus, Wright's pincushion cactus, and Visnagita cactus) are known to occur on KAFB. Two candidate species for federal listing (grama grass cactus and the Texas horned lizard) are also known to occur. Seven other federal candidate species (three birds, three bats, and one rodent species) are considered potentially present on KAFB but have not been found to occur. One state-listed rare and sensitive plant (List 2: Santa Fe milkvetch) is known to occur on KAFB, and two other List 2 species may occur there. One species under State review (List 3: strong prickly pear) may occur on KAFB.

Of the total area to be disturbed over a ten-year period by the proposed action (about 1,100 acres), nearly 900 acres (360 hectares) (about 70 percent) are comprised of ER Project sites known to support sensitive species. However, nearly half of this area (about 420 acres or 170 hectares) is in a single site (ER Site 54). The proposed cleanup would result in an overall reduction of exposure of ecological receptors, including sensitive species, to chemical and radiological contaminants, thereby reducing long-term risks. Minor to moderate short-term adverse impacts would be related to human activity, local noise, traffic, and potential releases of contaminants.

Disturbance to areas with highly sensitive habitat (e.g., one wetland area and sites with vigorous populations) would be avoided, if possible, during soil excavation operations. Where it was not feasible to protect isolated individual plant species, individual plants would be transplanted to an area outside the area of disturbance. Where special status plants are not found, long-term impacts to biological resources are expected to be minor to moderate. With mitigation measures, there would be no major impacts to sensitive plant species.

Effects on Cultural Resources

What are the effects on cultural resources? In 1994, a complete pedestrian survey of all known ER Project sites was conducted on DOE, KAFB, and U.S. Forest Service lands that had not been surveyed since 1988 or before. Sixty-two sites (32 prehistoric, 24 historic, 5 prehistoric-historic, and 1 site of unknown affiliation) have been recorded with the New Mexico Historic Preservation Division as being within areas designated as ER Project sites. Of these, 31 prehistoric sites, 17 historic sites, and 5 prehistoric-historic sites are candidates for possible inclusion in the National Register of Historic Places (NRHP). Although these sites have the potential for yielding significant information, they are not necessarily qualified for the NRHP. ER Project activities, including excavation, would be implemented to avoid all potential NRHP sites. If avoidance were impossible, subsurface testing and data recovery or monitoring during ground-disturbing activities would be instituted as required. If any cultural resources were uncovered during excavation, work would cease, and a qualified archeologist would be called in to make an assessment. With these mitigation measures, there would be minor to moderately adverse impacts on subsurface cultural resources.

Effects from Noise

What are the effects from noise? Noise sources associated with the proposed action would consist of normal construction noise, excavation equipment, and truck traffic. Noise emissions would generally be confined to daylight hours and would be sporadic. Also, most public noise receptors are located 1 mile (2 kilometers) or more from the major remediation activities. Thus, ambient noise levels associated with corrective measures would have only minor short-term on-site impacts.

Socioeconomic Effects

What are the socioeconomic effects? Implementation of the ER Project would create minor short-term employment for construction workers, equipment operators, and truck drivers. The number of technical support staff would remain constant. Most members of the required work force currently reside in the Albuquerque area and would be hired from the existing labor pool; net increases in local employment and payroll would be negligible. Community services and infrastructure would not be affected. None of the activities or potential impacts associated with the proposed ER Project would result in disproportionately high adverse human health or environmental effects on minority or low income populations.

Cleanup operations under the proposed action would, in the long term, reduce the risks of environmental contamination and human health effects for the entire Albuquerque region. Together with the general population as a whole, minority and low income populations in this region, including the Isleta Pueblo to the south, would benefit from cleanup activities at SNL/NM. Therefore, no foreseeable disproportionate or adverse health and environmental impacts would be expected on any particular segment of the surrounding population, including minority and low-income populations.

Cumulative Impacts

What are the cumulative impacts of the proposed action? The Council on Environmental Quality regulations defines, "cumulative impact" as that which results from the incremental effects of an action when added to other past, present and reasonably foreseeable future actions. Consistent with DOE guidance, the cumulative analysis in this environmental assessment focuses on issues of importance. The greatest contributor to the human health impacts from the proposed ER Project treatment options was estimated to be accidental injuries and fatalities associated with corrective measures operations. The incremental cancer risk for adults and children associated with the no action alternative was estimated to be somewhat greater than the incremental cancer risk for proposed routine corrective measures operations. However, this risk estimate is quite conservative because it is based on measured environmental concentrations that include contributions from operational releases and contaminants at ER Project sites. When risks from corrective measures accidents were included, however, the cancer risks from taking no action and from implementing routine corrective measures were together far lower than the total risk of industrial accidents occurring during corrective measures.

In general, therefore, the environmental and human health impacts associated with ER Project would be small, short-term impacts mainly associated with contamination exposures during cleanup activities. Under normal operations, the greatest risk is the risk of physical injuries from transportation accidents that would occur while transporting contaminated materials on site or off site for treatment and disposal. Although small, short-term impacts would occur, the long-term effects of the ER Project cleanup activities would reduce the existence of contamination as well as the potential risk of contamination spreading to areas where it does. not already exist.

Future Actions

What happens now? The ER Project is an ongoing process and, therefore, will be modified depending on the results of assessment activities. Future actions may include getting additional permits and approvals from the appropriate regulatory authority (e.g., air permits from EPA) and responding to any new regulatory requirements. Additional environmental reviews may be done under the National Environmental Policy Act. Work plans, safety analysis and additional risk assessments may be prepared. The public will be kept informed and have opportunities to participate in the ER Project through the public participation processes of such actions as future NEPA documents and new permit applications. The DOE will continue to work with our local Citizens Advisory Board as a continuing program of public outreach.

1.0 PURPOSE AND NEED FOR ACTION

1.1 Background

Sandia National Laboratories/New Mexico (SNL/NM) is managed and operated for the U.S. Department of Energy (DOE) by Sandia Corporation, a subsidiary of the Lockheed Martin Company. SNL/NM is located on land controlled by DOE within the boundaries of Kirtland Air Force Base (KAFB) in Albuquerque, New Mexico (see Figure 1-1). The major responsibilities of SNL/NM are the support of national security and energy projects. Among the primary missions of SNL/NM is the design and development of non-nuclear portions of weapons systems. These systems include the arming, fusing and firing systems used in nuclear ordnance.

In addition to designing and developing weapons systems, SNL/NM conducts nuclear reactor safety studies for the U.S. Nuclear Regulatory Commission; develops safe transport and storage systems for nuclear wastes; develops radioactive waste disposal techniques; and conducts pulsed power, thermonuclear fusion, solar energy, vertical-axis wind turbine, and fossil fuel and geothermal energy research. SNL/NM also supports the nation's industrial progress through Cooperative Research and Development Agreements with private sector companies.

Since the mid 1940s, some SNL/NM national defense operations have generated solid waste, such as low-level radioactive waste, hazardous waste, and mixed waste (a combination of radioactive and hazardous wastes) that contain contaminants of concern (CoCs). Prior to the regulatory requirements now in place, SNL/NM disposed of these wastes in landfills and release sites within the boundaries of SNL/NM and KAFB. In 1984, DOE through its Albuquerque Operations Office (DOE/AL), created a site cleanup program called the Comprehensive Environmental Assessment and Response Program (CEARP), which fulfilled DOE's compliance requirements under several statutes and regulations including, but not limited to:

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

- Resource Conservation and Recovery Act (RCRA) (Title 40 of the Code of Federal Regulations [CFR] Parts 260 through 279), as amended by the Hazardous and Solid Waste Amendments (HSWA) in 1984.

- National Environmental Policy Act (NEPA) (40 CFR 1500 through 1508).

- Atomic Energy Act (AEA) of 1954 (10 CFR 200 through 1060).

Under the goals of the CEARP, assessment and remediation activities were conducted from 1984 until March 1987, when DOE Headquarters, at the request of the U.S. House of Representatives Armed Services Committee, incorporated the separate field programs into a

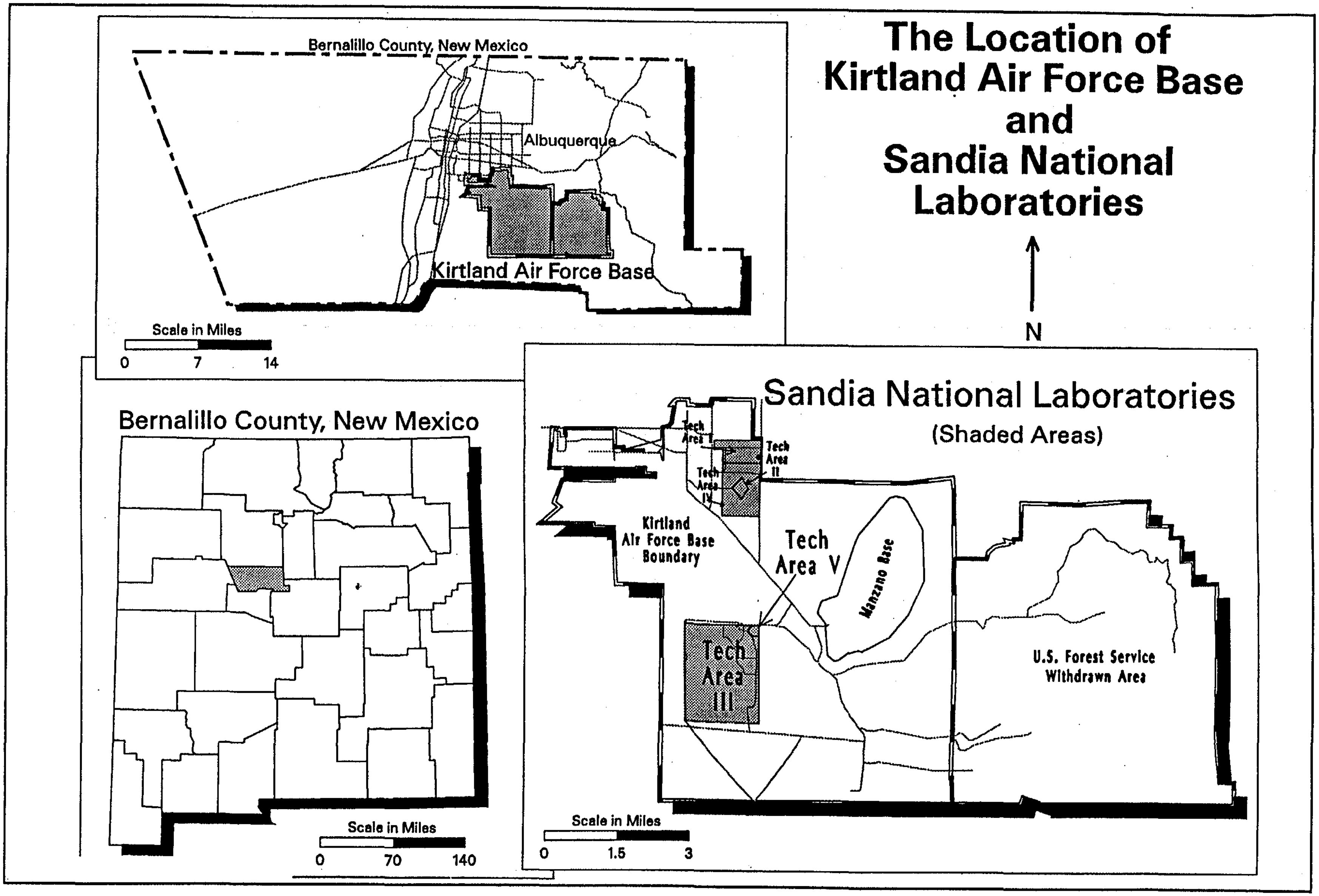

Figure 1-1
The Location of Kirtland Air Force Base and Sandia National Laboratories

national environmental restoration (ER) program for all DOE defense program facilities. In November 1987, the Secretary of Energy established the Office of Environmental Restoration and Waste Management to improve site remediation, waste management, and decontamination/decommissioning by consolidating these programs into one office. The primary goals of DOE ER Project activities are to ensure that risks to human health and the environment posed by inactive sites be either eliminated or reduced to safe levels (SNL/NM, 1995a) and to ensure compliance with all applicable regulations.

CEARP studies completed in the 1980s and several additional investigations have identified the suspected presence of 157 potential waste and release sites at SNL/NM (as of December 1995) where hazardous, radiological, or mixed materials may have been released to the environment. These potential release sites are referred to under the RCRA as solid waste management units (SWMUs); but, for the purposes of this environmental assessment (EA), these sites are referred to as ER Project sites. In general, the types of CoCs found at the ER Project sites include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), heavy metals, radionuclides, high explosives (HE), polychlorinated biphenyls (PCBs), petroleum hydrocarbons (PHCs), various inorganic compounds, and sanitary wastes.

The ER Project sites listed in Appendix A, Table A-1, require further investigation and possible corrective action. Additional sites may be added to this list in the future as more information becomes available. The analysis in this EA addresses currently listed sites as well as reasonably foreseeable additions to the ER Project site list.

1.2 Purpose And Need

DOE, through the Kirtland Area Office of DOE/AL, is proposing to conduct ER Project site corrective action (site characterization and cleanup) activities at SNL/NM. The overall purpose of and need for site characterization and cleanup is to reduce risk to human health and the environment posed by potential releases of CoCs at ER Project sites. Under the mission of the Office of Environmental Management/Office of Environmental Restoration and Waste Management, DOE will achieve and maintain full compliance with applicable federal, state, and local environmental laws and regulations pertaining to current waste management practices and cleanup of previously contaminated sites and facilities. The proposed action would start in fiscal year (FY) 1996 and continue for approximately 10 years.

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2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

DOE is proposing to characterize and clean up the ER Project sites using a range of treatment technologies (also referred to as treatment trains). These technologies may be selected singly or in combination, depending on the cleanup requirements. This cleanup could involve currently estimated 157 SNL/NM ER Project sites. The corrective measures selected for this cleanup and analyzed in this EA are those reasonable, feasible, and implementable technologies believed to be capable of achieving U.S. Environmental Protection Agency (EPA) correction action objectives and technology selection criteria.

The final selection of corrective measures would be made either by the appropriate HSWA permitting authority after the completion of the RCRA facility investigations (RFIs) and corrective measures studies (CMSs), by the State of New Mexico when the State receives RCRA corrective action authority or under other applicable regulations. This EA analyzes the potential environmental consequences of the corrective measures that are consistent with RCRA requirements, EPA guidance, HSWA permitting process, DOE policy, and other applicable regulations. In addition, corrective measures selected for this analysis are based on the best information on site characteristics available at this time. It is possible that not all of the currently estimated 157 SNL/NM ER Project sites would require corrective measures. Some sites would qualify for "no further action" (NFA), provided it could be demonstrated to the regulators that leaving the sites as they are poses no threat to human health or the environment. In addition, some sites would be addressed through a process of voluntary corrective measures (VCMs) designed to remedy immediate hazards.

Figures 2-1 through 2-7 depict the locations of the currently estimated 157 SNL/NM ER Project sites identified as of December 1995. More extensive information on these sites is available in Appendix A, Table A-1, which lists each ER Project site with information on past waste sources, geographical features, nearest point of public access, the area of concern and estimated contaminated soil volume, and the CoCs. For each site, hazardous materials *known* to have been associated with activities conducted at the site (based on archival evidence) are included as *potential* contaminants. Hazardous materials *suspected* to have been used are identified as *suspected* contaminants. The contaminated physical forms or media are also identified in the table.

Appendix A, Table A-2, lists the estimated volumes needed to be treated through corrective measures. For the purpose of this EA and in order to conservatively assess impacts, volume estimates are considered to be larger than the actual volumes that would require remediation. The range of possible treatment options at each site is also shown in this table. The table provides an overview of the types of sites and contaminants to be addressed by the ER Project and should not be interpreted as defining specific proposed remedial actions for each site. It is provided to assist the reader with background information on which this assessment of a range of proposed actions in the EA is based. Actual corrective measures for individual sites would be addressed as part of the HSWA permitting process and subsequent required documents.

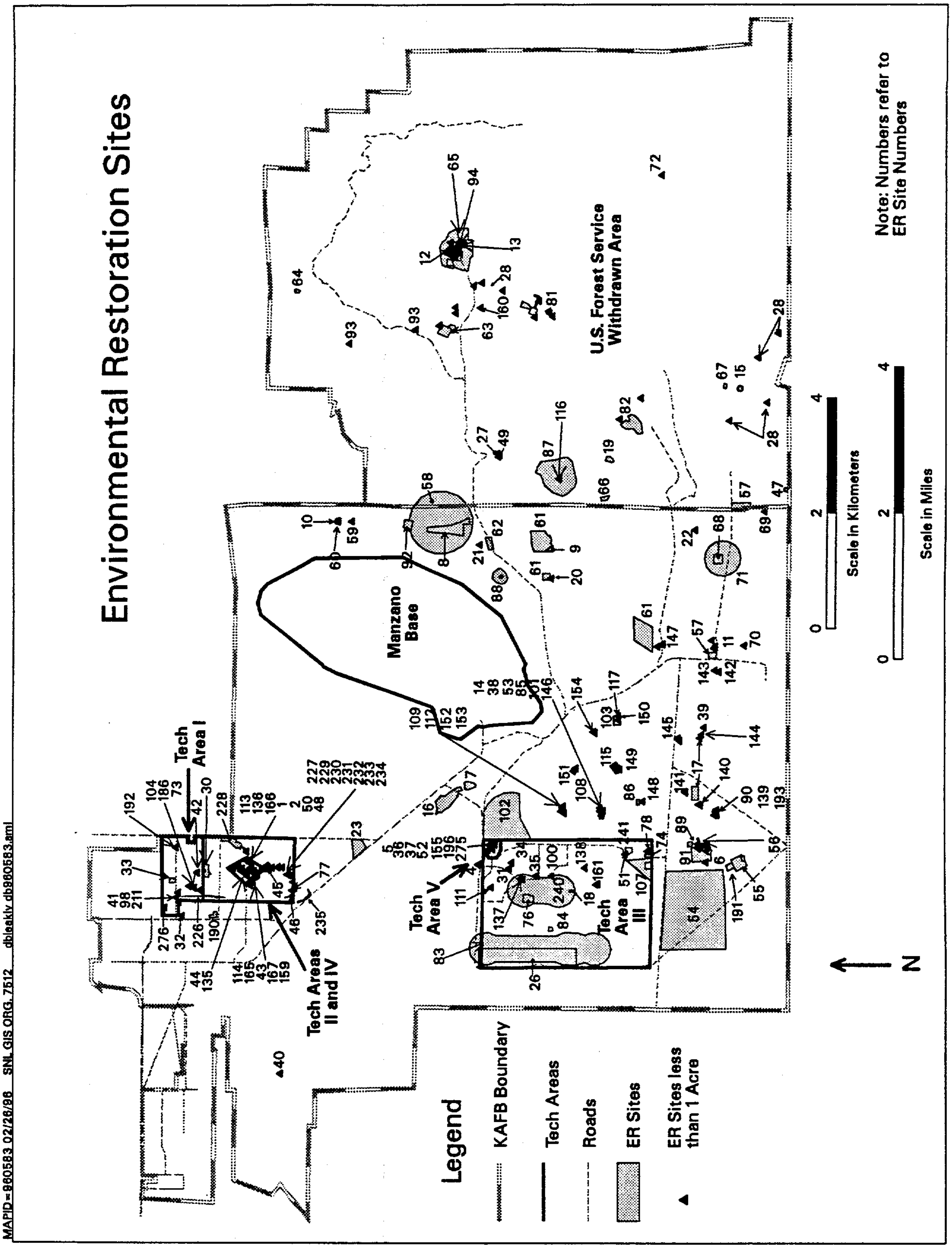

Figure 2-1
Sandia National Laboratories/New Mexico
Environmental Restoration Sites

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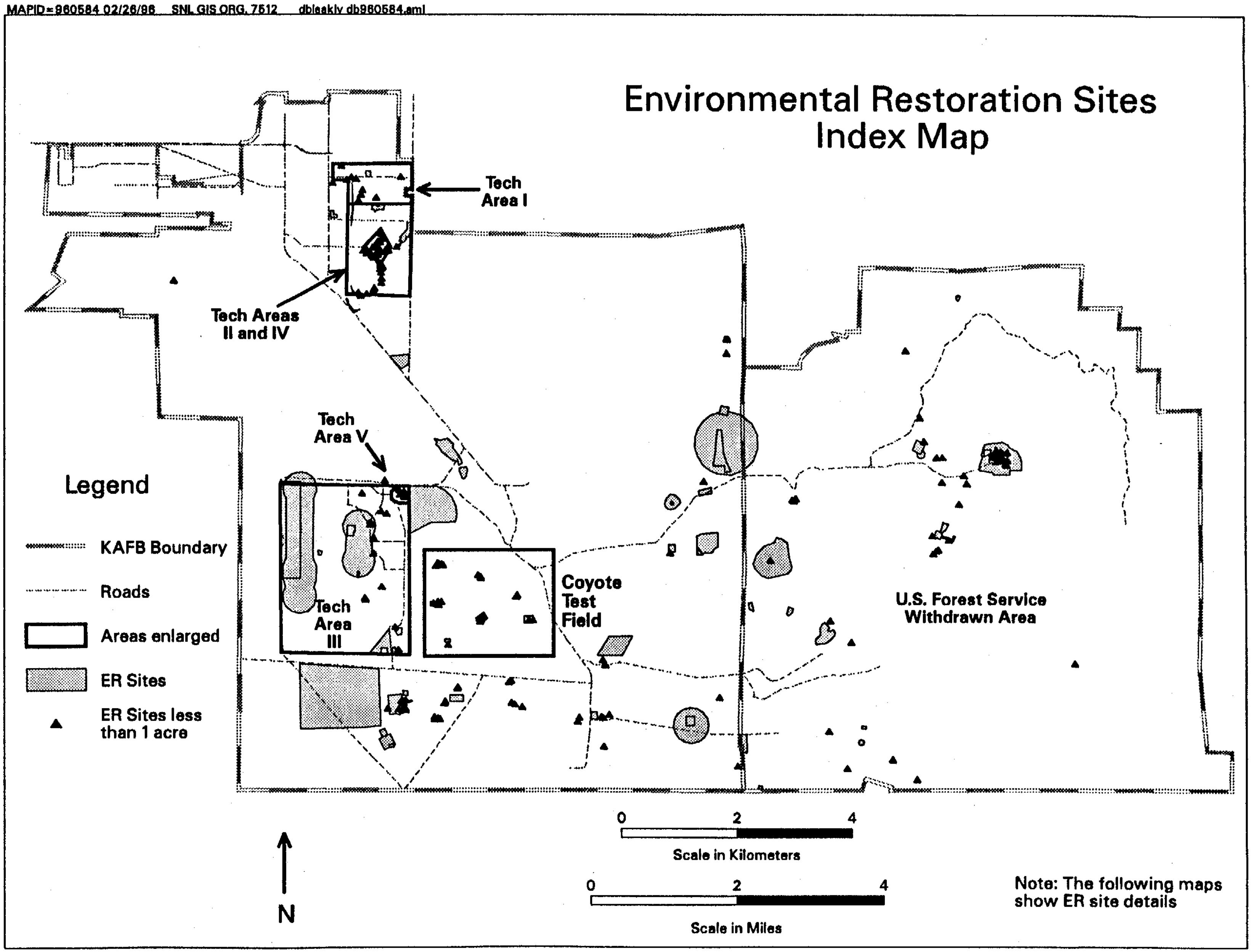

Figure 2-2
Locator Map for Environmental Restoration Site Detail Maps

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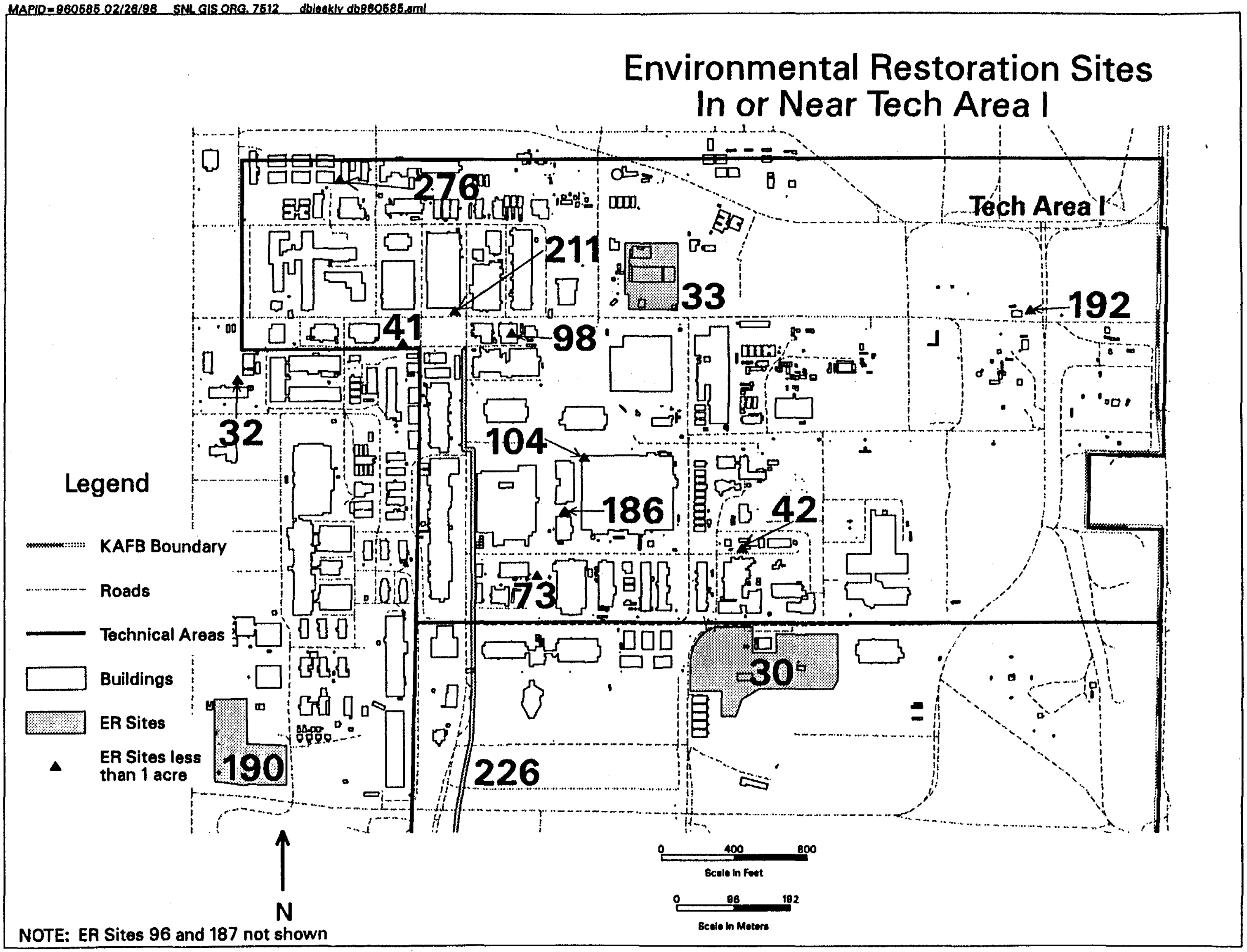

Figure 2-3
Environmental Restoration Sites In or Near Tech Area I

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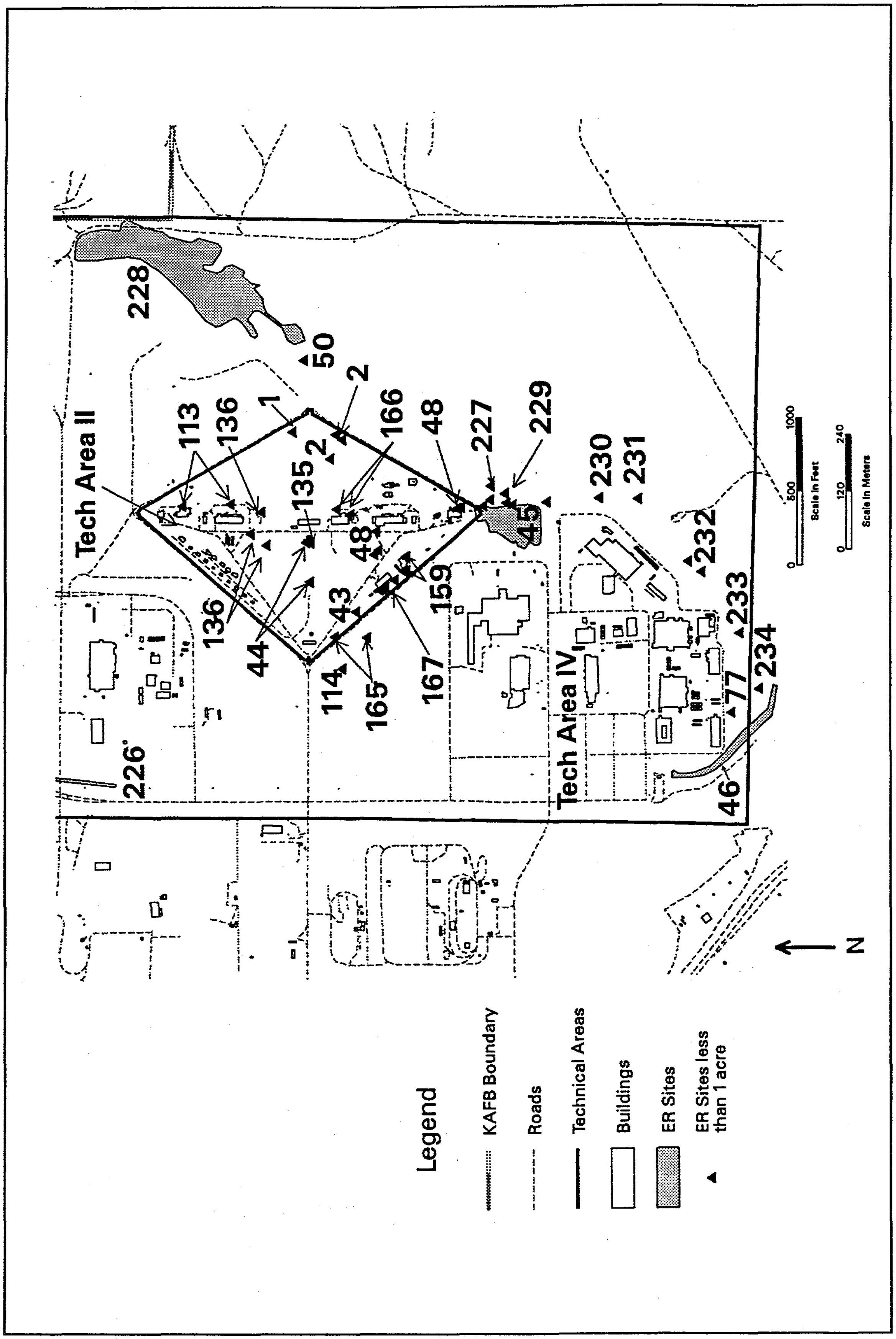


Figure 2-4
Environmental Restoration Sites In or Near Tech Areas II and IV

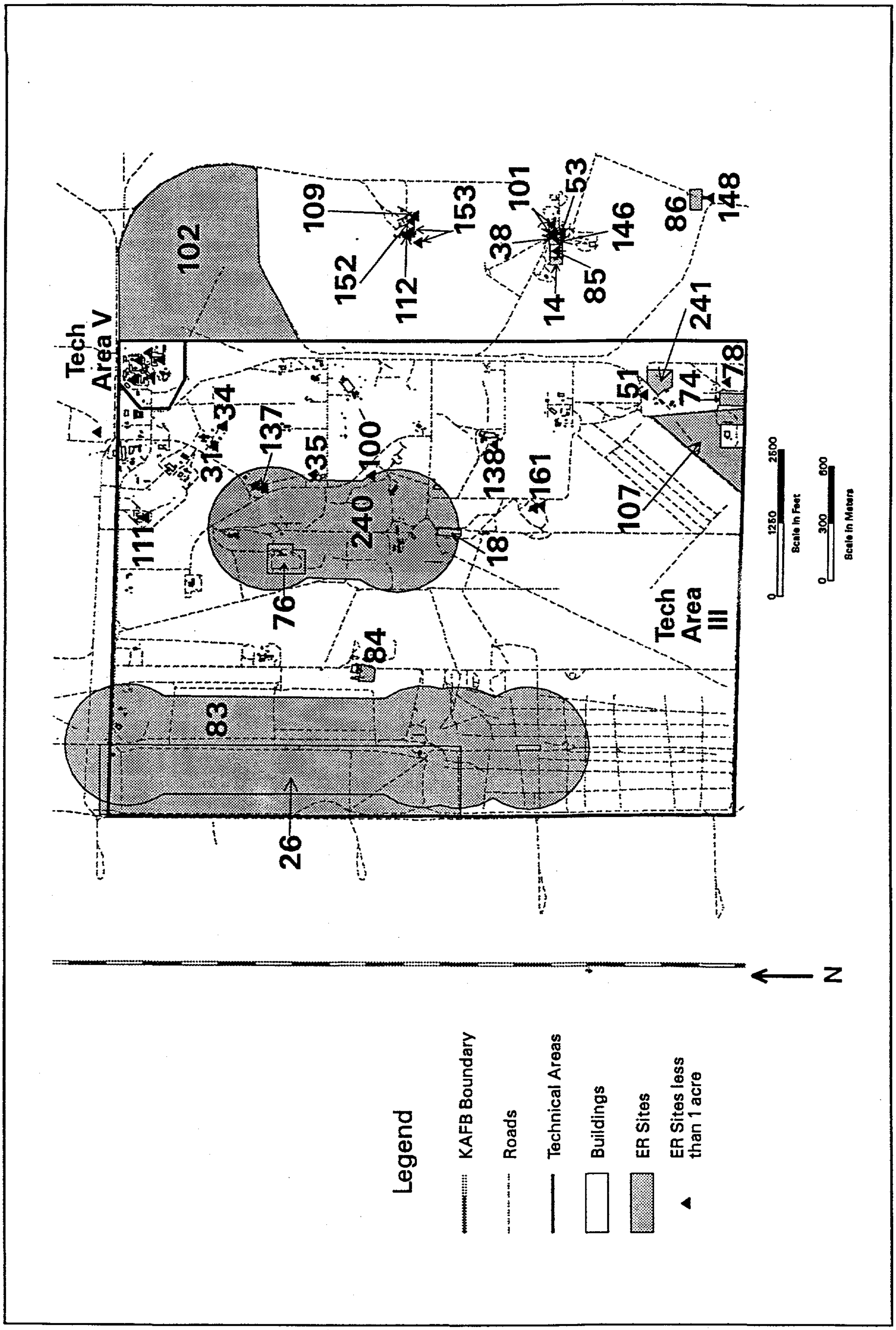


Figure 2-5
Environmental Restoration Sites In or Near Tech Area III

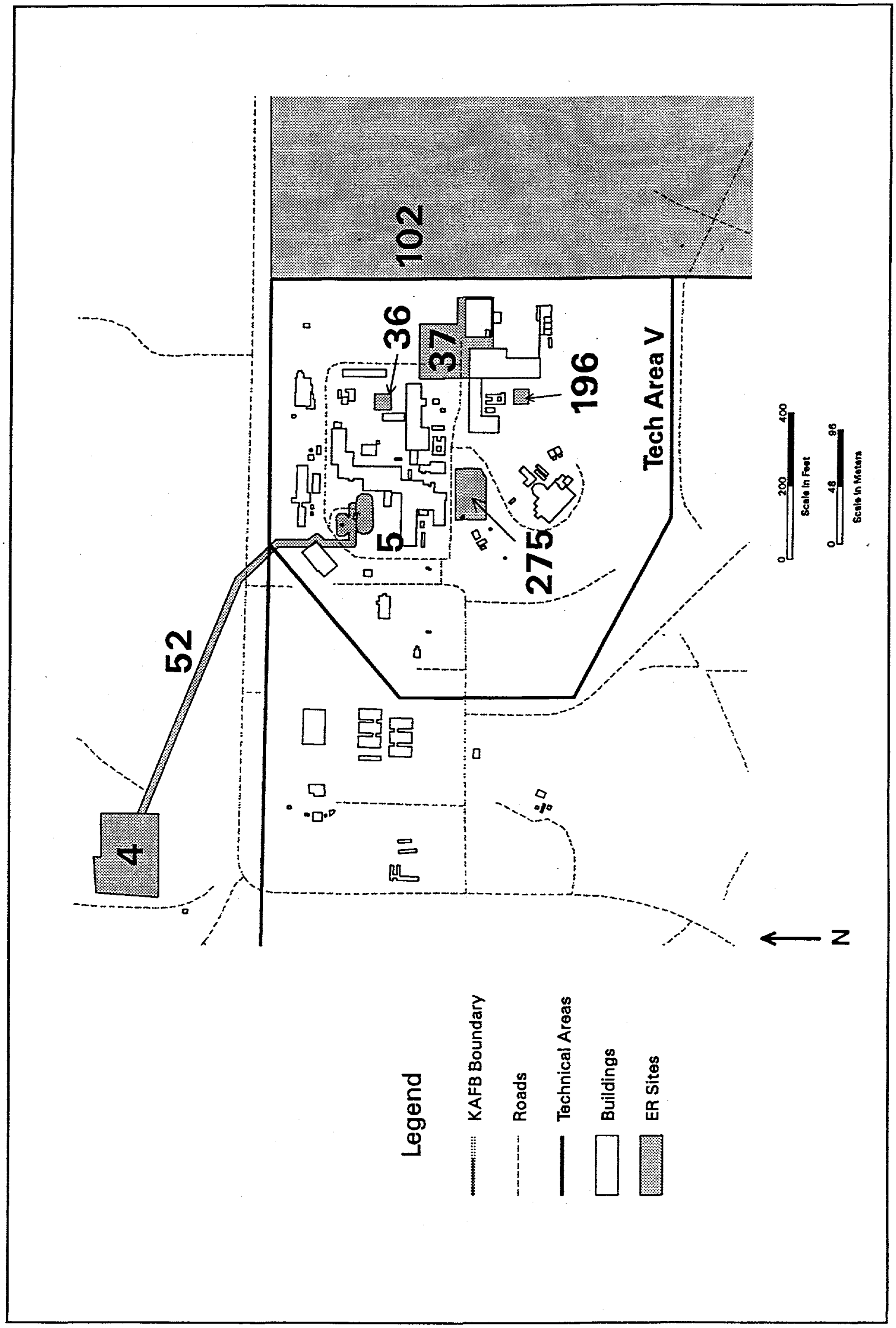


Figure 2-6
Environmental Restoration Sites In or Near Tech Area V

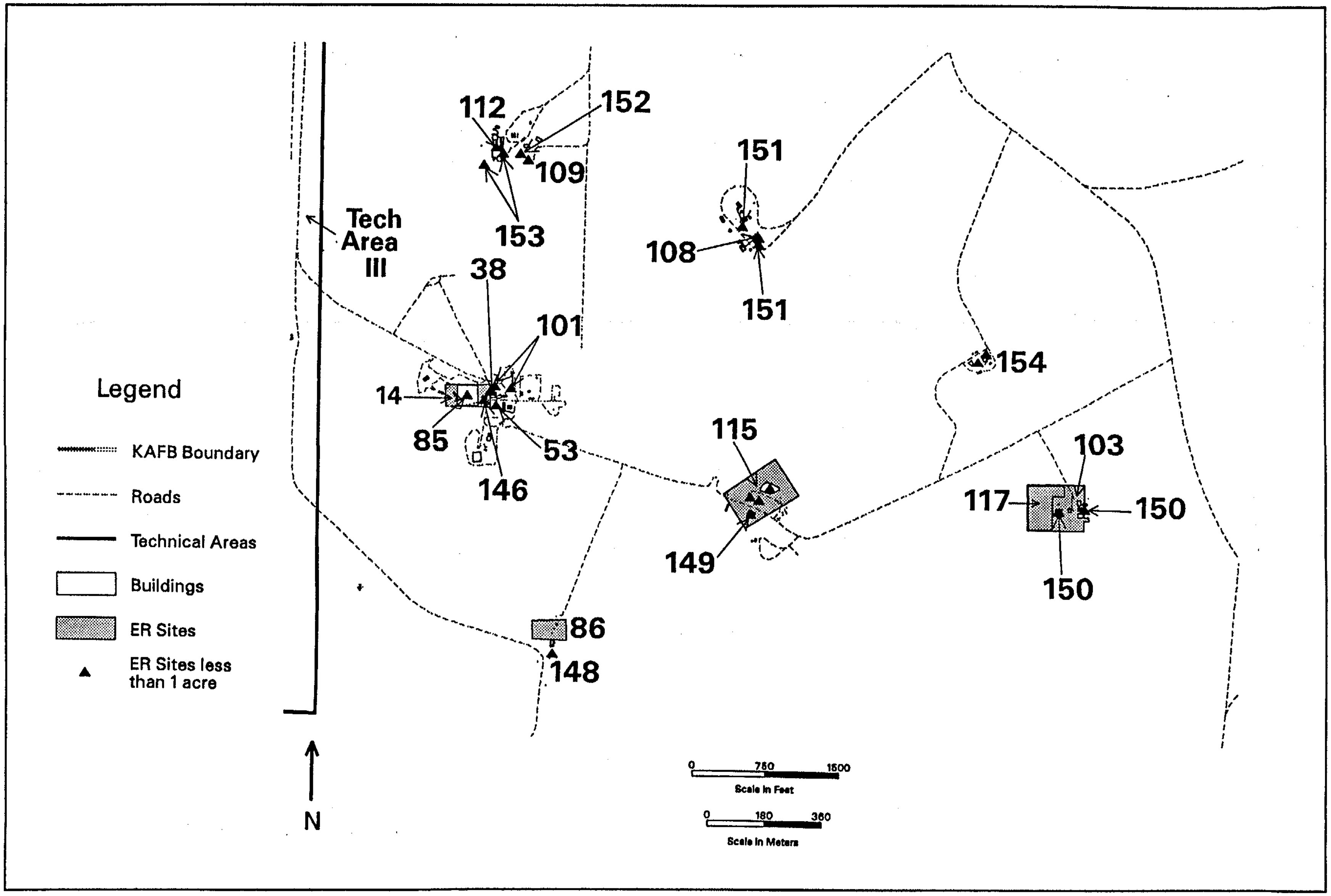


Figure 2-7
Environmental Restoration Sites In or Near Coyote Test Field

The proposed action to characterize and clean up the ER Project sites would select and apply a range of options at individual sites. Specific actions for specific sites would begin once characterization activities were complete and applicable permitting authorities selected specific remedies appropriate to the individual sites.

The proposed action can be broken down into steps (see Figure 2-8), as follows:

1. Identify those sites that may have been contaminated because of past SNL/NM activities.

2. Evaluate the nature and extent of the contamination and identify the CoCs.

3. Determine whether the site is contaminated at a level requiring cleanup, based on regulatory cleanup thresholds.

4. Determine appropriate cleanup method.

If a particular site is not contaminated at a level requiring cleanup, the site would be proposed to regulatory authorities for NFA status. However, if the contamination at a site exceeds regulatory cleanup levels, other choices must be made. One of these choices could be to immediately remove a hazard (e.g., surface debris) or reduce the risk to human health and the environment by performing a VCM, or the ER Project may proceed with further site characterization to determine the range of treatment options appropriate for site cleanup. Final decisions on NFA or cleanup actions will be made for each site using this process. For each site, contaminant characterization and evaluation of human health risks will be performed before a final decision regarding site disposition is made.

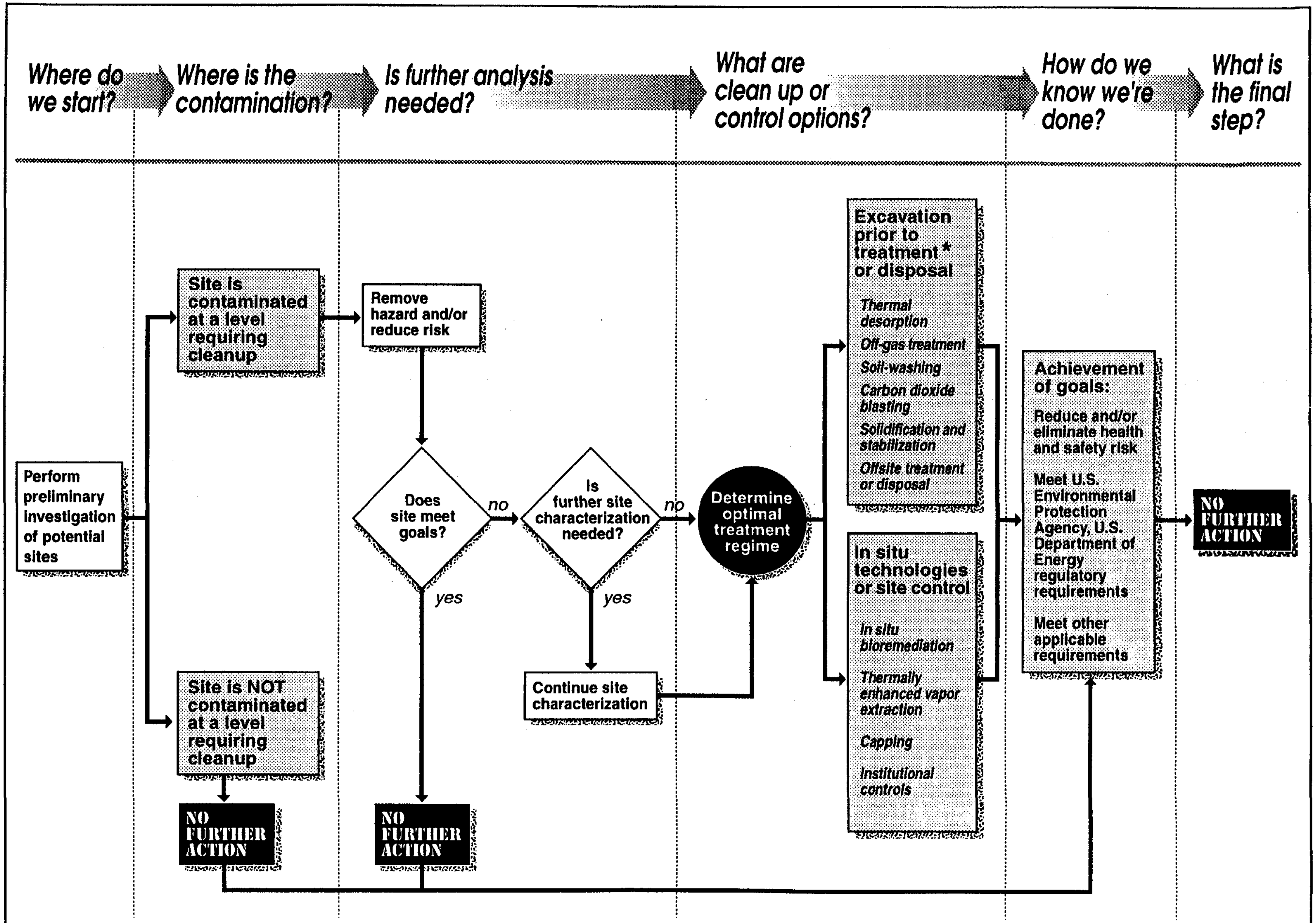
Once the site characterization is complete, actual treatment options will be identified and implemented to clean up the sites. The treatment options considered for the purpose of this analysis include two general approaches:

1. Excavation followed by treatment and disposal of contaminated soils, including the following:

   - Excavation, waste segregation, and site restoration.
   - Thermal desorption.
   - Off-gas treatment.
   - Soil-washing.
   - Carbon dioxide blasting.
   - Solidification and stabilization.
   - Off-site (ex situ) treatment and disposal.

2. In situ treatment or site control, including the following:

   - In situ bioremediation.
   - Thermally enhanced vapor extraction.



* These treatments may be performed at a temporary unit, corrective action management unit, or an off-site treatment facility

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Figure 2-8
Simplified Flow Process of the Proposed Action

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- Capping.
- Institutional controls.

Additional ex situ or in situ treatments may be evaluated and implemented in the future as technology improves and/or as the CoC types change with increased site knowledge. If such other treatments were considered, their impacts would be evaluated before implementation.

Once treatment or site control was accomplished, actions taken at a site would be documented and presented to applicable regulatory agencies for approval of NFA status. If NFA status were granted, the ER Project would have met its goals to reduce and/or eliminate environmental, health, or safety risks and would have met regulatory requirements for site cleanup. If NFA status were not granted, further site treatment would be needed. After any additional actions were completed, a new NFA proposal would be submitted to the appropriate regulatory agencies.

The process by which each ER Project site is evaluated for cleanup action involves the following steps, although not necessarily in this order:

- Identify probable contaminant types (and thus waste types) for each ER Project site.

- Identify and categorize the most likely CoCs.

- Perform assessment activities to determine the nature and extent of any contamination.

- Estimate volumes of waste to be treated and/or disposed of.

- Describe candidate corrective measure technologies and treatment option combinations for each waste category.

Therefore, impacts from treatment technologies proposed in this assessment would likely encompass potential impacts from the actual technologies selected by DOE and approved by EPA or other regulatory authorities as the ER Project progresses.

DOE policy for final selection of corrective measures is consistent with EPA Region 6 criterion of selecting corrective measures "imposing the least adverse environmental impact or greatest improvement on the environment over the shortest period of time" (EPA, 1993). However, to provide a conservative estimate of environmental impacts in this assessment, those corrective measures with greater anticipated adverse potential impacts have been analyzed. The majority of sites would likely qualify for corrective measures with less impact than the conservative assessment. The estimated volume requiring treatment is the most conservative element of the analyses. More refined volume estimates for specific sites currently being characterized indicate that the actual volumes to be excavated and treated are lower. Therefore, the analysis of impacts associated with implementation of proposed options evaluated in this assessment are considered to be conservative.

The corrective measures selected for analysis in this EA are intended to achieve the following corrective action objectives:

- To provide corrective measures that protect human health and the environment and are cost-effective, practicable, and suited to SNL/NM site conditions.
- To attain approved cleanup levels.
- To comply with applicable waste management regulations and requirements.

A major consideration in the approach to selecting corrective measures for analysis was to select those cleanup technologies (individually or in combination) that are consistent with the following EPA selection criteria: long-term reliability (including performance and safety); reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost.

2.1.1 Site Investigation and Characterization

Site investigation and characterization of potential sites would involve a number of field activities required to conduct RFIs at each ER Project site. Site characterization may include the following:

- Installing and operating monitoring wells to locate and monitor contamination sources and the extent of groundwater contamination.
- Sampling and analyzing groundwater, surface-water, and soil to identify the nature and extent of contamination.
- Performing aquifer and vadose zone permeability testing to identify characteristics of the soil to determine the mobility of contamination in the soil.
- Performing surface and borehole geophysical studies to assist in understanding surface and subsurface geological conditions.
- Extracting and analyzing soil-gas samples to understand the nature and extent of organic vapor contamination within the soil.
- Installing and operating air monitoring devices to determine whether contaminants are becoming airborne.
- Installing and maintaining site monitoring instrumentation, such as subsidence monitors and meteorological equipment, to assist in monitoring site environmental conditions.

The environmental consequences of site investigation and characterization activities are encompassed in this overall analysis of the proposed action. In compiling information on the nature and extent of contamination at the ER Project sites for this EA, the following site characteristics were considered:

- Past use and contaminant sources.
- Presence or absence of surface water.
- Depth to groundwater.
- Potentially contaminated media (air, water, soils).
- Areal extent of contamination.
- Treatable waste volume.
- Known or suspected contaminants.

2.1.2 Nature and Extent of Contamination

Nature of Contamination. Definitive detailed information on the presence or absence of the identified CoCs is not available for all of the ER Project sites subject to corrective action. This information would be available upon completion of an RFI for each site or site grouping. At present, these investigations are in various stages of completion. To help remedy the absence of specific information, a number of conservative assumptions (leading to greater rather than lesser anticipated environmental impacts) have been made to be consistent with the Council on Environmental Quality regulations related to incomplete information for analysis impact (40 CFR 1502.22).

Conservative assumptions, detailed in Appendix B, have been made for the following factors:

- The boundaries of each ER Project site—defined by historical records of the site if sampling data does not exist.

- The volumes of contaminated soil or debris needing treatment—assumed to be an average of 1 foot (0.3 meters]) deep over the areal extent of each site, unless more specific historical information is available (e.g., for landfills). This assumption is conservative because contaminants are not distributed evenly over the entire site.

- The site contaminant type—the more toxic and/or mobile form of chemicals—is assumed to be present at sites if they or similar less toxic contaminants were detected at the site.

- The acceptable level of risk (i.e., appropriate levels of cleanup)—acceptable risk levels are assumed to be defined per EPA proposed Subpart S (55 Federal Register [FR] 30796).

- The concentrations of CoCs—based on the high estimate of concentration for which data exist (see Appendix D2, Tables D2-1 through D2-5). At sites for which no VOC data exist, the concentration was set at 1 part per million (ppm), consistent with EPA's guidance on assessing unit risk if data are unavailable (EPA, 1989a).

To determine the potential environmental effects of the proposed corrective measures (analyzed in Chapter 4.0, "Environmental Consequences"), conservatively estimated releases of contaminant concentrations under unfavorable meteorological conditions were assumed in estimating exposure to workers and the public. Public receptors were assumed to be continuously located at KAFB site boundaries at points of maximum concentration, although there are no actual residences at those locations.

Although only four detailed site RFIs have been completed, past and interim investigations provide a basis for estimating the nature and extent of contamination. One such investigation was the 1984 DOE/AL-initiated CEARP to identify and assess the location of contaminated sites and the types of CoCs present (DOE, 1987). In 1987, EPA Region 6 conducted a similar investigation known as a RCRA facility assessment (EPA, 1987). Subsequent field investigations have been conducted or are in progress to identify site conditions, to complete gathering of evidence of spills or releases, to determine radiological contamination and background, and to assess and remove unexploded ordnance (UXO) hazards.

Based on these investigations, some general conclusions were made regarding whether one or more of the broad categories of contaminants are present or absent at each of the ER Project sites. The broad categories of contaminants and hazards (see Table 2-1) include:

- Radioactive materials such as depleted uranium (DU).
- Metals such as lead, copper, and mercury.
- Polychlorinated biphenyls (PCBs).
- Petroleum hydrocarbons (PHCs).
- Volatile organic compounds (VOCs) such as acetone, alcohol, carbon tetrachloride, and toluene.
- Semivolatile organic compounds (SVOCs) such as ethylene glycol.
- High Explosives (HE) compounds and residues such as ammonium nitrate, rocket propellant, and black powder.
- Inorganic chemicals such as acetic acid, sulfides, and sulfuric acid.
- Unexploded ordnance (UXO) hazards.
- Miscellaneous contaminants such as asbestos and hydrazine.

Table 2-1
Potential Contaminants at Sandia National Laboratories/New Mexico Environmental Restoration Project Sites Grouped by Category

Radioactive Materials	Metals	Poly-chlorinated Compounds	Petroleum Hydrocarbons	Volatile Organic Compounds	Semivolatile Organic Compounds	High Explosive Compounds and Residues	Inorganic Chemicals	Unexploded Ordnance	Miscellaneous Contaminants
Beryllium-7	Aluminum oxide	PCB	#2 Diesel oil	Acetone	Ethylene glycol	Amatol	Acetic acid	Ordnance debris	Asbestos
Bismuth-214	Arsenic	Aroclors	Dielectric transformer oil (non-PCB)	Alcohol		Ammonium nitrate	Ammonium hydroxide	Unexploded ordnance	Hydrazine (BNA)
Cadmium-109	Barium	Herbicides	Diesel fuel	Carbon tetrachloride		Ammonium perchlorate	Boric acid		Nonradioactive chemical
Cesium-137	Barium oxide		Fuel oil	Explosive resins		Baritol	Chromic acid		
Cobalt-60	Beryllium		Gasoline	Ethanol		Black powder	Chromium sulfate		
Lead-210	Cadmium		Heat transfer oil	Hexane		Composition 4	Cyanide (BNA)		
Manganese-54	Calcium oxide		Heating oil	Isopropanol		Composition B	Ferric chloride		
Osmium	Cesium		Hydraulic oil (paraffin-based)	Methanol		High explosives	Hydrochloric acid		
Plutonium	Cesium oxide		Hydraulic oil	Methylene chloride		HMX	Lithium hydride		
Potassium-40	Chromium		JP-4	MEK		Iramite	Nitric acid		
Radium	Copper		Kerosene	PCE		N-methyl pyrrolidine	Phosphate detergents		
Thorium	Graphite		Leaded gasoline	Rubber cement		Nitro-compounds	Picric acid		
Uranium	Iron		Rocket propellant	Toluene		Nitro-methane	Sodium dichromate		
Uranium-235	Lanthanum oxide		Transformer oil (mineral oil-based)	TCE		Nitrocellulose	Sulfides		
Uranium oxide	Lead		Unleaded gasoline	TCA		Nitroguanidine	Sulfuric acid		
Uranyl nitrate	Lithium		Waste oil	Xylene		Nitrostyphenate			
	Magnesium					Octol			
	Manganese					PBX			
	Mercury					PETN			
	Molybdenum					RDX			
	Molybdenum/titanium alloy					Rocket propellant			
	Niobium					TATB			
	Polonium					TNT			
	Silicon								
	Silicon oxide								
	Silver								
	Steel								
	Tellurium								
	Tin								
	Titanium								
	Zinc								
	Zirconium								
	Zirconium oxide								

See footnotes at end of table.

Table 2-1 (Concluded)
Potential Contaminants at Sandia National Laboratories/New Mexico Environmental Restoration Project Sites
Grouped by Category

Radioactive Materials	Metals	Poly-chlorinated Compounds	Petroleum Hydrocarbons	Volatile Organic Compounds	Semivolatile Organic Compounds	High Explosive Compounds and Residues	Inorganic Chemicals	Unexploded Ordnance	Miscellaneous Contaminants
SUSPECTED CONTAMINANTS									
Nickel-63 Strontium	Antimony Bismuth Platinum Selenium			1,2-Dichloroethylene Benzene Chloroform Dichloromethane Methyl cyanide Paints		Composition C Titanium potassium perchlorate Zirconium potassium perchlorate	Cadmium sulfide Chromates Chromosulfuric acid Hydrofluoric acid Potassium permanganate Titanium tetrachloride		Freons Hexafluorine (BNA) Phenolic compounds (BNA)

BNA = Base, neutral, or acid extractable compound
Compositions B, C, and 4 = Specific gunpowder formulations
JP-4 = Jet fuel
HMX = Cyclotetramethylene tetranitramine
MEK = Methylethylketone
PBX = Plastic-bonded high explosives
PCB = Polychlorinated biphenyl
PCE = Perchloroethylene
PETN = Pentaerythritol tetranitrate
RDX = Cyclo-1,3,5-trimethylene-2,4,6-trinitramine
TATB = Triaminotrinitrobenzene
TCA = Trichloroethane
TCE = Trichloroethene
TNT = Trinitrotoluene

Extent of Contamination. The types and amounts of contamination at the ER Project sites vary. The site types include (but are not limited to) landfills, chemical disposal pits, explosives burial sites, detonation areas, burn sites, trash pits, storage areas, open dumps, waste disposal trenches, oil spill areas, underground storage tanks, septic tanks and leach fields, and test pits. Some sites, such as PCB or fuel-oil spill areas, contain only one category of contaminants (e.g., PCBs or PHCs). Other sites, including some septic systems, contain the entire spectrum of CoCs found at SNL/NM (see Appendix A, Table A-1). Many sites at SNL/NM were used for testing detonation primers and conventional explosive devices. These firing sites are contaminated with scattered debris (including UXO, HE compounds and residues, pieces of shrapnel, and chunks of DU or DU-contaminated metal that have been partially buried as a result of weathering and/or the force of the testing).

It is anticipated that ER Project activities at SNL/NM would generate regulated waste such as hazardous, radioactive, and mixed. Mixed waste is radioactive waste that also contains RCRA-regulated hazardous waste as defined in 40 CFR 261, Subparts C and D. In order to minimize waste generation and to treat waste volumes properly, the waste must be characterized and segregated prior to treatment or disposal. Hazardous, radioactive, and mixed wastes could be treated using technologies appropriate to the contaminant compound and physical form.

The areal extent of individual ER Project sites ranges from an estimated 700 square feet (65 square meters) for an oil spill (ER Site 39) to an estimated 18,000,000 square feet (1.7 million square meters) for the Pickax HE area (ER Site 54) at Thunder Range (see Appendix A). Estimated contaminated soil volumes range from less than 35 cubic feet (less than 1 cubic meter) at a waste disposal trench (ER Site 23) to about 10.8 million cubic feet (about 306,000 cubic meters) at the Chemical Waste Landfill (ER Site 74), although only partial excavation of about 934,000 cubic feet (about 26,500 cubic meters) of soil to eliminate groundwater contamination sources at the Chemical Waste Landfill is currently planned. Volume estimates were made assuming an average contaminant depth of 1 foot (0.3 meters), unless site information provided a better basis for depth or total volume assumptions. Appendix A, Table A-2, shows the areal extent, depth, and volume assumptions used for this assessment. Current, more refined volume estimates for all sites indicate that volumes of contaminated soils are actually lower than those assumed for this EA.

It was assumed from the information available that at least 80 percent of the volume subject to treatment consists of contaminated soils. An additional 10 percent of the volume of contaminated material is buried nonsoil material, while the remaining 10 percent is debris resulting from the demolition of pipelines and structures. Buried non-soil material includes former underground storage tanks, waste drums, gas cylinders, scrap associated with laboratory operations, and discarded machinery. This buried, non-soil debris could be managed under the debris rule (40 CFR 260.2).

Groundwater remediation could require removing the contamination source through excavation, soil treatment, in situ vadose-zone vapor extraction, or a pump-and-treat system. These measures could, over a period of months to a few years, reduce groundwater-contamination concentrations to a level consistent with regulatory standards.

2.1.3 Undertaking Voluntary Corrective Measures

In keeping with its intent to employ a flexible approach to ER Project site cleanup, EPA encourages voluntary cleanup in its proposed Subpart S (55 FR 30796). Voluntary corrective measures, referred to in the SNL/NM RCRA Part B permit as VCMs, are actions undertaken by the ER Project to reduce or eliminate human health or environmental risks, reduce costs, and/or shorten the overall cleanup schedule.

VCM activities could involve cleaning up general debris, removing waste drums or spot sources of contaminated soils, or removing discreet explosive or radioactive waste sources. VCMs are expedited versions of the investigation/remedy selection process presented in this document. VCMs generally would be undertaken at ER Project sites for which the remedies are obvious. EPA has approved procedures for performing VCMs at SNL/NM; these procedures include EPA review of the plans and early and complete public participation.

2.1.4 Range of Treatment Options

Two groups of treatment options are proposed for all remediation wastes expected to be generated during cleanup of the ER Project sites. These treatment options represent technologies commonly used to treat hazardous, radioactive, or mixed wastes. The treatment options include:

- Excavation followed by treatment and disposal of contaminated soils. (All these treatments may be performed at a central facility, such as a temporary unit [TU] and/or corrective action management unit [CAMU], or at a mobile unit.)
  - Excavation, waste segregation, and site restoration.
  - Thermal desorption.
  - Off-gas treatment.
  - Soil-washing.
  - Carbon dioxide blasting.
  - Solidification and stabilization.
  - Off-site treatment or disposal.
- In situ treatment or site control.
  - In situ bioremediation.
  - Thermally enhanced vapor extraction.
  - Capping.
  - Institutional controls.

Table 2-2 is a matrix that shows how these technologies might be used for different waste types. These treatments would be used in specific applications suitable to the waste type. This table is presented as a guide for the discussion of the treatment options to follow. Until the completion of field sampling activities, application of the proposed waste treatment technologies must be described in general terms. In order to verify that a particular treatment technology would be effective for specific ER wastes, analytical data on CoC concentrations, treatment process modeling, and (possibly) treatability studies would be necessary. At this time, it is unknown whether restoration activities would be conducted at single sites sequentially or whether activities would occur at multiple sites concurrently.

Table 2-2
Matrix of Proposed Action Options

Treatment Option	Section Number	Figure Number	Hazardous Waste	Radioactive Waste	Mixed Waste
Excavation, segregation	2.1.4.1	2-9	X	X	X
Thermal desorption	2.1.4.2	2-11	X		X
Off-gas treatment	2.1.4.3	2-12	X		X
Soil-washing	2.1.4.4	2-13	X	X	X[a]
Carbon dioxide blasting	2.1.4.5	2-14		X	X
Solidification and stabilization	2.1.4.6	2-15		X	X[a]
Corrective action management unit	2.1.4.7	2-17	X	X	X
Off-site treatment or disposal	2.1.4.8	None	X	X	X
In situ bioremediation	2.1.4.9	2-18	X		
Thermally enhanced vapor extraction	2.1.4.10	None	X		
Capping/institutional controls	2.1.4.11	2-19	X	X	X

[a]Selected only if the contaminants are metals.

All site remediation activities using these treatment options would be conducted in accordance with DOE-approved work plans and health and safety plans. All work would be performed in accordance with standard SNL/NM policies set forth in SNL/NM safe operating procedures. Wastes generated as part of these treatment options would be handled in accordance with project-specific waste management plans.

2.1.4.1 Site Excavation, Waste Segregation, and Site Reclamation

Most treatment options could require some form of excavation to remove contamination from the ER Project site prior to treatment or disposal. Excavation is applicable to hazardous, radioactive, and mixed wastes.

Before any disturbance, including excavation, of an ER Project site, detailed studies to identify, evaluate, and map biological and cultural resources located on or near suspected ER Project sites would be performed. Detailed maps showing the locations of these resources would be used to avoid disturbing cultural resources, particularly those potentially eligible for inclusion in the National Register of Historic Places (NRHP). These surveys would also provide information about any sensitive species or sensitive species habitat that might be located on or near any ER Project sites. At sites where avoidance was not feasible, the cultural resource would be evaluated further in order to minimize impacts from ER Project efforts. In the event that archaeological or historic artifacts are uncovered during site excavation, work would be halted, and a qualified archaeologist would be called in to make an assessment. Also, the KAFB Historic Preservation Officer and the State Historic Preservation Officer (SHPO) would be contacted.

Mitigation for sensitive species would principally involve avoidance of areas where populations of sensitive species were identified. Disturbance of areas with a highly sensitive habitat, such as wetlands and sites of vigorous populations of sensitive species, would be strictly avoided during soil-excavation operations. Disturbance of moderately sensitive habitats, such as floodplains and sites of scattered individuals of a sensitive species, would be avoided whenever possible, or a mitigation action specific to the conditions would be implemented to reduce damage to the resource. Isolated sensitive plants found in areas to be disturbed would be transplanted to a suitable habitat outside of the area of disturbance.

Because, historically, land use at KAFB involved ordnance testing and other uses of explosives, each ER Project site could be surveyed for UXO or HE fragments under the supervision of the KAFB Explosive Ordnance Disposal (EOD) Unit. Any fragments found would be either exploded in place or sent to the existing KAFB EOD Range, where they would be detonated.

After the initial surveys and investigations, the ER Project sites would then be ready for either further site characterization or site cleanup, which could involve excavation for onsite treatment or removal for treatment or disposal elsewhere. Figure 2-9 illustrates soil excavation activity. Excavation of contaminated soil would probably use tracked backhoes and front-end loaders. If soil treatment were to be done elsewhere, contaminated soils would be loaded into metal boxes and transported off the ER Project site on flatbed trailer trucks.

Containment zones would be maintained during excavation activities to minimize the potential for contaminant migration. Any unexpected changes (e.g., changes in CoC type or concentration or waste type) in the conditions encountered during excavation activities would require a temporary shutdown of operations to ensure worker and public safety. Excavation equipment would be monitored to detect excessive levels of contamination, and decontamination areas would be constructed to manage any contaminated equipment. To prevent spread of contamination, equipment decontamination processes would be performed inside the containment zone. Wastes from the decontamination process would be handled in accordance with standard waste-handling procedures, as required by SNL/NM waste management policies.

Any debris, metal, or DU fragments encountered during excavation would be segregated from other wastes. Depending on the type and quantity of the contamination, debris would be either disposed of in an appropriate type of disposal facility or treated by carbon dioxide blasting to remove surface contamination, as described in Section 2.1.4.5. After excavation, samples would be analyzed to determine whether the targeted cleanup level were achieved. Sanitary and low-level radioactive wastes may be stored at the excavation site for longer than 90 days until further appropriate action is taken.

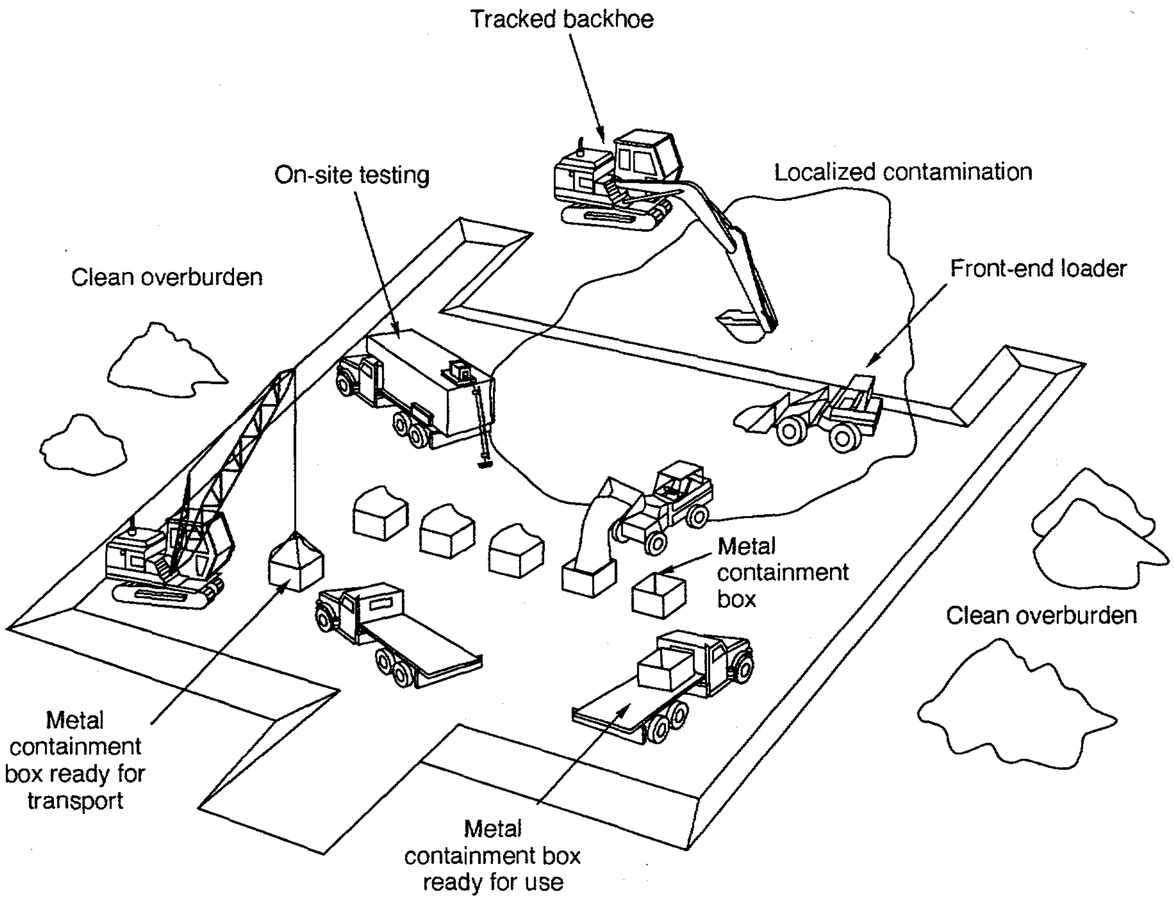


Figure 2-9
Illustration of Soil Excavation Activities

ER Project sites would be restored and reclaimed to their approximate natural condition. The reclamation process would consist of the following steps (see Figure 2-10):

- Backfilling—Excavations would be backfilled and compacted using clean overburden and/or treated soil if approved by the appropriate regulatory agency.
- Side-Slope Reduction—Earth-moving equipment would be used to smooth the contours of excavations.
- Topsoil Application—When necessary, uncontaminated top soil would be imported from designated SNL/NM borrow and fill locations to replace excavated contaminated soils. Top soil would be broken up to promote bonding to the backfill and would then be ripped, following newly established contours to retard erosion.
- Reseeding—An appropriate mixture of native grasses and shrubs would be planted.
- Establishing Plant Growth—Plants would be fertilized and irrigated for one or more growing seasons to establish growth.

Excavation and segregation of the contaminated soils would be followed by appropriate waste treatment or disposal. Consistent with the goals of the ER Project, waste management and disposal activities would accomplish several important objectives:

- Reduce the extent of the soil contamination area.
- Consolidate both low- and high-concentration RCRA-listed/characteristic hazardous wastes.
- Consolidate both low- and high-concentration radioactive wastes.
- Reduce the volume, mobility, and/or toxicity of contaminants.

Wastes would be treated using the range of technologies included in the proposed action. Depending on design parameters, these technologies would achieve land disposal restrictions (LDR) treatment standards. Where LDR treatment standards would apply to waste treatment options, the treated wastes would be tested to verify compliance with applicable treatment standards.

2.1.4.2 Thermal Desorption

Thermal desorption units would be used to volatilize (gasify) and/or destroy the hazardous organic compounds (VOCs, SVOCs, PHCs, and PCBs) present in the contaminated soils (see Figure 2-11). Volatilizing organic compounds removes VOCs, SVOCs, PHCs, and PCBs from

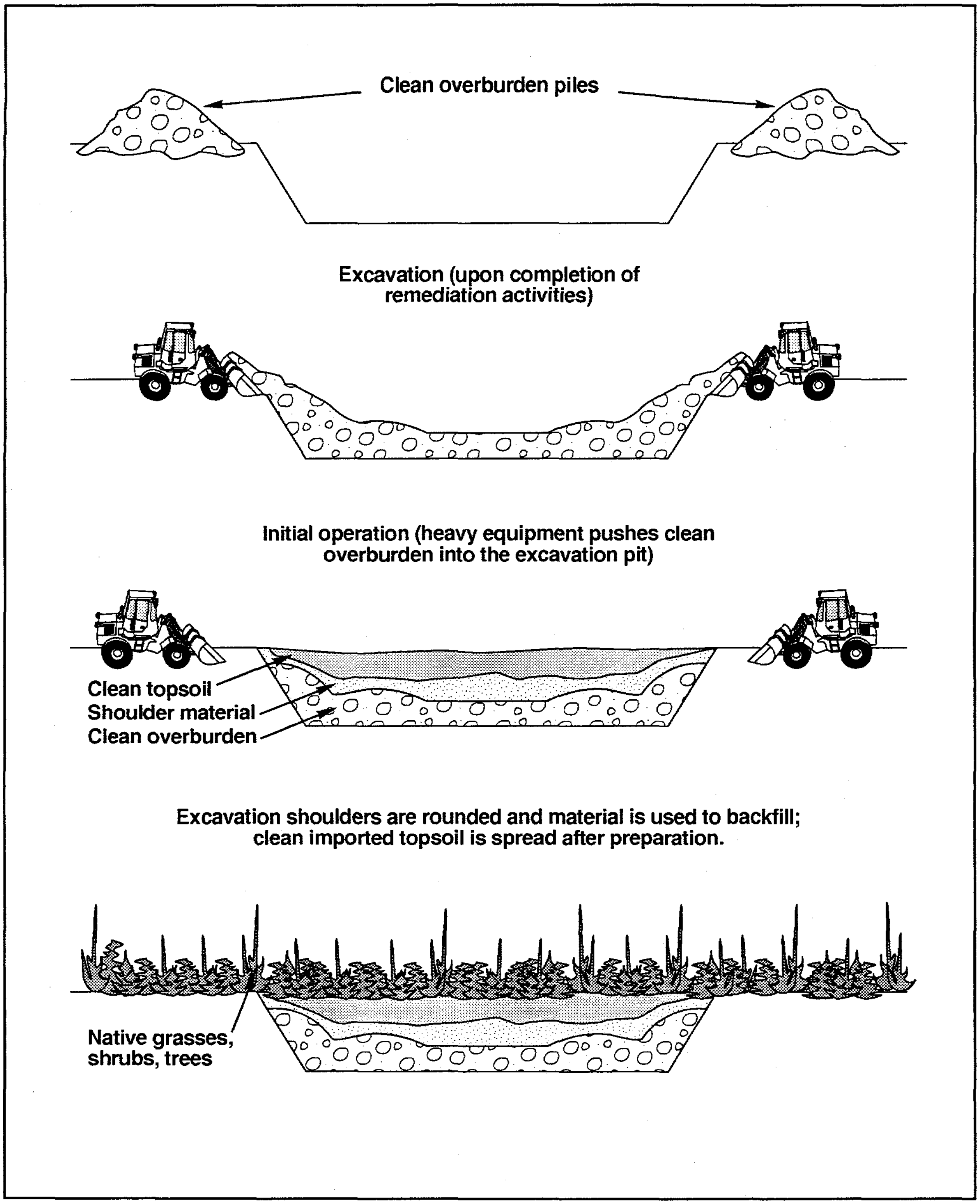


Figure 2-10
Illustration of Site Reclamation

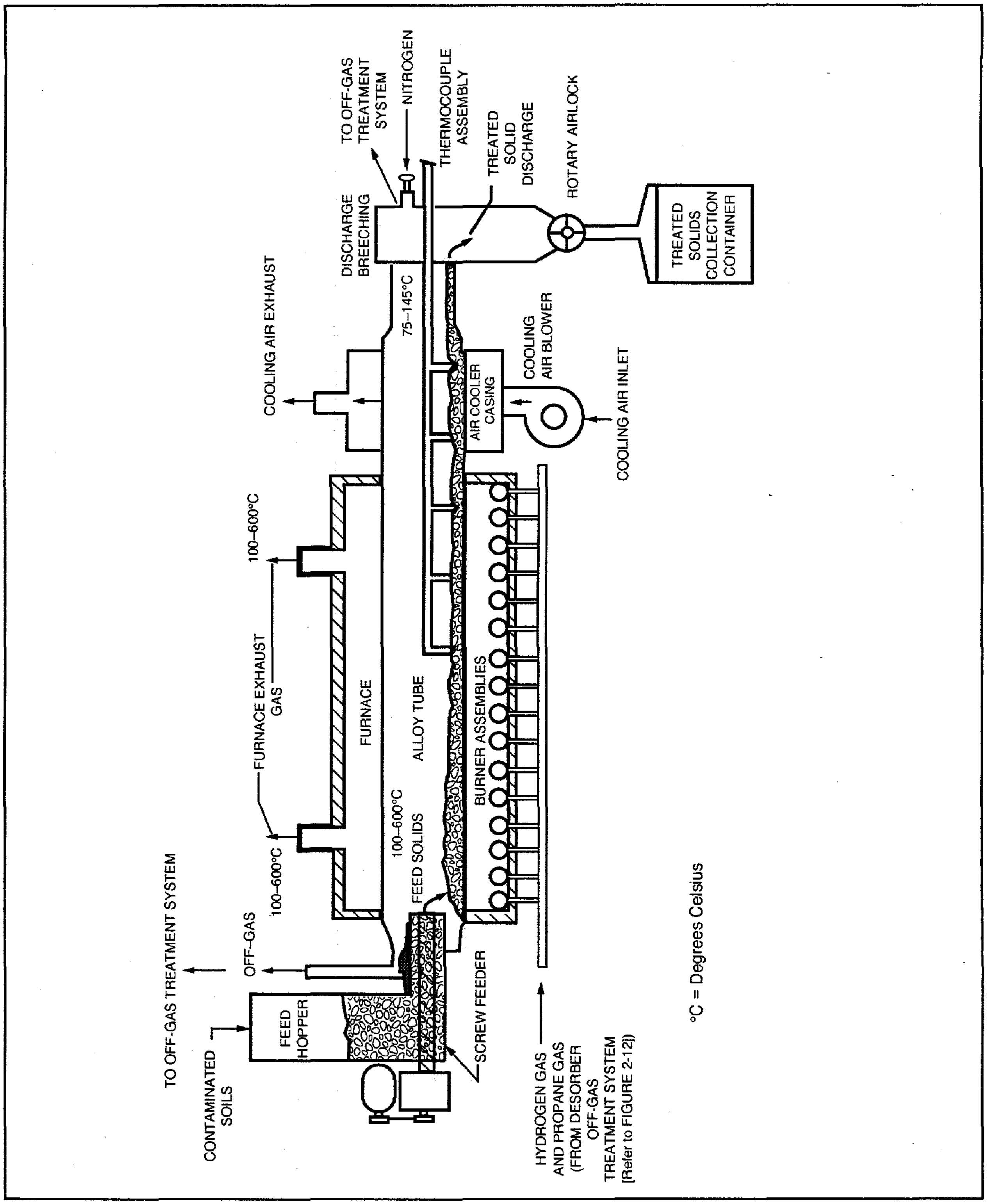


Figure 2-11
Simplified Conceptual Design of Thermal Desorber

the soil to facilitate treatment of these hazardous compounds. A number of effective thermal technologies are available for removing and destroying organic compounds. The thermal treatment discussed in this section represents thermal treatment technologies in general and is an accepted technical treatment capable of meeting treatment goals with a minimum environmental impact. Thermal desorption is appropriate for volatile and semivolatile hazardous wastes and for the volatile and semivolatile components of mixed wastes.

A thermal desorption system is essentially a long cylindrical tube with three sections. The size of a thermal desorption unit depends on the capacity for which the unit is designed, but it typically ranges from approximately 50 to 200 feet (15 to 61 meters) in length. A screw feeder draws contaminated soils into the first part of the tube. From there, the soils are drawn into a gas furnace located in the middle section of the tube. The tumbling motion continuously exposes the soils to heat, causing vaporization of VOCs, SVOCs, PHCs, and PCBs. The flow rate and residence time of the solids traveling through the thermal desorber are controlled by varying the slope and rotational speed of the tube. The treated solid residue remaining after the VOCs, SVOCs, PHCs, and PCBs are removed drops onto a rotary airlock leading into a solids collection container (Vavruska, 1993).

The thermal desorption unit is continuously purged with nitrogen gas to maintain the oxygen concentration below a level needed for combustion. This prevents open-flame burning (incineration). To control emissions, the sealed desorber is operated under a slightly negative pressure created by an induced-draft fan used to draw the off-gas into the off-gas treatment system (see Section 2.1.4.3). However, depending on specific waste stream characteristics, oxidation capability may be required. If this becomes necessary, a supplemental environmental analysis will be performed.

The thermal desorber would be designed to operate over a wide range of conditions and would facilitate effective treatment for varying soil characteristics. Contamination measurements taken during excavation of individual lifts of contaminated soil, as well as measurements of moisture content taken at the treatment facility, would be used to adjust operating parameters such as residence time and temperature. Continuous radiation monitoring would be conducted to confirm safe working conditions during the treatment of mixed wastes. Fuel for the thermal desorber (hydrogen and propane gases) would be stored at a safe distance from the burner assembly; piping for the fuel would be routinely inspected for leaks.

2.1.4.3 Off-Gas Treatment

Treatment of the gaseous wastes from the thermal desorption unit (see Section 2.1.4.2) is critical in controlling the release of off-gases to the ambient air. Off-gases would result from heating contaminated soils. Off-gas treatment is an integral part of the thermal desorption unit design necessary to minimize potential human health and environmental impacts of the thermal desorption treatment option. Gaseous waste vapors are expected to contain organic compounds (VOCs, SVOCs, PHCs, and PCBs), traces of acid vapor, and (possibly) dust particulates. The technology to remove these contaminants is illustrated in Figure 2-12 and consists of the following:

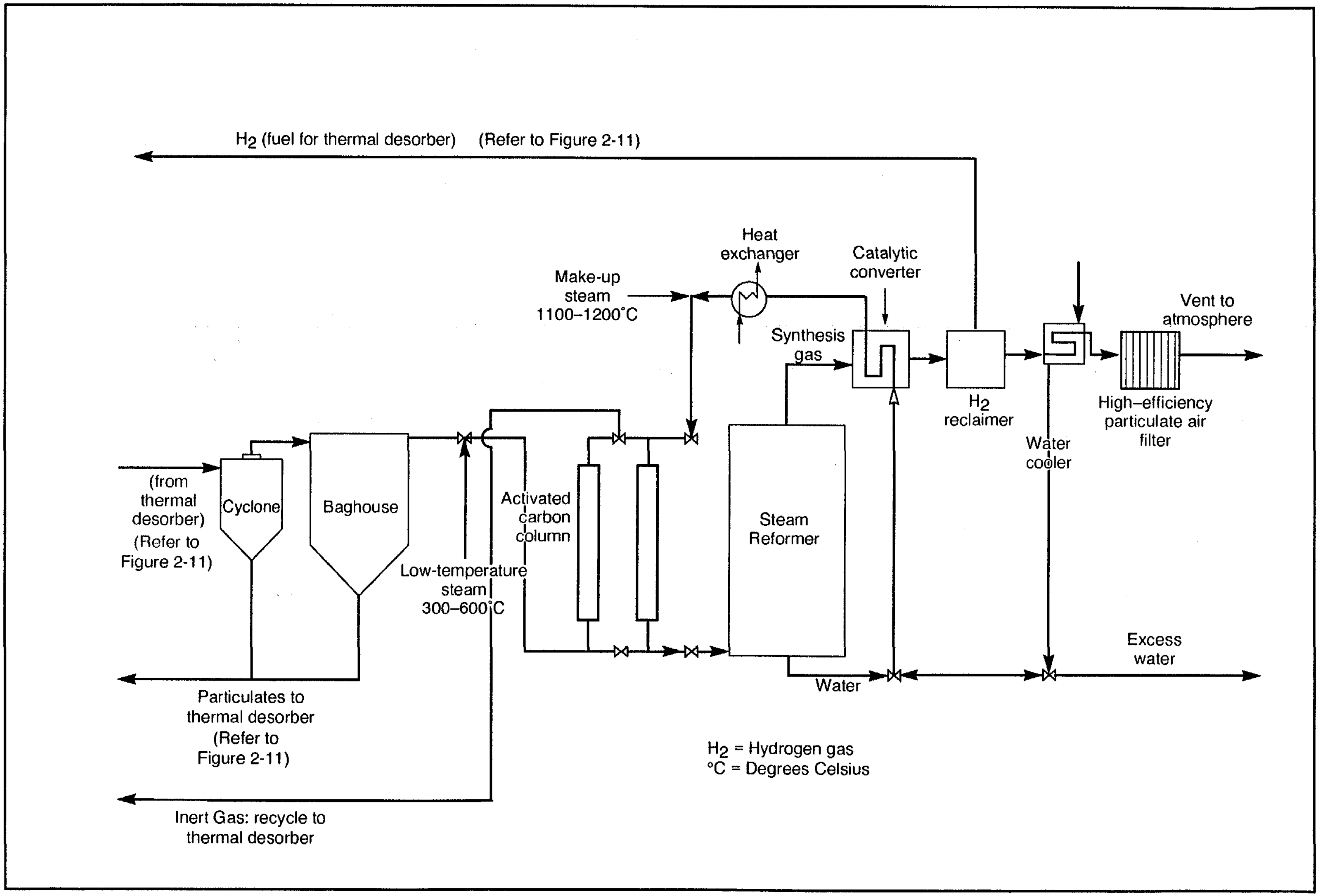


Figure 2-12
Process Flow Diagram: Desorber Off-Gas Treatment System

- A cyclone separator (used to separate small particles of soils from the vapor using centrifugal force).
- A baghouse (a series of fabric filter bags).
- Granular activated carbon columns (to absorb organic vapors).
- A steam reformer (to convert hazardous organic compounds such as VOCs and SVOCs to nontoxic products by exposing them to superheated steam).
- A catalytic converter/hydrogen gas reclaimer.
- High efficiency particulate air (HEPA) filters.

This closed-loop technology for off-gas treatment is representative of the types of emissions control technologies used for thermal treatment units.

The treatment process would involve routing the contaminated off-gas streams from the thermal desorption system or other proposed waste treatment system into the off-gas treatment system. Initially, a cyclone and a baghouse would be used to remove particulate matter from the off-gas. Granular activated-carbon columns would then be used to adsorb organic compounds, facilitating off-gas treatment in the steam-reformer by concentrating the organics. High-pressure make-up steam would be used to regenerate the carbon columns and to transport the organics to a steam reformer, which would destroy the organics in the off-gas stream (Bustand et al., 1994). Following treatment in a steam reformer, the off-gas would first pass through a catalytic converter to eliminate any carbon monoxide present in the off-gas and then would pass through a hydrogen reclaimer to remove and recycle hydrogen in the off-gas. Finally, the off-gas would go through a HEPA-filter bank to remove any particulate radionuclides from the off-gas.

2.1.4.4 Soil-Washing

Soil-washing would be used to segregate and concentrate radionuclide and metal contamination onto smaller soil particles, such as silts and clays. It is an effective, common decontamination technique used to remove fine-particulate contaminants from the soil matrix. Soil-washing occurs as a self-contained closed-loop process and is representative of related technologies, including the process of chemical extraction of contaminants from soil surfaces. It is a simple and effective process that is appropriate for the radioactive and metal components of mixed wastes in soil. Initially, the contaminated soils would be sent through a series of vibratory screens, gravity separators, and a cyclone separator to segregate the variously sized soil particles and to allow the contaminants to adhere to the silt and clay particles. Separating out the smaller contaminated silt and clay fractions would reduce the volume of contaminated soil needing any further treatment (see Figure 2-13).

For the purpose of this EA, the clean soils resulting from the treatment process (estimated to be 75 percent of the original soil volume) were assumed to be dewatered and returned to their

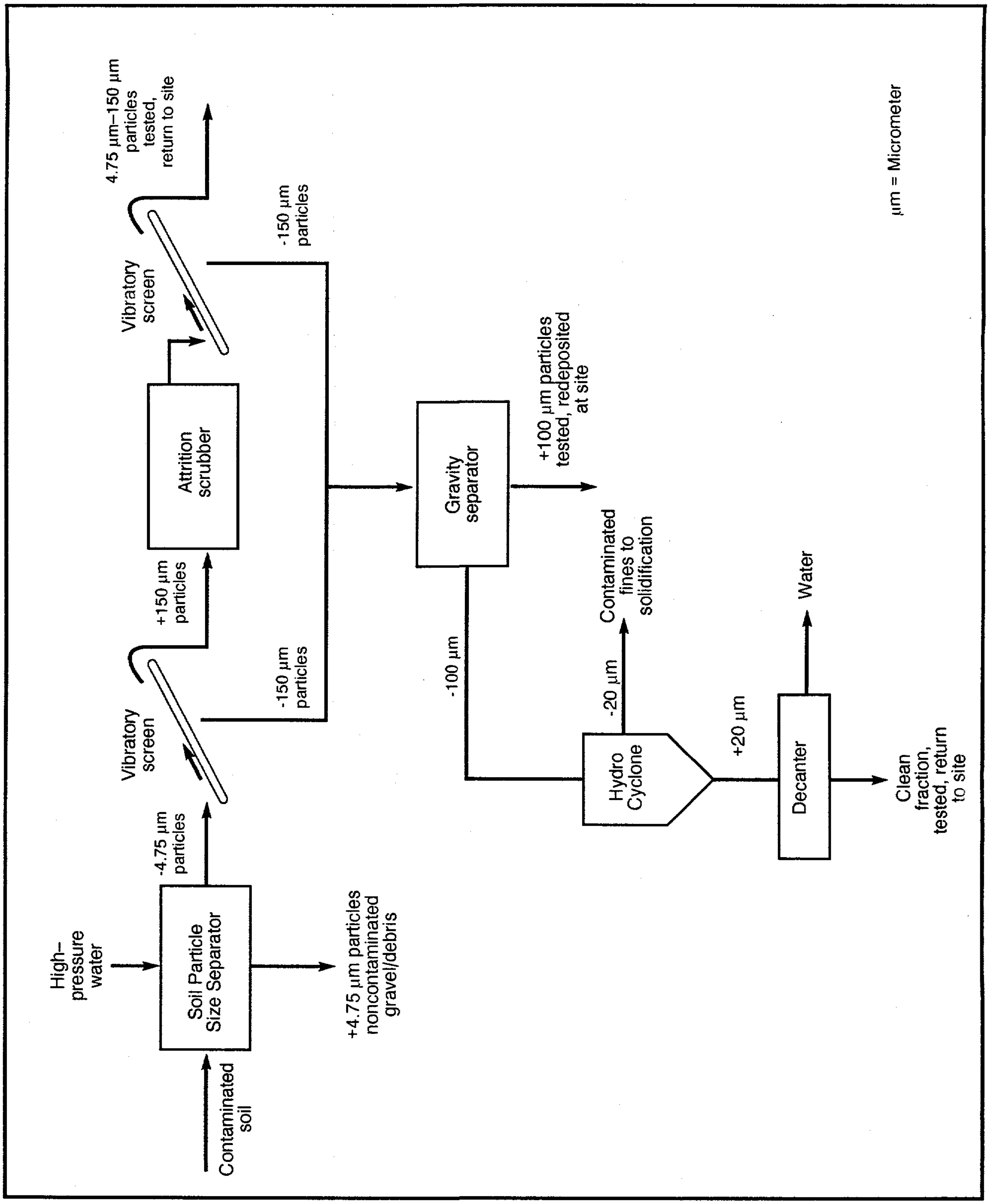


Figure 2-13
Process Flow Diagram: Soil-Washing Plant

original ER Project sites. The remaining (contaminated) soils (estimated to be 25 percent of the original soil volume) would be decanted and sent to a solidification and stabilization (S/S) unit (see Section 2.1.4.6).

Residual wash water resulting from both the soil-washing and the dewatering process would be filtered through two ion-exchange columns in series. One column would contain anionic-exchange media to capture the anionic species (negatively charged ions) that would form as a result of the alkaline nature of SNL/NM soils (such as negatively charged uranium complexes). The other column, containing cationic media, would capture the radioactive and/or metal cations present in the wash water. The filtered water would then be recycled as feed water for the soil-washing unit. The used ion-exchange media would be regenerated at an off-site facility. Because the water would be recycled within the soil-washing process, contaminants escaping the ion-exchange columns would not be a major concern.

All off-gas streams from the soil-washing unit would be sent to the off-gas treatment system (see Section 2.1.4.3). Dust generation would be controlled by regularly moistening the soil. There would be no discharge of process water to the environment. Any contaminated soils remaining from this process would be loaded into roll-off bins with lids and transported to an S/S unit for further treatment if necessary.

2.1.4.5 Carbon Dioxide Blasting

Debris recovered from ER Project sites with RCRA-regulated metals or radioactive surface contamination would be treated using a surface-blasting technique. This technique is appropriate for nonporous surfaces. A carbon dioxide blasting unit is representative of surface-blasting techniques proposed for use at SNL/NM. This technology is appropriate for radioactive wastes and for the radioactive portion of mixed wastes.

In an enclosed area, liquid carbon dioxide is pressurized into pellet form (see Figure 2-14). These pellets are injected into a compressed air stream and shot from a blast nozzle at the surface to be cleaned. When the pellets come into contact with the surface, the contamination becomes brittle and easily removed. Contaminated particulates resulting from this process would be sent through the S/S process (see Section 2.1.4.6). Cleaned debris would be designated as recovered scrap material or sent to an industrial landfill.

To ensure operator safety and in order to capture all dispersed particulates, this operation would be conducted in an enclosed area where air would be replaced according to Occupational Safety and Health Administration (OSHA) standards. The air leaving the room would be vented through a HEPA filter before being released to the atmosphere.

2.1.4.6 Solidification and Stabilization

An S/S process would be used to make wastes safer to handle and prevent contamination from spreading to surrounding materials. Solidification refers to processes that reduce the

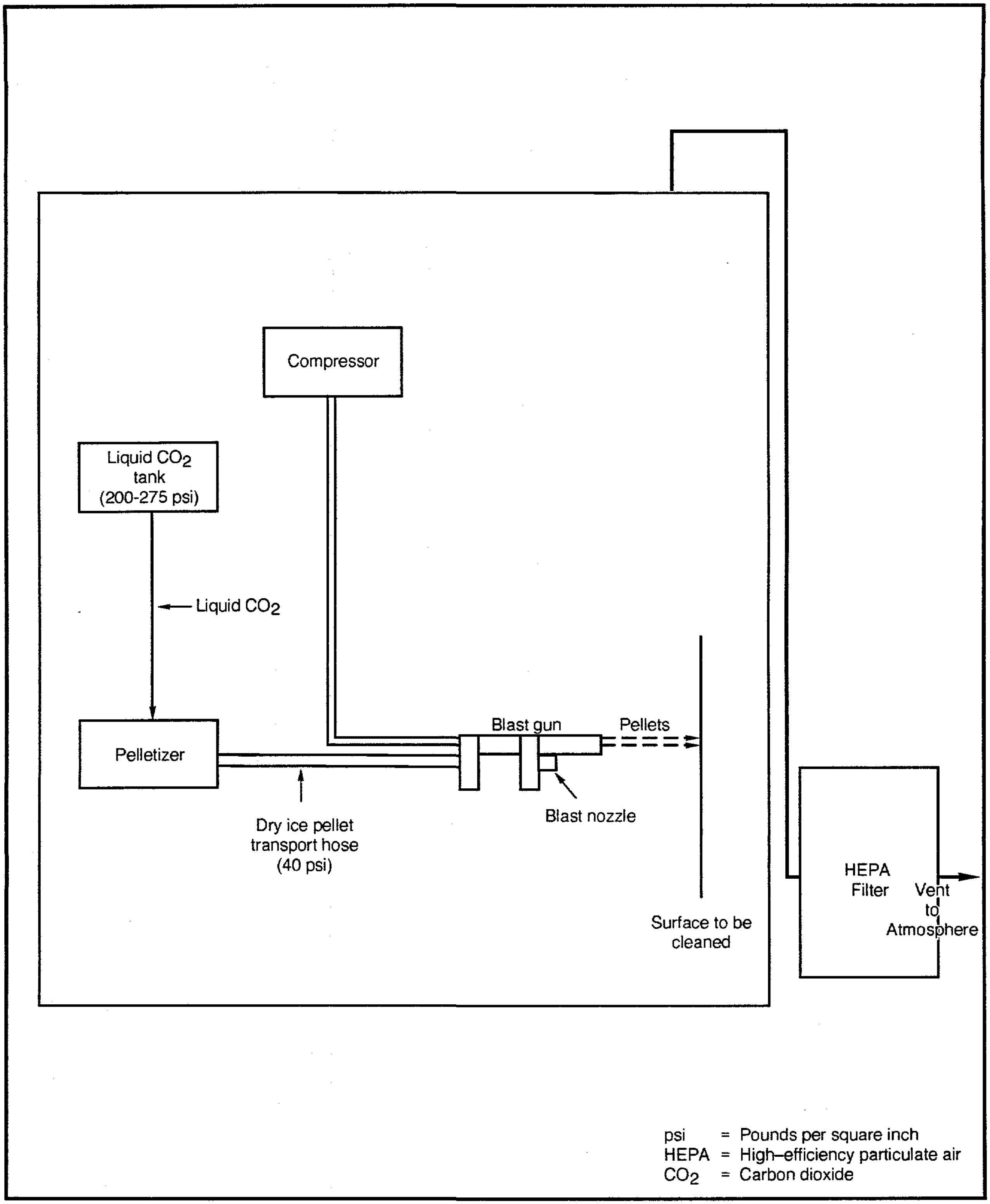


Figure 2-14

Process Flow Diagram: Carbon Dioxide Blasting Process

mobility of CoCs, usually by processing the wastes into a single, solid block. Stabilization refers to processes that limit the solubility of CoCs (e.g., by changing the pH of the solution or by detoxifying the CoCs by chemical reaction). Stabilization processes can also alter the physical characteristics of the waste. This technology is appropriate for radioactive wastes and for the radioactive metal components of mixed wastes.

The S/S process is accomplished by mixing contaminated soil and particles with Portland cement, water, and nontoxic additives to form a solid block (see Figure 2-15). The amount of wastes and additives mixed together are determined by the specific CoCs to be treated. The final form of this waste product is stable and prevents leaching. The treatment process could be performed in a mobile unit temporarily housed within a larger treatment building.

Solidification of ER Project site wastes would be accomplished by feeding contaminated soil, Portland cement, water, and additives into a lock hopper and a rotating screw feeder in a continuous weighing system. The waste and solidification materials would be mixed in a ribbon mixer and then poured into 0.1 inch (2.5 millimeter) thick 55-gallon (208 liter) steel drums. The contents of the drums would be allowed to solidify for 8 to 10 hours before drums were transferred to a curing/dewatering storage area. Each drum would be connected in the curing/dewatering cell to a vacuum vapor treatment manifold. The connections of the manifold would be tested for leaks. The vapor treatment manifold would be attached to the vapor treatment system to prevent uncontrolled emissions. The solidified waste forms in the drums would be tested to confirm that they comply with waste acceptance criteria for final disposal.

To the extent possible, all materials moving and mixing equipment would be enclosed to control dust. Additionally, a portion of the mix water would be used to dampen the soil after weighing. In order to minimize the distance over which additives and Portland cement would be transferred, these materials would be stored in appropriate containment vessels located adjacent to the S/S unit. Vacuum-vapor system piping and equipment would be inspected routinely for leaks.

2.1.4.7 Temporary Unit and/or Corrective Action Management Unit

Another option under the proposed action is to store and treat excavated soils and other remediation wastes at a centralized area known as a TU and/or a CAMU. A TU, as defined in 40 CFR 264.553, is a container storage area used for limit types of treatment or storage of hazardous remediation wastes. The TU would have a lifespan of one to two years. The TU could then be closed or become part of a permitted CAMU. A CAMU is defined in the final EPA CAMU regulations as an "area within a facility that is designated . . . for the management of remediation wastes" (40 CFR 260.10). The lifespan of the CAMU would be the remaining term of the SNL/NM RCRA Part B permit and any subsequent renewals.

The goals for the use of this option are:

- To accelerate remediation of high-priority sites.

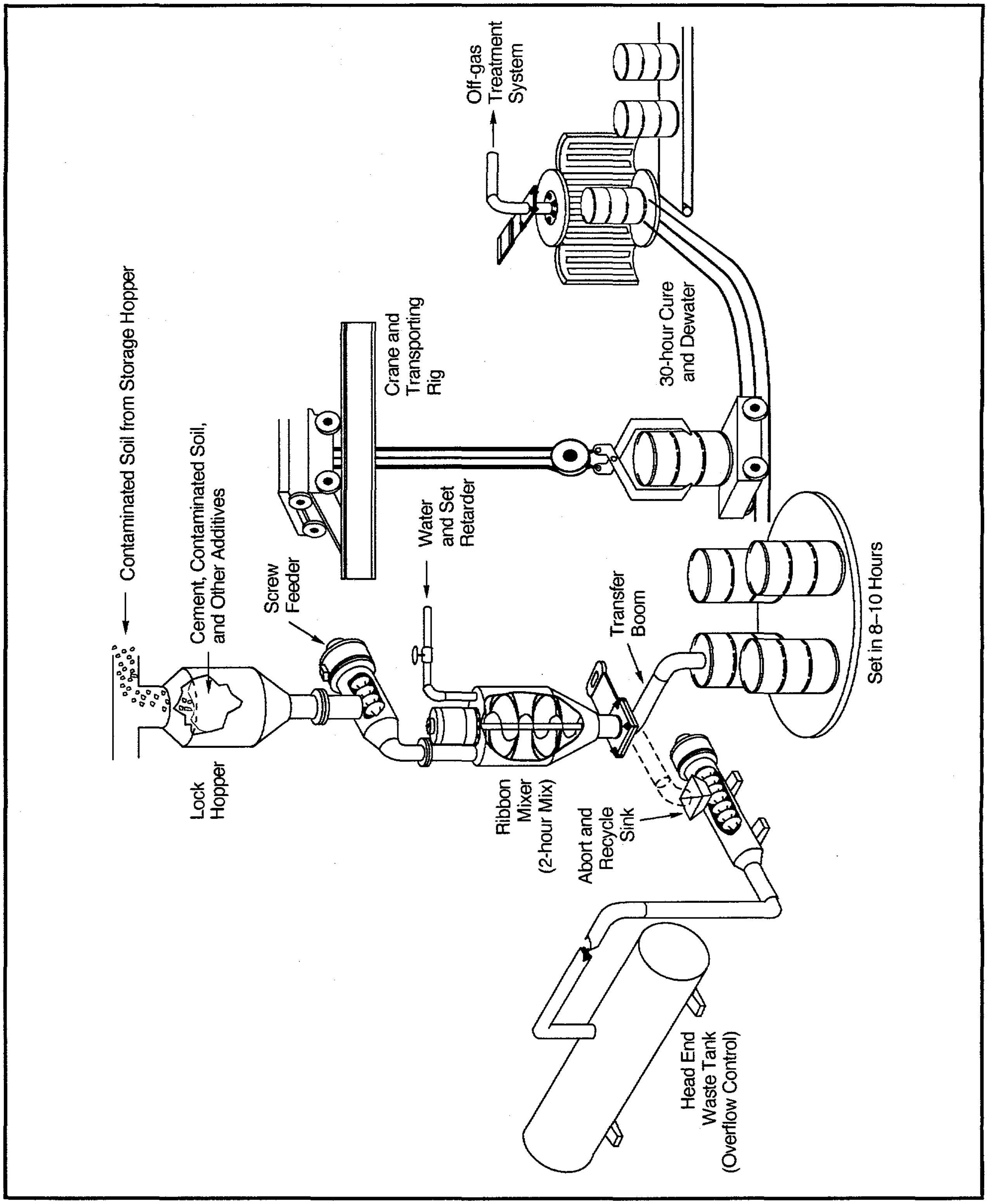


Figure 2-15

Simplified Conceptual Diagram of Solidification System

- To achieve cost savings by accumulating wastes for bulk shipment and treatment.

- To reduce costs and risks associated with off-site shipment of large volumes of contaminated soils.

The single proposed CAMU would be capable of storing and treating loose soils and debris contaminated with organics, metals or both. The CAMU would be designed with the flexibility to store and treat additional hazardous waste streams and larger waste volumes in case current estimates were found to be low. The only disposal currently proposed for the CAMU is treated soils for which EPA has not approved for return to the ER Project sites from which they came. Concentrated wastes from treatment units, as well as from debris that could not be decontaminated, would be most likely shipped off site for final treatment and disposal.

EPA requires that a CAMU be placed on a contaminated site. Therefore, the ER Project evaluated all 157 ER project sites and identified five potential CAMU locations. These five candidate CAMU locations are ER Sites 18, 74, 107, 240, and 241 (see Figure 2-16), all five of which are located within Tech Area III. After review and analysis by members of the public on a TU/CAMU Working Group and the Citizens Advisory Board, a single site would be selected for the location of the proposed CAMU.

The conceptual layout of the single CAMU site would consist of three primary staging areas: a storage area, a treatment area, and an underground cell for permanent waste management (see Figure 2-17). The storage area would consist of temporary containment structures erected on concrete pads. Additional storage space would be provided for covered roll-off bins. The temporary structures would be aluminum or have an aluminum frame/fabric cover. Treatment would be performed using skid-mounted mobile treatment units placed on bermed concrete or asphalt pads. The treatment area may be enclosed in a temporary structure. The design of the permanent waste management cell would include a liner and cap approximately level with the surrounding grade. Natural and native materials would be incorporated into design features wherever applicable to ensure compatibility with local conditions and long-term effectiveness. Implementation of long-term monitoring of the groundwater beneath the disposal cell would be determined as part of the permit process. Designation of a CAMU requires approval of a request for an SNL/NM RCRA Part B permit modification and can include existing TUs.

A TU area where wastes can be stored or treated is included in this option. Later, additional TUs could be constructed within a CAMU for storage and treatment of contaminated soils. To designate a TU, whether for temporary storage of wastes or for treatment, SNL/NM must apply for and obtain EPA approval of a request for modification to the SNL/NM RCRA Part B permit.

The life of a TU is limited to one year, with the potential for a one-year extension. After it is no longer needed to store or treat wastes, clean closure of a TU is required if it has not been incorporated into a permitted CAMU.

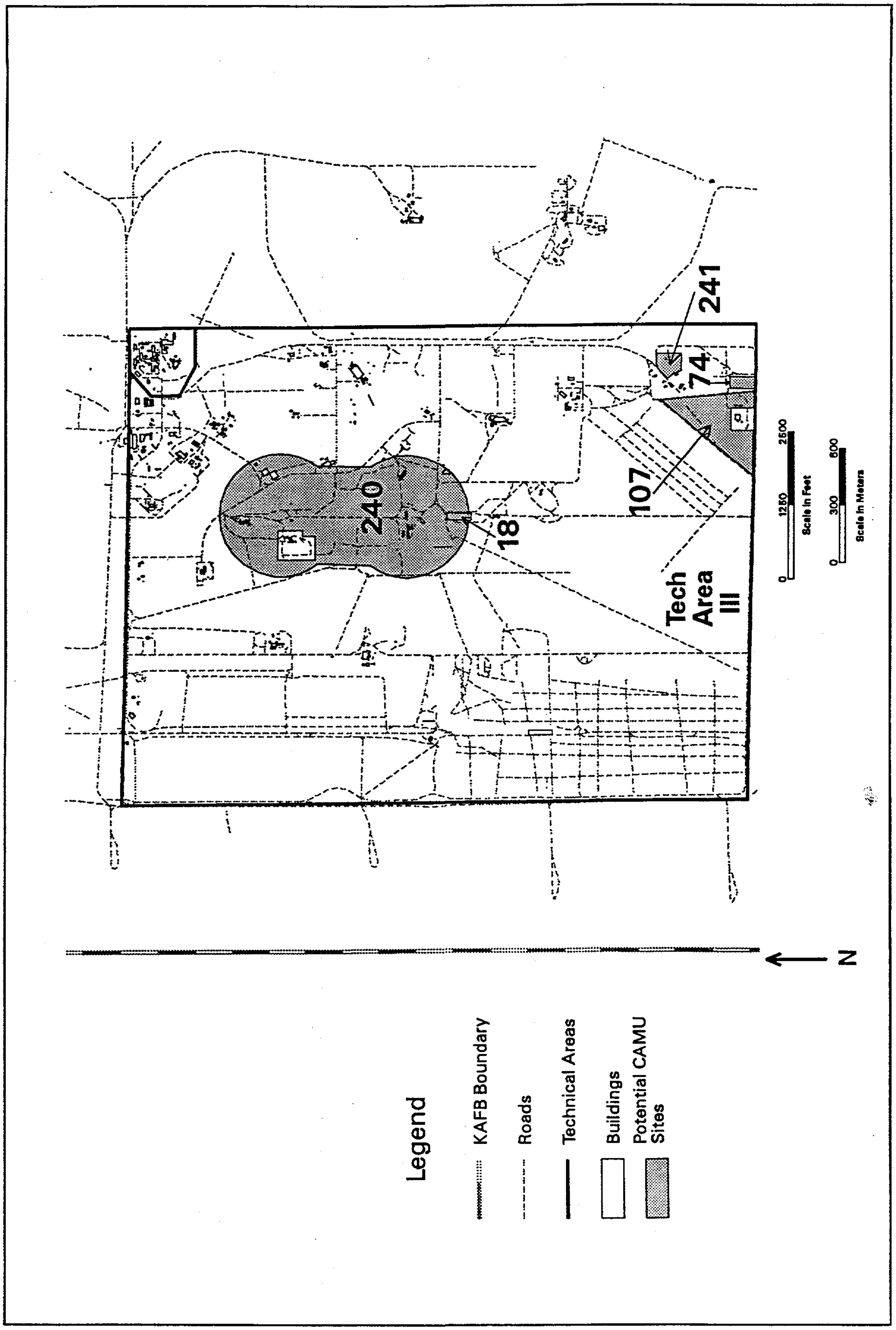


Figure 2-16
Candidate Locations
Corrective Action Management Unit (CAMU)

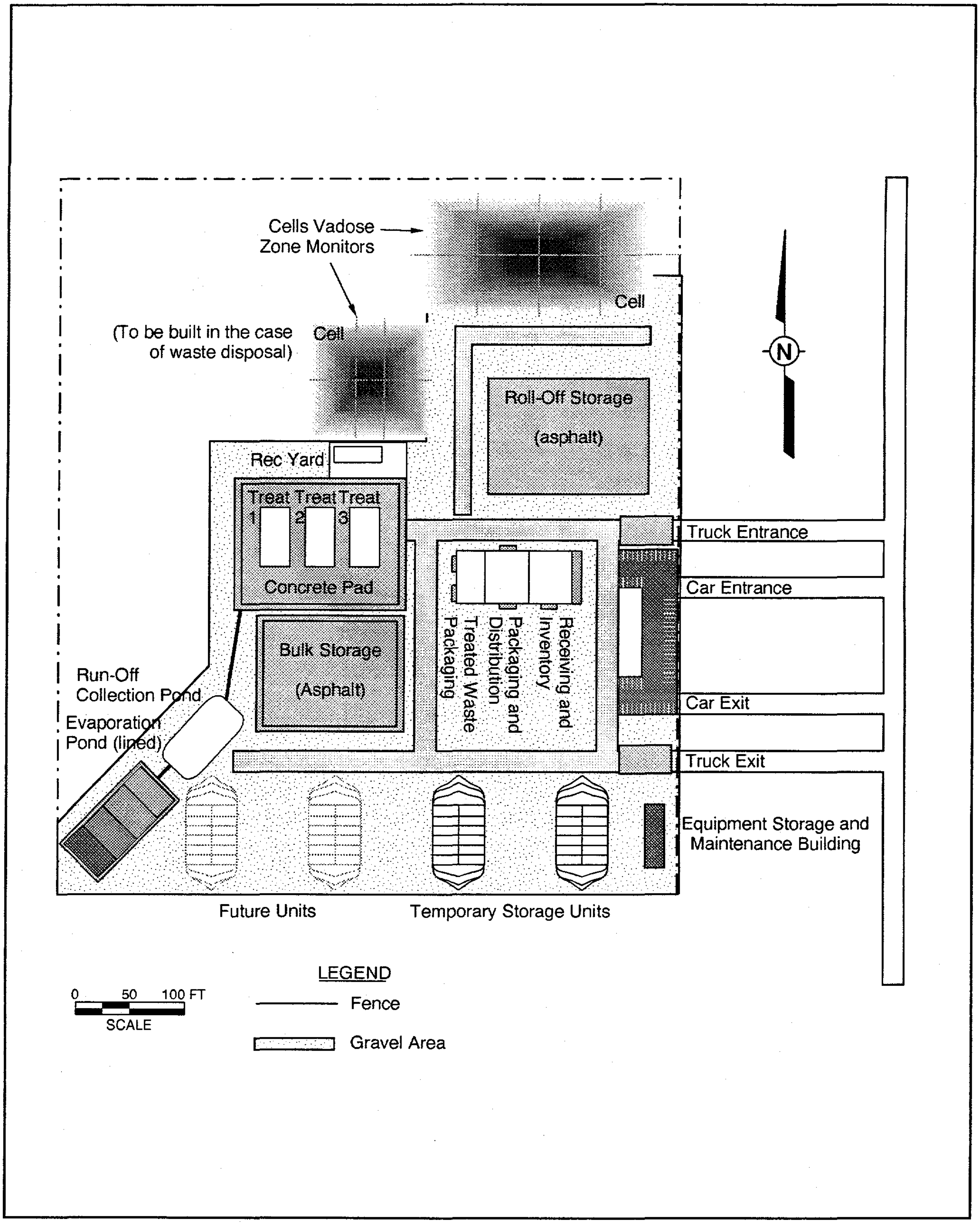


Figure 2-17
Conceptual Layout of Corrective Action Management Unit

2.1.4.8 Off-Site Treatment and Disposal

It is assumed that ER Project activities would generate waste requiring treatment and disposal. The waste volume assumed to require off-site treatment is shown in Appendix A, Table A-3, as the volume excavated. A conservative volume estimate of about 7,300,000 cubic feet (about 210,000 cubic meters) of excavated soils contaminated with mixed or hazardous wastes has been assumed in this assessment. This includes an estimated 934,000 cubic feet (26,459 cubic meters) of waste from the Chemical Waste Landfill (ER Site 74), because only partial excavation at the Chemical Waste Landfill is currently planned to eliminate groundwater contamination sources.

Wastes generated in volumes as described above and in Table A-3 would be temporarily collected on ER sites where they were generated and/or moved to waste collection locations for ER wastes such as the waste collection location at ER Site 18. Such wastes would be kept at these locations until such time as they are manifested and shipped off-site to a RCRA-permitted facility for treatment and disposal of hazardous waste, or to a permanent disposal facility for low level radioactive waste. Alternatively, some wastes may be moved from the ER collection locations to Sandia's permitted waste storage facilities (such as the Interim Storage Site or the Radioactive and Mixed Waste Management Facility in TA-3).

All waste collection at the locations on ER sites would be in strict compliance with applicable RCRA storage and other applicable requirements. In general, at such time as excavated materials are determined to be wastes, they will be properly containerized and labeled to prevent loss of contaminants into the air, water, or soils.

If a CAMU is not established at SNL/NM, hazardous and mixed wastes would have to be treated and disposed of in a RCRA-permitted disposal site. Hazardous waste from SNL/NM operations is presently transported off site for treatment at commercial RCRA-permitted treatment facilities. Under this option, it is anticipated that remediation wastes could also be sent off-site to commercial facilities for treatment. The treated soils would meet LDR treatment standards for hazardous organic contaminants. The residues would be treated to meet LDR treatment standards for hazardous characteristics and would be disposed of in a landfill at a commercial facility.

Off-site disposal could be chosen as a disposal option. SNL/NM ER waste streams comprise less than one percent of the projected DOE ER wastes that would be generated nationally. This volume could be accommodated by existing off-site facilities. All waste would have to be characterized to meet the applicable receiving facility's waste acceptance criteria and permit requirements. Hazardous and mixed waste shipments would need to be properly manifested and identified as LDR waste to comply with RCRA waste generator requirements. All waste would be shipped according to U.S. Department of Transportation requirements. All applicable characterization and notification regulatory requirements would be met. If disposal is appropriate, the impacts associated with off-site transportation are covered in Section 4.1.9.

2.1.4.9 In Situ Bioremediation

In situ bioremediation using microorganisms to remove wastes is proposed for soils contaminated with organic compounds such as VOCs, SVOCs and PHCs and/or low-concentration (less than 12 percent) HE residues (see Figure 2-18). Typically, these contaminants are treated in situ through a process in which naturally occurring and cultured organic-digesting organisms and nutrients are added to contaminated soils via wells to enhance biological activity. The organisms break down hazardous VOCs and/or SVOCs into nonhazardous by-products. In general, this option requires that a series of vertical wells be drilled to serve as air inlets into the soil and to monitor the effectiveness of the treatment.

Oxygen and nutrients for the soil are introduced via these wells. A liquid extraction system is installed in some of the wells to produce a negative pressure system to draw the oxygen and nutrients into the contaminated soils. Soils are tested periodically to assess the rates of hazardous organic removal. The culture and nutrient mix would be adjusted as necessary to ensure effective treatment, where in situ bioremediation is proposed as the appropriate treatment of ER Project sites.

2.1.4.10 Thermally Enhanced Vapor Extraction System

Vapor extraction technologies have been successfully used in the remediation of PHC spills. However, the effectiveness of this technology depends on the size and volume of air spaces between soil particles. The technology's effectiveness is increased by heating the contaminated soils in situ with electromagnetic and radiofrequency devices. This technology is not appropriate for radioactive or mixed wastes.

The thermally enhanced vapor extraction system (TEVES) is designed to volatilize organic contaminants (PHC, in this case) by heating the subsurface with electrodes placed in the soil around the zones of contamination. The volatilized organics are recovered with vacuum-extraction devices connected to vapor-recovery wells screened in the contamination zones. The contaminants captured by the vacuum wells are destroyed in an off-gas treatment system (see Section 2.1.4.3). This technology would be employed at SNL/NM ER Project sites where contaminants and conditions indicate it would be effective.

2.1.4.11 Capping and Institutional Controls

A combination of physical isolation barriers (caps) and institutional controls would be implemented at sites where excavation or treatment was not deemed the most effective corrective measure and for sites with large volumes of contamination where excavation might produce extensive impacts. This alternative would meet the RCRA corrective action criteria by reducing the mobility of wastes. Caps placed over wastes would be designed to prevent transport of contaminants into the surrounding environment by limiting pathways of water infiltration, intrusion of plants and animals, wind and water erosion, human intrusion, and gaseous releases. To limit pathways of environmental exposure during the first 100 years and beyond, earthen or cement-type caps would be used where wastes would be disposed of in

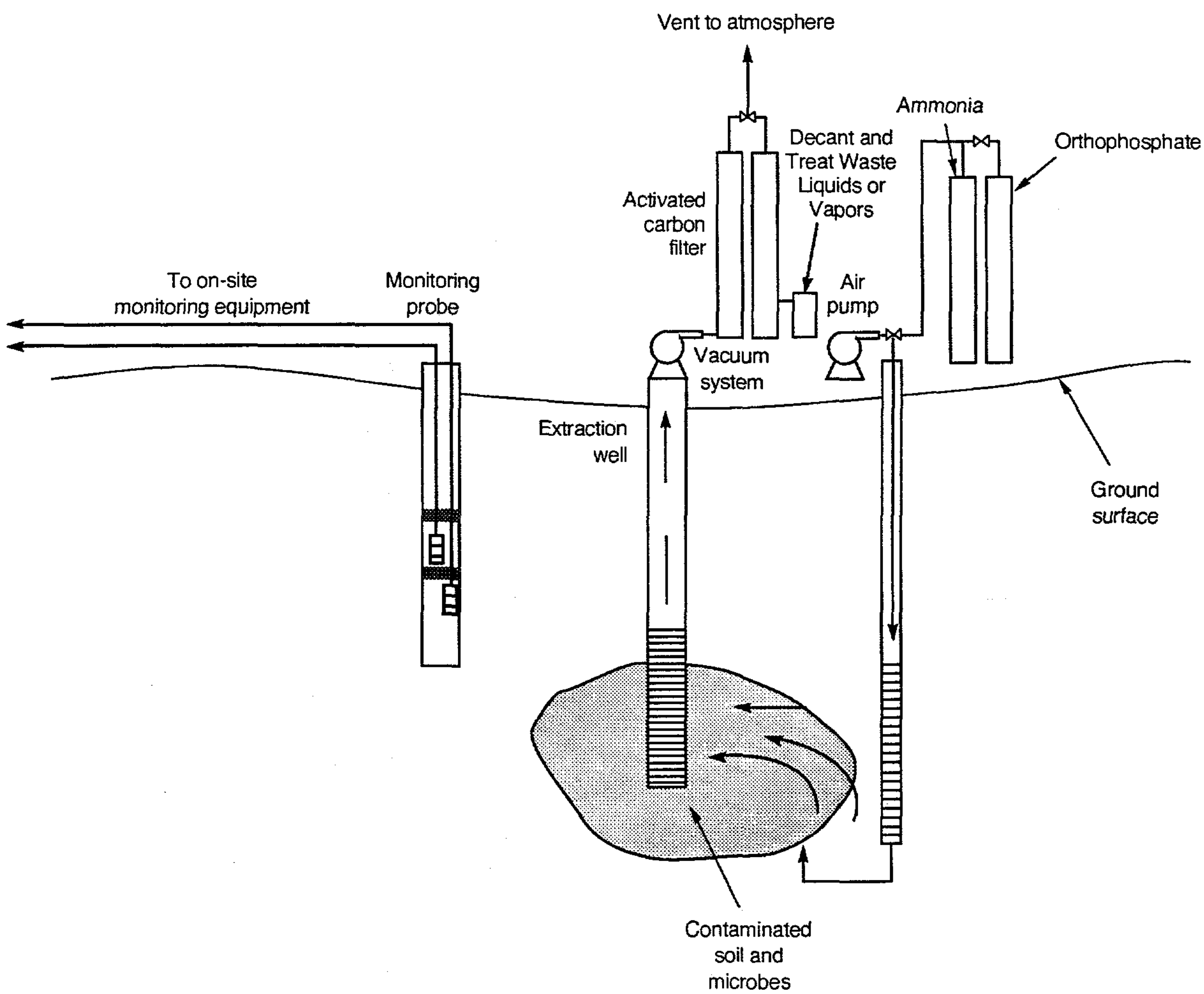


Figure 2-18
Schematic Diagram of In Situ Bioremediation

place or in shallow burial locations. Capping and institutional controls are appropriate for hazardous, radioactive, and mixed wastes.

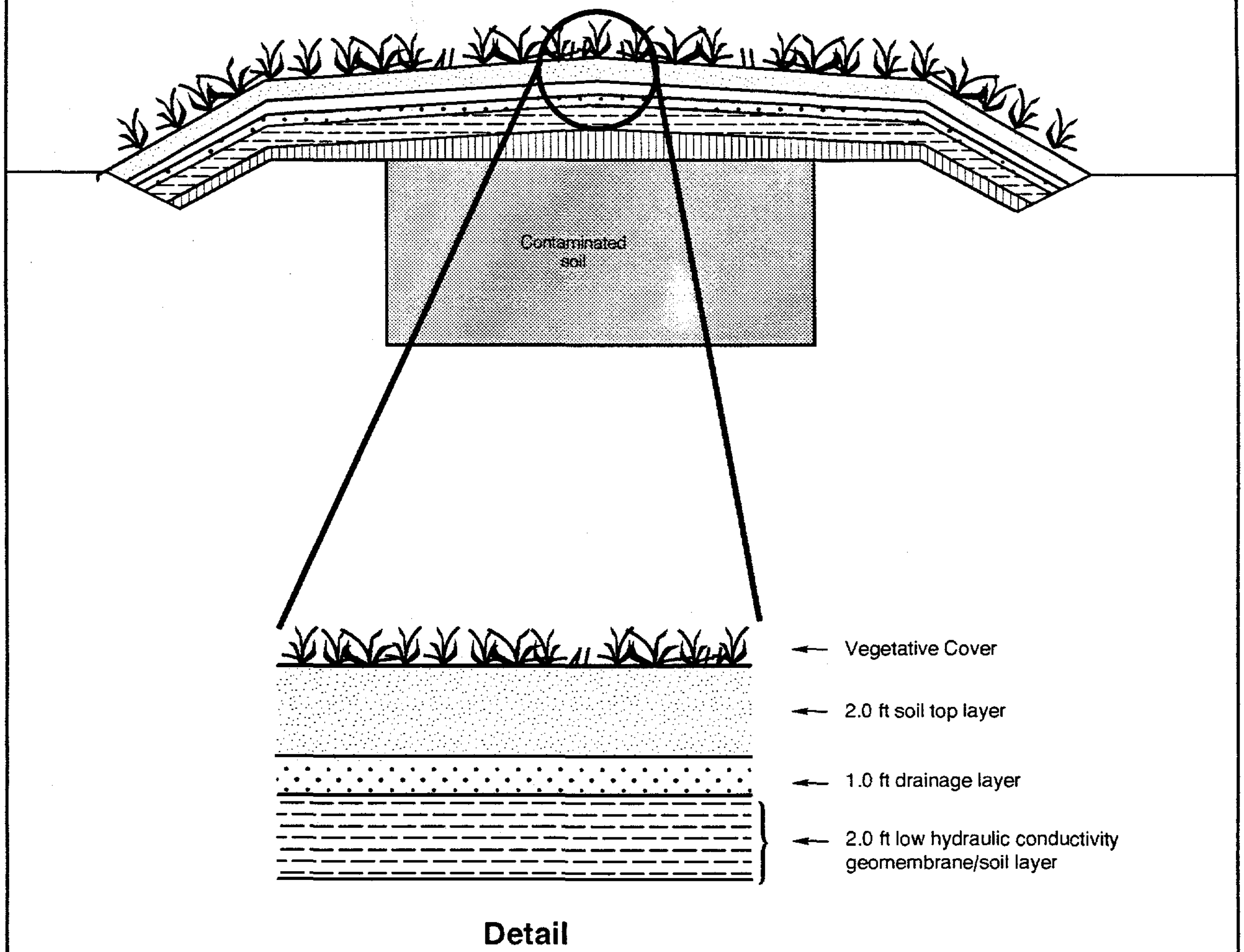
Capping. Capping would be a viable option when it would result in the control, minimization, or elimination of post-closure escape of hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the extent necessary to protect human health and the environment (in accordance with 40 CFR 264.111). Capping would reduce the likelihood of vertical downward migration of hazardous constituents, facilitated by the creation of a hydraulic head from surface water infiltration, and would reduce or eliminate VOC migration. Construction of caps or barriers could be selected as the most feasible corrective measure during the CMS.

Caps would be designed to be impermeable to specific VOCs present at the ER Project sites, soil erosion and runoff from the cap slope, low moisture and high evapotranspiration rates associated with an arid climate, and high-volume storm events. Caps would be a likely option for environmental restoration of landfill sites. A conceptual diagram of a cap design is shown in Figure 2-19. Capping materials would come from existing SNL/NM-designated "borrow and fill" areas or from off-site sources if appropriate onsite sources or materials do not exist.

A cap is composed of three layers: a bottom low-hydraulic-conductivity layer, a middle drainage layer, and a top soil/vegetation layer. The bottom layer functions as a barrier to moisture that would otherwise move downward through the landfill. It consists of a low-hydraulic-conductivity geomembrane and soil layer. Above the bottom layer is a drainage layer consisting of a minimum 12-inch (30.5-cm) soil layer with a minimum hydraulic conductivity of 4×10^{-3} inches[1] (1×10^{-2} cm) per second, or a layer of geosynthetic material having the same characteristics. The purpose of this layer is to minimize the time the infiltrated water is in contact with the bottom, low-hydraulic-conductivity layer, thus lessening the potential for water to reach the waste in the landfill. A top soil/vegetation soil layer forms the uppermost portion of the cap. At suitable SNL/NM ER Project sites when this remedy is appropriate, this layer would be designed to inhibit soil erosion from storms while allowing runoff. The vegetation would be indigenous and would have a root system that would not penetrate into the drainage layer. It would have sufficient density to control the rate of erosion to the recommended level of less than 2 tons per acre per year (4.5 metric tons per hectare per year). Based on specific conditions at a particular site, alternate cap designs for arid environments may be used as well.

Institutional Controls. Depending on the remedial action applied, the projected land use and the site-specific conditions, some ER Project sites would be controlled through the use of deed restrictions and through institutional and access controls (e.g., fences) to allow for sufficient time for natural processes of degradation or radioactive decay to occur and render waste less hazardous. Under this option, it is assumed that DOE or another government agency (e.g., the U.S. Air Force) would retain control of the ER Project sites. Public access controls would be implemented, such as placing fencing and warning signs, assessing trespassing fines, and

[1] NOTE: Throughout this document, a scientific shorthand notation is often used. 4×10^{-3} is equivalent to 0.004, with two zeros after the decimal and 4 appearing in the third place after the decimal.



Reference: Holdren et. al. 1994.

Figure 2-19
Conceptual Cap Design

establishing training requirements for persons allowed access. Workers would have access to ER Project sites only under controlled conditions with safety requirements that would prevent or limit unsafe exposure to contaminants.

The use of this option would depend on future land-use plans for the individual ER Project sites. At present, the ER Project Program Implementation Plan calls for institutional controls to remain in place for 100 years (SNL/NM, 1995a), consistent with EPA's requirements for waste disposal facility performance evaluation criteria in 40 CFR 191. After this period, a large number of land-use scenarios would be possible. For this reason, the health and environmental consequences of future intrusion into contaminated areas must be considered.

2.1.5 Examples of Treatment Option Combinations

2.1.5.1 Example 1: Treatment Options for Hazardous Waste

Contaminated soil would be processed initially in the thermal desorption unit (see Section 2.1.4.2) to volatilize and/or destroy the organic compounds (VOCs, SVOCs, PHCs, and PCBs) and HE. The desorbed vapor produced in this unit would be routed to the off-gas treatment system (see Section 2.1.4.3) to destroy residual organics. Soil leaving the desorber would be transferred to a soil-washing unit (see Section 2.1.4.4), which would segregate and concentrate metal contamination on smaller soil particles, such as silts and clays. The primary purpose of the soil-washing unit would be to reduce the volume of contaminated media removed from the site. With EPA approval, clean soil would be returned to the ER Project sites as part of site reclamation activities, which are detailed in Section 2.1.4.1. Contaminated media would be treated in an S/S unit (see Section 2.1.4.6) to produce a final stabilized waste form suitable for disposal.

2.1.5.2 Example 2: Treatment Options for Radioactive or Mixed Waste

Based on field sampling results, soil and debris from ER Project sites contaminated with radioactive constituents could be routed through a series of treatment options. Following initial excavation and segregation activities, radioactive waste would be processed in a carbondioxide blasting unit (see Section 2.1.4.5) to remove radioactive surface contamination. Decontaminated debris and equipment would then be segregated for disposal or reuse. Items that could not be decontaminated to meet release criteria specified by DOE Order 5400.5 for unrestricted reuse would be disposed of as radioactive waste.

Initially, radioactively contaminated soil would be processed in a soil-washing unit (see Section 2.1.4.4) to segregate and concentrate radionuclide contamination on smaller soil particles, such as silts and clays. The primary purpose of the soil-washing unit is to reduce the volume of contaminated media. With EPA approval, clean soil would be returned to the ER Project sites as part of site reclamation activities, which are detailed in Section 2.1.4.1. Contaminated media generated by these processes would be treated in an S/S unit (see Section 2.1.4.6) to produce a final waste form suitable for disposal.

2.1.5.3 Example 3: Waste Treatment at Individual ER Project Sites

This option would involve using a mobile thermal desorption unit (see Section 2.1.4.2), an off-gas treatment system (see Section 2.1.4.3), a soil-washing unit (see Section 2.1.4.4), an S/S unit (see Section 2.1.4.6), and other treatment units that could travel to individual ER Project sites or be assembled at the site. This approach may require individual RCRA permitting for treatment.

Under this option, the sites would be excavated as described in Section 2.1.4.1, although contaminated soils would not be hauled to a central treatment facility. Because the only transport required would be moving the wastes to the mobile treatment units, related operating equipment, or units assembled on site, onsite truck transport would be minimized. Excavating contaminated soils and treating them at individual ER Project sites, instead of at a central treatment facility, and returning the treated soils to the site of origin would require the treatment process to meet the LDR treatment standards and the RCRA minimum technology requirements at the disposal site (where wastes would be replaced).

2.1.6 Designating Sites for No Further Action

As of December 1995, 71 of the currently estimated 157 SNL/NM ER Project sites were proposed for an NFA determination. For these sites, DOE and SNL/NM have requested from EPA a RCRA Part B permit modification, which would end the schedule for compliance with the SNL/NM RCRA Part B permit. Other actions might be required by other applicable state and federal laws and regulations.

Some sites are subject to confirmatory sampling to demonstrate that there are no CoCs present. Although some contaminants may still be present, sites could be eligible for NFA designation with regulatory agency approval. This approval would be based on a demonstrated low-level of risk associated with existing contaminants.

2.2 No Action Alternative

Under the no action alternative, corrective action, in the form of the specific corrective measures and treatment options described in Section 2.1.4.1, would not be undertaken at sites where releases of contamination currently occur or where there is a threat of a future release of hazardous wastes or constituents. Contamination, including VOCs, SVOCs, PHCs, heavy metals, HE, PCBs, DU, and other CoCs listed in Table 2-1, would remain at the various ER Project sites and would receive no treatment. There would be no excavation of contaminated soils or debris and no transport of contaminated media for treatment and/or disposal. None of the corrective measures described in Section 2.1.4.1 (excavation and transportation, thermal desorption, desorbed vapor treatment system, soil washing, stabilization, etc.) would take place.

Under the no action alternative, DOE and SNL/NM would not comply with the requirements of EPA Region 6 HSWA Module, which was effective August 26, 1993, nor would SNL/NM activities comply with the requirements of Sections 3004(u) and (v) of RCRA or other applicable regulatory requirements. In addition, DOE's purpose and need for this proposed action would not be met.

The anticipated risks to human health and the environment associated with the no action alternative are evaluated in the risk assessment (see Section 4.2.10).

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3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

This chapter describes the environmental parameters (e.g., soils, surface water, air, and vegetation) that could be affected by activities associated with the proposed action and the no action alternative described in Chapter 2.0.

3.1 Physical Setting

The SNL/NM facility is in Bernalillo County, New Mexico, and is situated entirely within the external boundaries of KAFB, located immediately south of Albuquerque, New Mexico (see Figure 3-1). KAFB is situated on two broad alluvial fans bisected by the Tijeras Arroyo, an east/west-trending canyon. These alluvial fans are bounded by the Manzano Mountains (the Cibola National Forest) to the east and by the Rio Grande to the west. Most of the area is relatively flat, sloping gently westward toward the Rio Grande. However, the eastern portions of KAFB and SNL/NM extend into the canyons of the Manzanita Mountains. The western slope of the Manzanita Mountains facing KAFB is precipitous and rough and has numerous arroyos. Elevations range from 4,920 feet (1,500 meters) at the Rio Grande to 7,990 feet (2,430 meters) at the Manzano Lookout Tower in the Manzano Mountains. The mean elevation of KAFB and SNL/NM is 5,350 feet (1,630 meters) (SNL/NM, 1995a).

The climate in the Albuquerque area is characterized by low precipitation; wide temperature extremes; frequent, drying winds; heavy rain showers (usually of short duration and often with erosive effects) and erratic, seasonal distribution of precipitation. The average annual temperature in Albuquerque is 55 degree Fahrenheit (°F) (13 degrees Celsius [°C]), with an average diurnal temperature of 28°F (-2.2°C) (NOAA, 1990). The average number of clear days per year is 169, with 76 percent sunshine possible.

The valley and mesa areas are arid, with an average annual precipitation of approximately 8 inches (20 cm). The average annual precipitation in the mountains is considerably heavier, up to 20 inches (51 cm) (SNL/NM, 1989). Half of the average annual precipitation occurs in the form of brief but heavy thunderstorms during the summer period (July through September), occasionally resulting in flash floods.

The average annual wind speed for the Albuquerque area is 9 miles per hour (mph) (14 kilometers per hour [km/hr]). Sustained winds of 12 mph (19 km/hr) or less occur approximately 80 percent of the time at the Albuquerque International Airport (near KAFB), while sustained winds greater than 25 mph (40 km/hr) have a frequency of less than 3 percent (NOAA, 1990). Airport data shows that winds blow most frequently from the north in winter and from the south in summer (see Figure 3-2). At SNL/NM, where local land features modify prevailing wind patterns, winds are almost equally probable from all directions under normal conditions and occur at speeds generally less than 8 mph (13 km/hr). Wind speeds reach 30 mph (48 km/hr) on fewer than 48 days each year (SNL, 1993a). Tijeras Arroyo appears to divert surface-air flow between Tech Area III, Tech Area V, and the Coyote Test Field on the

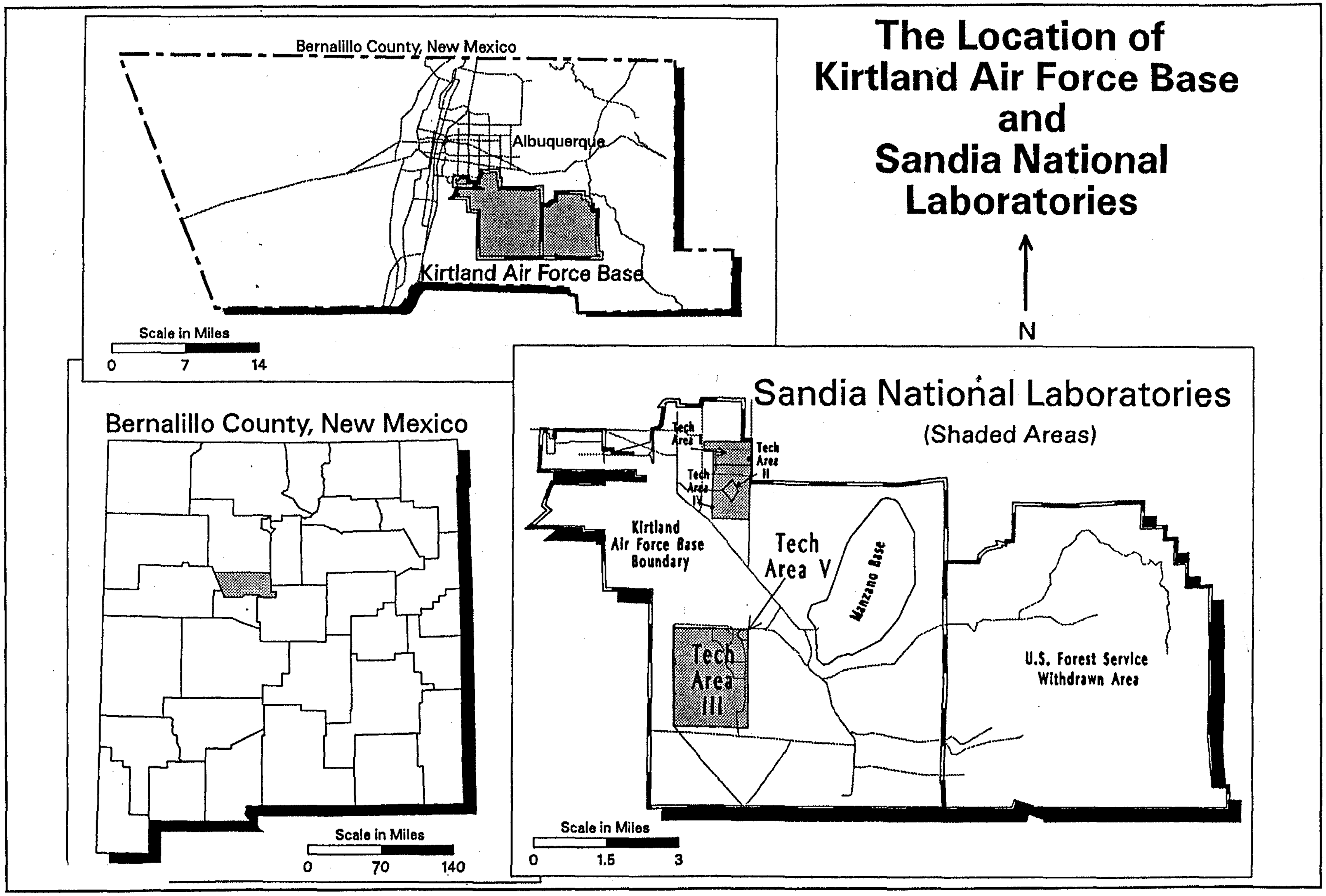
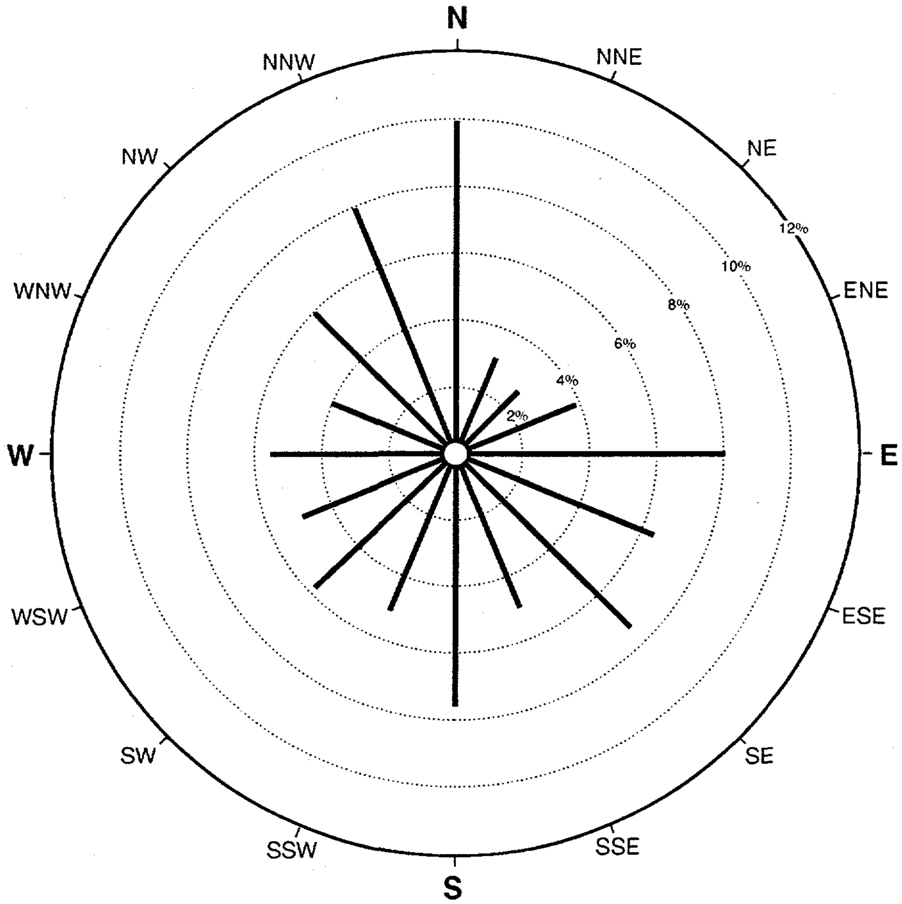


Figure 3-1
The Location of Kirtland Air Force Base and Sandia National Laboratories



Reference: EPA 1992.

Note: Windrose indicates direction from which the wind blows.

Figure 3-2
Average Annual Wind Direction, Albuquerque International Airport (1983–1991)
(Windrose Frequency in Percent Time)

one hand and Tech Area I, Tech Area II, Tech Area IV, and Albuquerque on the other (Culp et al., 1995).

Meteorological data used in estimating SNL/NM-site air-dispersion characteristics for this EA were taken from the most recently available Albuquerque National Weather Service observations from the EPA Technology Transfer Network (EPA, 1992). These observations were made in 1991 at the Albuquerque International Airport, located adjacent to SNL/NM and KAFB boundary. A composite windrose generated from the same meteorological data set for the years 1983 to 1991 shows prevailing wind speeds and directions in Figure 3-2.

Albuquerque is classified as a region of low tornado occurrence, with an annual frequency of 0.1 or less. Severe winds may be associated with local thunderstorms occurring primarily during the summer. The average number of thunderstorm days per year in the Albuquerque area is 41 (SNL/NM, 1995a).

3.2 Land Use

It is anticipated that the size of the SNL/NM site would remain at its current 2,840 acres (1,150 hectares) owned by DOE. Because 17,800 acres (7,200 hectares) are required to conduct operations, the additional 15,000 acres (6,070 hectares) are provided to DOE through ingrant land from KAFB (approximately 5,910 acres [2,390 hectares]), from the State of New Mexico (approximately 2,750 acres [1,110 hectares]) and from the Isleta Pueblo (approximately 6,350 acres [2,570 hectares]) (SNL/NM, 1995b) (see Figure 3-3).

KAFB encompasses 52,200 acres (21,100 hectares) and is bounded on the north and northwest by the city of Albuquerque, on the east by the Cibola National Forest, on the south by the Isleta Pueblo, and on the west by land owned by the State of New Mexico, DOE buffer lands, and the Albuquerque International Airport. A portion of KAFB located east of Manzano Base is on land withdrawn from Cibola National Forest, which is managed by the U.S. Forest Service (USFS). On the southwestern corner of KAFB, there are two restricted access buffer zones that separate public access areas and the Isleta Pueblo from KAFB and SNL/NM operations.

SNL/NM technical areas and test areas are described in the following paragraphs. Tech Area I (350 acres [140 hectares]), with approximately 5,000 employees, has the largest working population. This area is dedicated primarily to the design, research, and development of weapon systems; limited production of weapon system components; and energy programs. It also includes the main library and offices, laboratories, and shops used by the administrative and technical staff. Facilities include a paint shop, a process development laboratory, an emergency diesel generator plant, a foundry, a solvent spray booth, and a steam plant.

Tech Area II is a 45-acre (18-hectare) facility that was established in 1948 for the assembly of chemical HE main charges for nuclear weapons and later for production-scale assembly of nuclear weapons. Also located in Tech Area II are an inactive low-level radioactive waste disposal site and a small radioactive material decontamination and storage facility

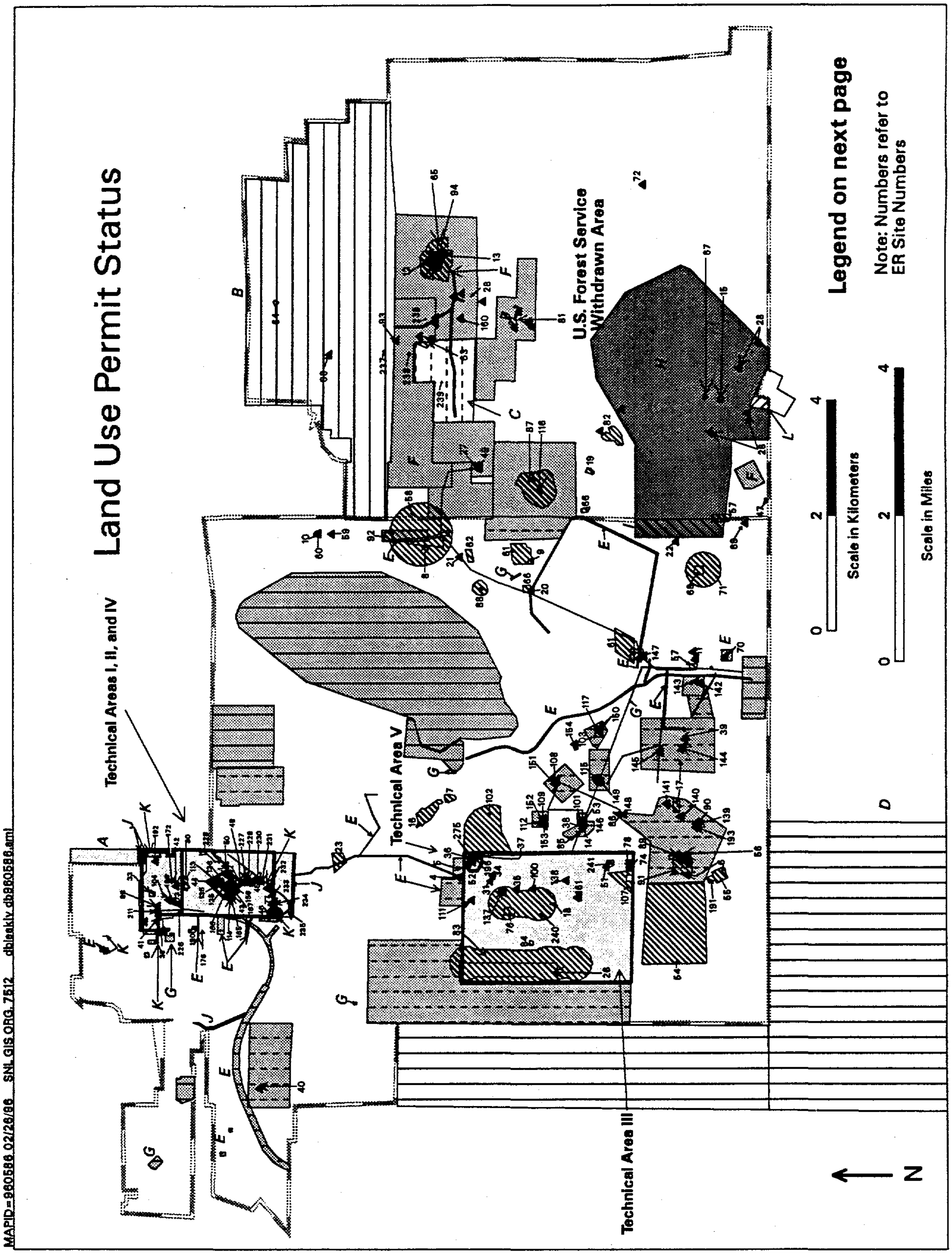


Figure 3-3
Land Use Permit Status

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Land Use Permit Status Legend

KAFB Boundary

Technical Areas

ER Sites

ER Sites less than 1 acre

A DOE Fee

B DOE Withdrawn from USFS

C DOE Withdrawn from BLM

D DOE Leased (State of N.M. & BIA)

E USAF Permitted to DOE

F USAF Withdrawn from BLM Permitted to DOE

G USAF Various Structures Within this Area Permitted to DOE/SNL/TSD/CTA and Support Agreement Between USAF and DOE for Various Facilities

H USAF Withdrawn from BLM Joint Operating Agreement between DOE/BLM/Phillips Laboratories

I USAF Fee Joint Operating Agreement between DOE/SNL/Phillips Laboratories

J DOE Fee to USAF

K DOE Permit to Others

L Private Property

Note: TSD = Transportation Safeguards Division
CTA = Central Training Academy
BIA = Bureau of Indian Affairs

Note: Numbers refer to environmental restoration (ER) sites.

Figure 3-3 (Continued)
Land Use Permit Status

(Building 906). The inactive low-level radioactive waste disposal site (ER Site 1) has not been used for over 20 years.

Tech Area III (1,920 acres [780 hectares]) is located 5 miles (8 km) south of Tech Area I and is composed of 20 test facilities, which include extensive environmental test facilities (such as sled tracks, centrifuges, and a radiant heat facility). Other facilities include a paper incinerator, an inactive chemical waste landfill (ER Site 74), an inactive low-level waste and mixed waste landfill (ER Site 76), and a melting and solidification laboratory. The inactive radioactive waste disposal site (ER Site 76) in Tech Area III consists of two adjoining fenced areas that occupy 6,460 square feet (600 square meters). One area was used for low-level waste disposal and consists of seven trenches. The second area consists of 37 pits that were used for disposal of classified low-level waste. Three other pits in the second area were used for disposal of depleted and natural uranium. The Chemical Waste Landfill (ER Site 74) is an inactive hazardous waste disposal and storage site located near the southern boundary of Tech Area III.

Tech Area IV, located 2 miles (3 km) south of Tech Area I, consists of several inertial-confinement fusion research and pulsed-power research facilities and covers approximately 80 acres (30 hectares). A large accelerator, the Particle Beam Fusion Accelerator, was completed in 1985. A large accelerator facility, the Simulation Technology Laboratory, houses seven pulsed-power accelerators: HERMES-3, RLA, TROLL, STF, SPEED, HYDRAMITE, and PROTO 2. Several of these accelerators were transferred from Tech Area V. Another accelerator facility, SATURN, and a major research facility, the Strategic Defense Facility, also are part of Tech Area IV facilities.

Tech Area V, located in the northeastern corner of Tech Area III, houses several electron beam accelerators, three research reactors in two reactor facilities, an intense gamma irradiation facility, and a hot cell facility (20 acres [8 hectares]). HERMES-2 is the largest accelerator located in Tech Area V.

SNL/NM has three other test areas that are located east and south of Tech Area III and in the canyon on the western side of the Manzano Mountains. The Coyote Test Field, the Canyons Test Area, and the Thunder Range areas comprise the remaining test areas of SNL/NM.

There are no national or State of New Mexico parks, wildlife refuges, or monuments within 6 miles (10 km) of the KAFB boundary. Cibola National Forest is a multiple-use area, adjacent to KAFB on the eastern side.

3.3 Geology and Soils

This section summarizes the geology and soils at SNL/NM.

3.3.1 Geology

SNL/NM is located on KAFB, which is situated in the eastern portion of the Albuquerque Basin (see Figure 3-4). This basin is one of the largest of a series of north-trending basins. It is about 62 miles (100 km) long and 31 miles (50 km) wide and is located along the Rio Grande. The basin lies within the northern portion of the Mexican Highlands section of the Basin and Range physiographic province (Fenneman, 1931). The basin is bounded by the Sandia and Manzano Mountains to the east, the Lucero Uplift and Puerco Plateau to the west, and the Nacimiento Uplift to the north. The southern boundary is defined by the Socorro Channel. Landforms within the basin include mesas and structural benches, low hills and ridges, inset stream terraces, and graded alluvial slopes (Lozinsky et al., 1991; Kelley, 1977; Kelley and Northrup, 1975).

Most of the Albuquerque Basin is composed of poorly consolidated sediments that have been eroded from the surrounding mountain areas following large-scale faulting and structural changes that occurred 11.2 to 5.3 million years ago. Underlying sediment sequences are sedimentary rocks about 15,200 feet (4,630 meters) thick, as indicated by gravity and aeromagnetic mapping (ERDA, 1977). These overlie the Precambrian (590 million-year-old) rocks that underlie the entire basin and then lift up to form the western plateaus and eastern mountains.

The Albuquerque Basin is flanked by normal faults to the east and west (see Figure 3-4 and Figure 3-5), which are exposed along the eastern margins of the mountains (Kelley, 1961; Kelley and Northrup, 1975; Kelley, 1977; Machette, 1982). The north-trending Hubble Springs Fault runs parallel to the Manzano Fault along the east side of the basin. The northeast-trending Tijeras Fault is manifested by a fault scarp that extends 31 miles (50 km) from Manzano Base to Golden, New Mexico. These fault systems intersect in the SNL/NM area, where the subsurface structure is probably complex. There is no evidence that movement on these faults, with accompanying strong earthquakes, has occurred within geologically recent times (the past 10,000 years) (ERDA, 1977).

The Albuquerque area is located in Seismic Risk Zone 2 (ERDA, 1977), which, by definition, is a region that can be expected to receive moderate damage from earthquakes (corresponding to intensity V2 of the Modified Mercalli intensity scale of 1931,[1] which is based on the degree of destruction of cultural structures). The records for this region show fairly high activity but low magnitude and intensity. There have been only 10 earthquakes of intensity V2 in New Mexico in the last century (ERDA, 1977). Many of the earthquakes have occurred in sparsely populated regions where there are no records. It is likely that earthquakes have occurred in the Albuquerque Basin since the basin stabilized in its present form, approximately 11.2 to 5.3 million years ago (ERDA, 1977).

[1]The Mercalli method of measuring earthquake intensity in terms of damage incurred originated in 1902 and continued to about 1935, when the Richter method of recording earthquake magnitude in terms of energy released replaced the Mercalli scale.

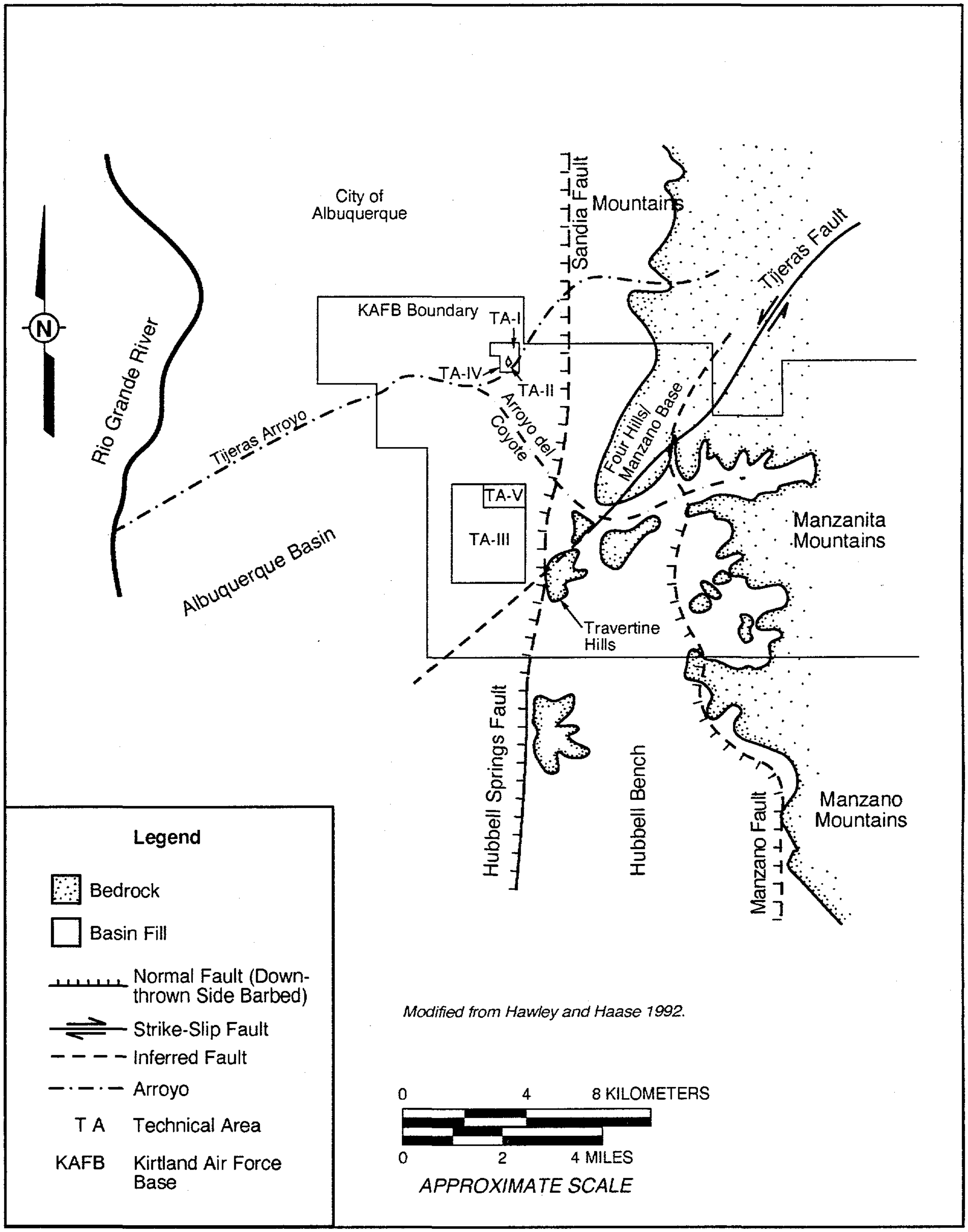

Figure 3-4
Eastern Portion of the Albuquerque Basin

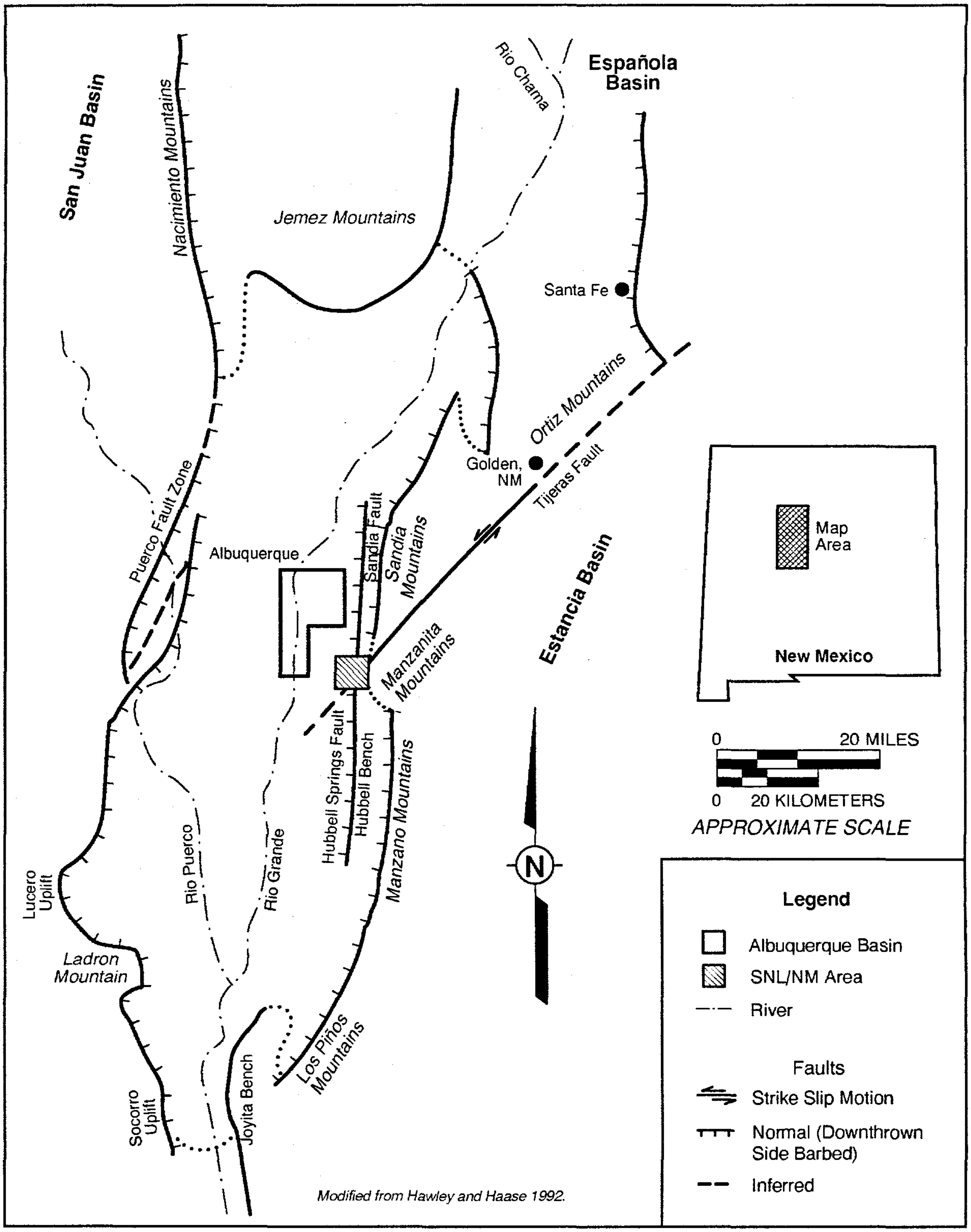

Figure 3-5
Location of Major Faults in Relation to Sandia National Laboratories/New Mexico

3.3.2 Soils

The Albuquerque Basin extends from the gently sloping area near the Rio Grande to the steeply sloping Manzano and Sandia Mountains. Well drained, loamy soils dominate, with minor amounts of gravelly and stony soils along the arroyos and on the mountains. Table 3-1 provides general soils information, including runoff potential and erosion hazard. Figure 3-6 shows the location of soil types in relation to ER Project sites. The soil series of primary concern with respect to erosion at ER Project site locations are the Bluepoint, the Embudo, the Madurez, the Tome, the Latene, the Laporte, the Tesajo, the Tijeras, and the Wink. Table 3-1 also shows the soil and water erosion hazards for each soil series (USDA, 1977).

3.4 Surface-Water and Groundwater Hydrology

This section describes the surface-water and groundwater hydrology of the SNL/NM area and the monitoring programs at SNL/NM, KAFB, and vicinity.

3.4.1 Surface-Water Hydrology

The surface-water system within the SNL/NM-KAFB area primarily consists of drainage channels (arroyos) that experience intermittent flow during rain storms or winter snow melt. This drainage rarely reaches the lower portions of the arroyos or the Rio Grande 5 miles (8 km) west of the site (SNL/NM, 1993b).

The major surface-water drainage feature in the SNL/NM-KAFB area is the Tijeras Arroyo, which flows westward from the Sandia and Manzano Mountains to the Rio Grande. The Tijeras Arroyo drains a 130-square-mile (330-square-km [km^2]) area at a point just downstream of the KAFB boundary. This includes runoff from the Arroyo del Coyote and some urban run-off from city flood channels. The Arroyo del Coyote has a 30-square mile (78-km^2) drainage area that includes Lurance Canyon, Madera Canyon, and much of the Manzano Base area. The major part of the Tijeras Arroyo watershed lies to the north and east of KAFB, whereas the Arroyo del Coyote watershed is within SNL/NM-KAFB (SNL/NM, 1992). The U.S. Geological Survey collected water quality samples at four sites on the Tijeras Arroyo and the Arroyo del Coyote during 1991 and 1992. The results of this study indicate no contamination in the surface water (SNL/NM, 1993b).

Floods in the Tijeras Arroyo and the Arroyo del Coyote are characterized by high-peak flows, small volumes, and short durations. Figures 3-7 and 3-8 present the areas that could be inundated by 100- and 500-year floods in the Tijeras Arroyo and the Arroyo del Coyote. Three ER Project sites (ER Sites 7, 16, and 23) are within the 100-year floodplain.

There are also two perennial springs in the Arroyo del Coyote drainage: Coyote Springs and Sol se Mete Spring. Other springs, G Spring, Burn Site Spring, and some localized seeps do

Table 3-1
General Soils Classification for Sandia National Laboratories/New Mexico

Series	Type	Elevation (feet)	Percent Slope	Runoff	Soil and Water Erosion Hazard	Use
Bluepoint	BCC—Bluepoint loamy fine sand	4850–6000	1–9	Slow	Severe	Range, watershed, wildlife habitat, recreation, and community development
	BKD—Bluepoint-Kokan association		5–40	Slow	Water erosion—moderate to severe	Range, watershed, wildlife habitat, recreation, and community development
Cut & Fill	Cu—Cut and fill land	4900–6000	1–25	Slow to Rapid	Slight to severe	Community development and watershed
Embudo	EmB—Embudo—gravelly fine sandy loam	5000–6500	0–5	Medium	Water erosion—moderate	Watershed, wildlife habitat, and community development
	EtC—Embudo Tijeras complex		0–9	Medium	Water erosion—moderate	Community development, watershed, wildlife habitat, and range
Gila	GA—Gila fine sandy loam	4850–6000	0–0.5	Slow	Water erosion and soil blowing—moderate	Wildlife habitat, watershed, and community development
Ildefonso	ILC—Ildefonso gravelly sandy loam	6000–7000	1–9	Medium	Water erosion—moderate	Range, watershed, and wildlife habitat
Laporte	LRD—Laporte-Rock outcrop Escabosa complex	6500–7500	5–20	Moderate	Moderate	Watershed, wildlife habitat, community development, and recreation
Latene	LtB—Latene sandy loam	5000–6000	1–5	Medium	Water erosion and soil blowing—moderate	Range, watershed, wildlife habitat, and community development
Madurez	MaB—Madurez-loamy fine sand	4900–5900	1–5	Slow	Soil blowing—severe	Range, wildlife habitat, watershed, and community development
	MWA—Madurez—Wink association		1–5	Slow	Soil blowing—moderate to severe	Range, wildlife habitat, watershed, and community development
Nickel	NL—Nickel Latene association	5200–5800	5–30	Rapid	Water erosion—moderate to severe	Range, watershed, and wildlife habitat
Pino	PR—Pino-Rock outcrop association	7400–8000	3–15	Medium	Water erosion—moderate	Range, timber, recreation, wildlife habitat, and watershed
Rock Outcrop	RLF—Rock outcrop—Laporte complex	6000–10000	30–80	Rapid	Water erosion—slight	Watershed, wildlife habitat, and range
	ROF—Rock outcrop-Orthids complex		40–80	Rapid	Water erosion—moderate	Watershed, recreation, and wildlife habitat
	RUF—Rock outcrop-Ustolls complex		15–70	Rapid	Water erosion—moderate	Range, wildlife habitat, recreation, and watershed
Salas	SAF—Salas Complex	6000–7000	20–80	Rapid	Water erosion—moderate	Wildlife habitat, watershed, and recreation
Seis	SEC—Seis very cobbly loam	6000–7800	0–15	Medium	Water erosion—moderate	Range, recreation, wildlife habitat, watershed, and limestone quarrying
	SGE—Seis-Silver Complex		10–40	Medium to rapid	Water erosion—moderate to severe	Range, wildlife habitat, and watershed
	SHF—Seis complex		30–80	Rapid	Water erosion—severe	Wildlife, habitat, watershed, recreation, and range
Silver	SwC—Silver and Witt soils	6400–7500	5–9	Rapid	Water erosion—moderate to severe	Range, watershed, wildlife habitat, and community development
Tesajo	Te—Tesajo-Millet stony sandy loams	6000–7000	3–20	Medium	Water erosion—moderate	Watershed, wildlife habitat, community development, and range
Tijeras	TgB—Tijeras gravelly fine sandy loam	5000–6500	1–5	Moderate	Water erosion—moderate	Community development, range, watershed, and wildlife habitat
Tome	To—Tome very fine sandy loam	4800–5600	0–2	Medium	Water erosion—moderate	Range, watershed, and wildlife habitat
Wink	WaB—Wink fine sandy loam	5000–6000	0–5	Medium	Water erosion—slight to moderate; soil blowing—moderate	Range, watershed, wildlife habitat, and community development
	Web—Wink-Embudo complex		0–5	Medium	Water erosion—moderate	Community development, watershed, and wildlife habitat
	WM—Wink-Madurez association		1–7	Medium	Soil blowing—severe	Range, watershed, and wildlife habitat

NOTE: Highlighted soil series are those of concern with respect to erosion at ER Project sites.

References:

U.S. Department of Agriculture, 1977. "Soil Survey of Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico," Soil Conservation Service, U.S. Department of the Interior, Bureau of Indian Affairs and Bureau of Land Management, Washington, D.C.

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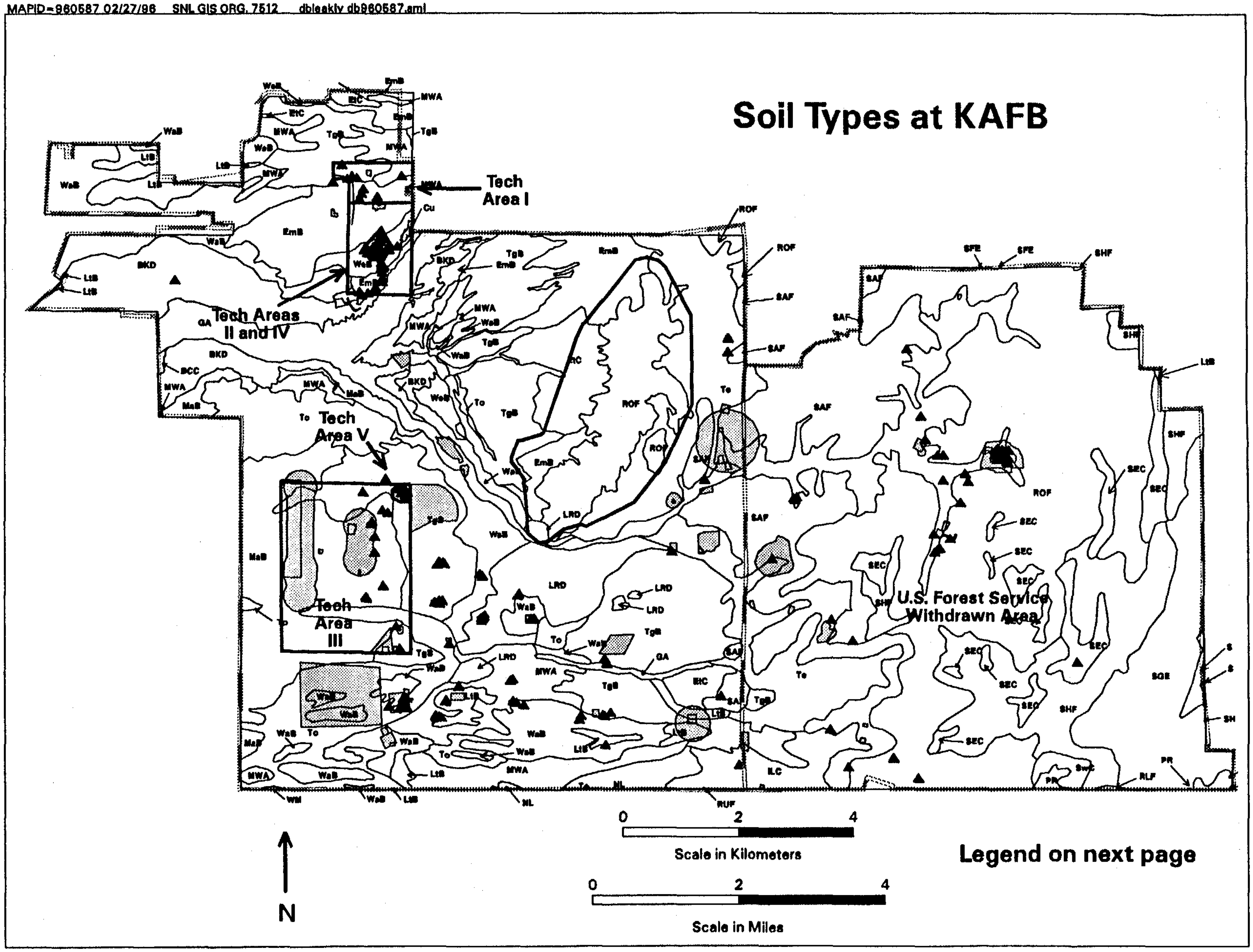

Figure 3-6
Soil Types at Kirtland Air Force Base

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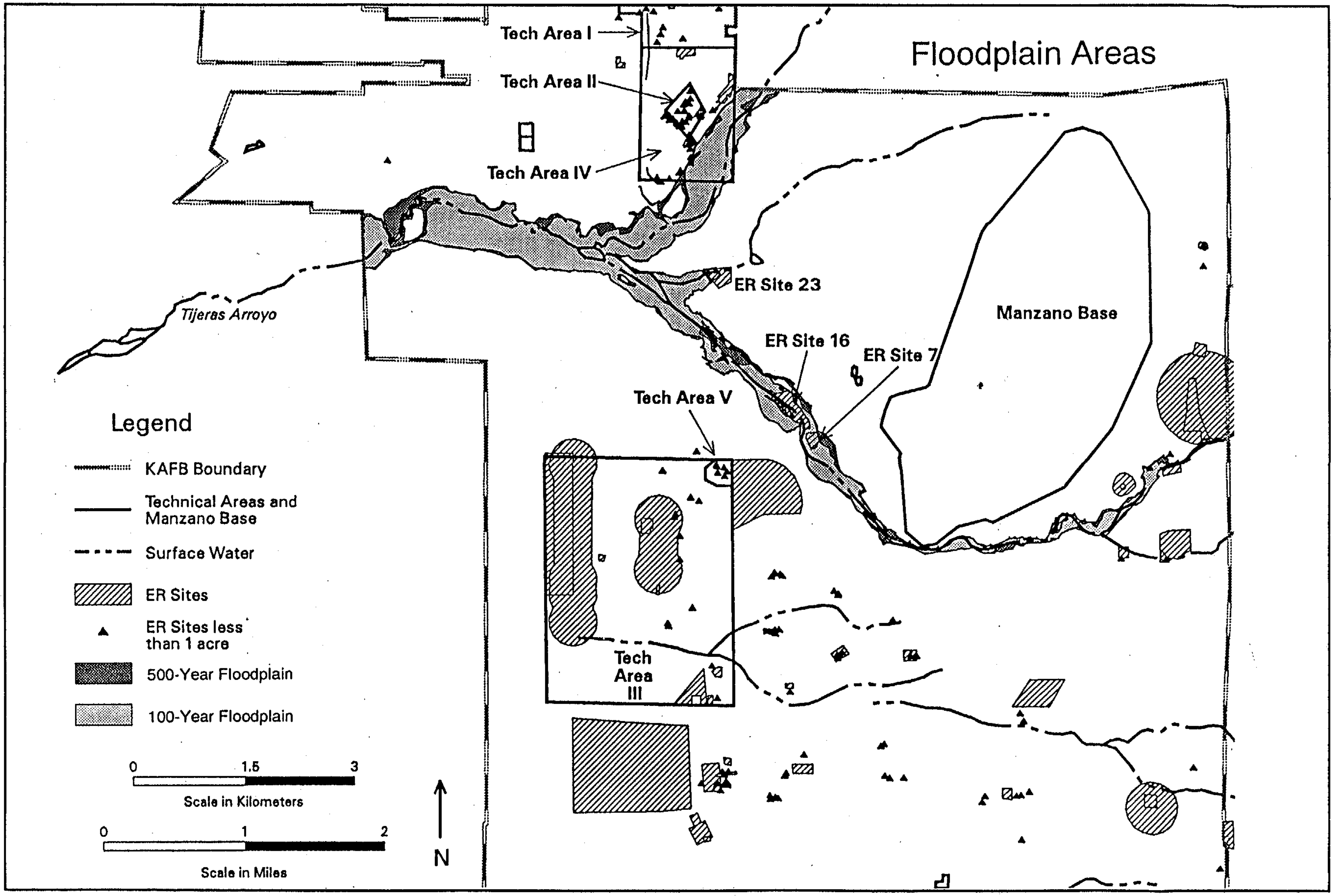
Soil Types Legend

(dotted line)	KAFB Boundary
(solid line)	Technical Areas and Manzano Base
(shaded box)	ER Sites
▲	ER Sites less than 1 acre
BCC	Bluepoint Loamy Fine Sand
BKD	Bluepoint-Kokan Association
Cu	Cut and Fill land
EmB	Embudo-Gravelly Fine Sandy Loam
EtC	Embudo Tijeras Complex
GA	Gila Fine Sandy loam
ILC	Ildefanso Gravelly Sandy Loam
LRD	Laporte-Rock Outcrops-Escalosa Complex
LTB	Latene Sandy Loam
MaB	Madurez Loamy Fine Sand
MWA	Madurez-Wink Association

NL	Nickel Latene Association
PR	Pino-Rock outcrop
RLF	Rock Outcrop-Laporte Complex
ROF	Rock Outcrop-Orthids Complex
RUF	Rock Outcrop-Ustolls Complex
SAF	Salas Complex
SEC	Seis-Very Cobbly Loam
SGE	Seis-Silver Complex
SHF	Seis-Complex
SwC	Silver and Witt Soils
Te	Tesajo-Millet Stony Sandy Loam
TgB	Tijeras Gravelly Fine Sandy Loam
To	Tome Very Fine Sandy Loam
WM	Wink-Madurez Association
WaB	Wink Fine Sandy Loam
WeB	Wink-Embudo Complex

Figure 3-6 (cont.)
Soil Types at Kirtland Air Force Base Legend



Reference: U.S. Corps Of Engineers, 1979. "Special Flood Hazard Information Tijeras Arroyo And Arroyo Del Coyote, KAFB, New Mexico," U.S. Corps of Engineers, Albuquerque, New Mexico.

Figure 3-7
Floodplain Areas

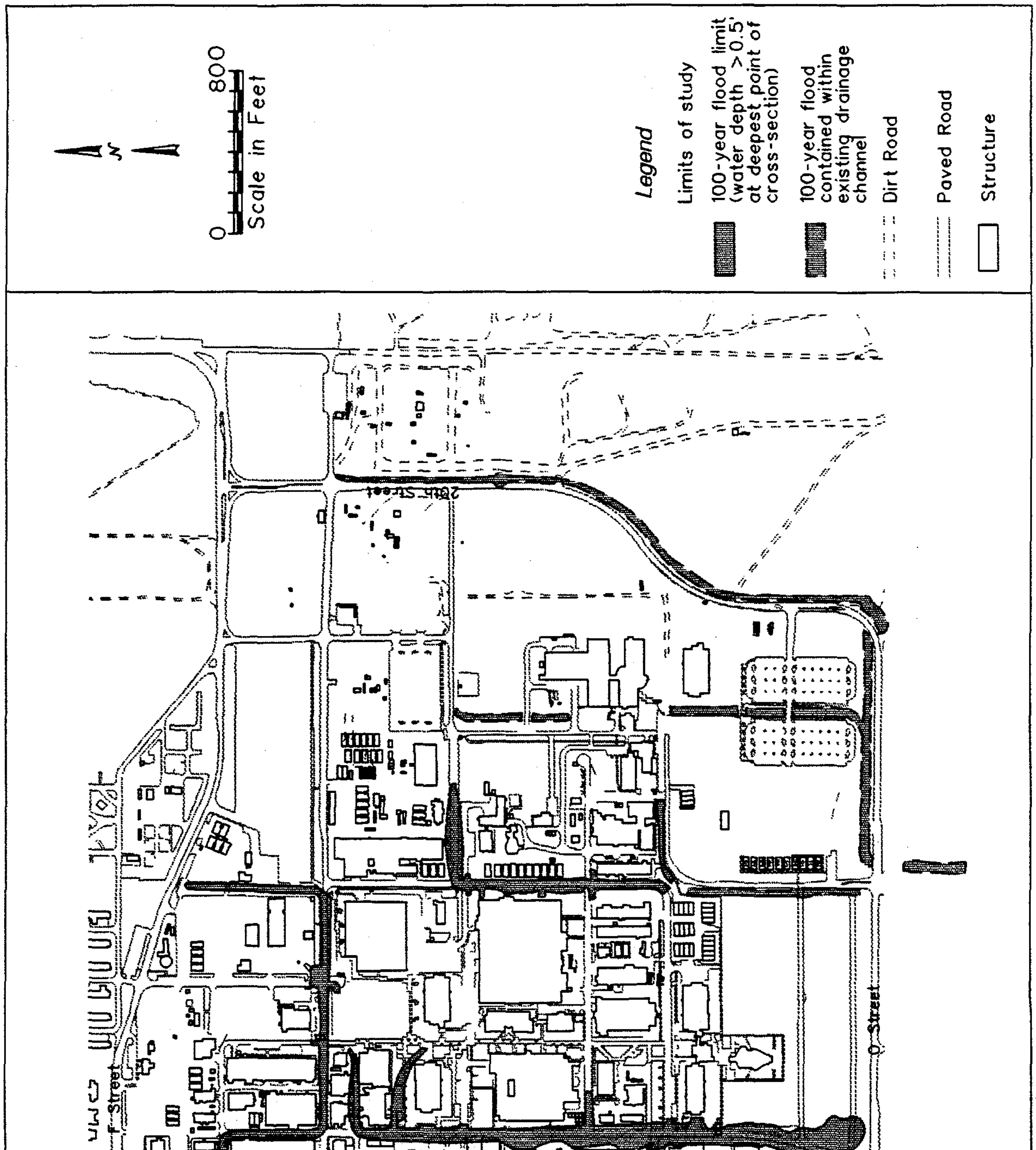


Figure 3-8
100-Year Flood Map of TA-I

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not run continuously (SNL/NM, 1993b). These springs are shown in Figure 3-9. Springs provide limited and localized wetland habitat. These springs are periodically monitored for radionuclides, primarily cesium-137 and tritium. Gross alpha and gross beta screening analyses are performed on water samples. The Metal Scrap (Coyote Springs) site (ER Site 21) is the ER Project site closest to a wetland habitat. SNL/NM has nonradiological surface-water monitoring programs in place for waste water, storm water, and surface discharges (Culp et al., 1995).

Discharges to surface impoundments resulting from operational activities at SNL/NM are permitted under authority of the New Mexico Water Quality Control Commission and are routinely monitored by SNL/NM. Sulphate, chloride, and total dissolved solids were reported at levels well below applicable water quality control commission standards. These discharges do not impact any ER Project site. Storm-water monitoring has been suspended pending approval of the storm-water discharge permit by the State of New Mexico.

3.4.2 Groundwater Hydrology

SNL/NM shares the same large unconfined aquifer that occupies the Albuquerque Basin. The faults described in Section 3.3.1 separate the regional water table into a somewhat deeper region west of the fault complex and a much shallower region on the eastern side. The depth to regional groundwater underlying SNL/NM facilities varies from 50 to 100 feet (15 to 31 meters) east of the faults and from 377 to 492 feet (115 to 150 meters) west of the faults (SNL/NM, 1991). Most SNL/NM facilities are located west of the fault system in an area of deeper regional groundwater. At KAFB and vicinity, the capacity of the regional aquifer to transmit groundwater is estimated at about 1.6 square feet (0.15 square meters) per second (SAIC, 1985).

ER Project assessment activities have identified a shallow water-bearing zone beneath Tech Area II at approximately 300 feet (91 meters) below ground surface (about 200 feet [61 meters] above the regional aquifer). The full extent of this shallow water-bearing zone has not been identified. Intermittent saturated conditions may exist from the shallow water-bearing zone down to the regional aquifer.

The apparent direction of groundwater flow west of the fault complex is generally to the west and northwest (Culp et al., 1995). Regional groundwater has been reported to move generally from north to south, east of the fault complex (at a depth of above 4,200 feet [1,280 meters]), while deep zone groundwater (below 4,920 feet [1,500 meters]), moves from the northwest to the east and southeast (Kues 1986). The direction of groundwater flow reported by Bjorklund and Maxwell (1961) is southwesterly. These differences are attributed to the influence of KAFB and nearby City of Albuquerque production wells (Culp et al., 1995). The gradient of the shallow water bearing zone identified beneath Tech Area II is generally to the southeast.

The unconfined regional aquifer under SNL/NM is recharged primarily by inflow from the mountains to the east. Recharge is nearly nonexistent due to high evaportranspiration, low

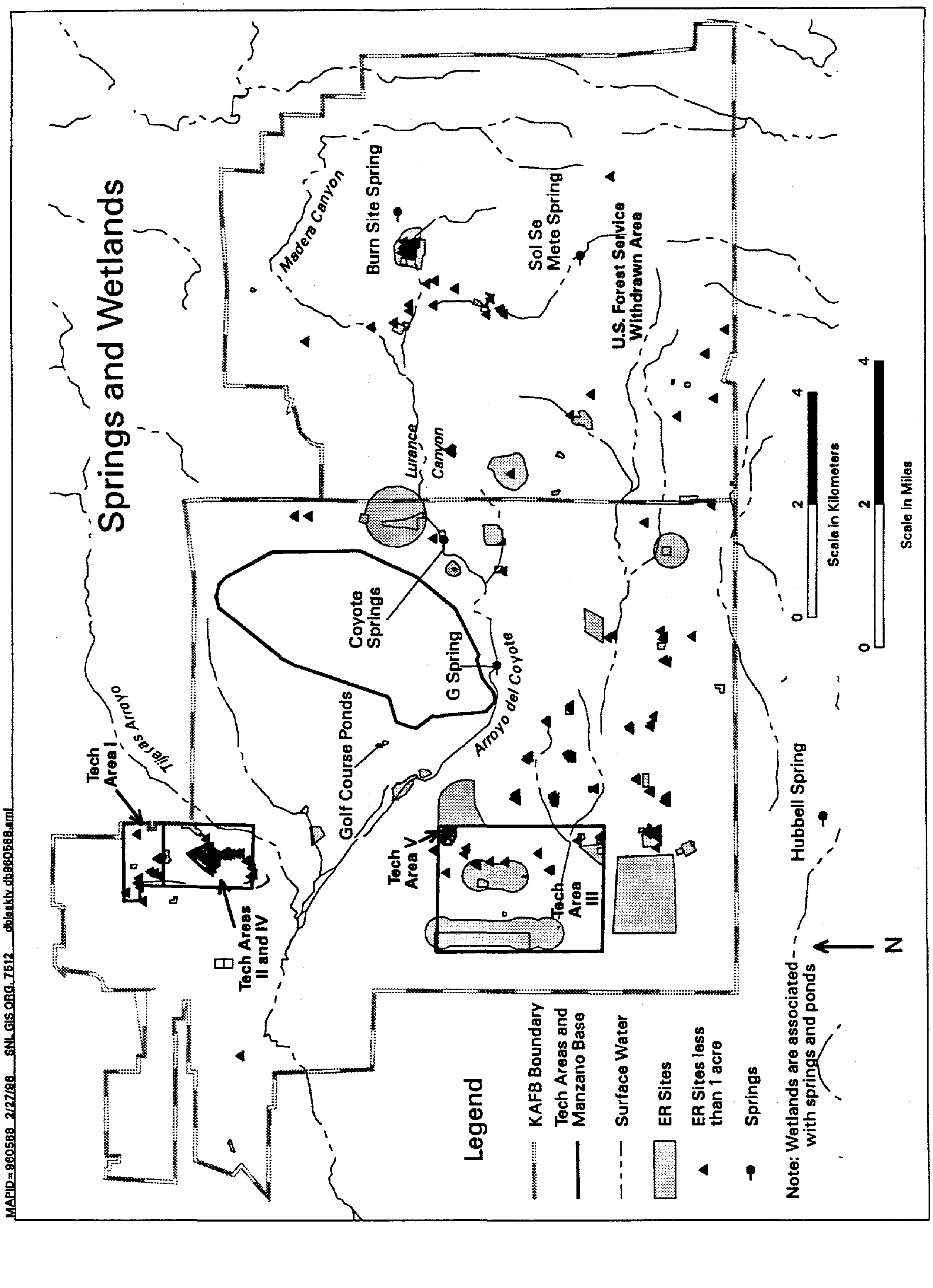

Figure 3-9
Springs and Wetlands

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precipitation, and an extensive vadose zone. Moisture that falls in the form of rain or snowmelt flows into small channels that feed the Tijeras Arroyo and the Rio Grande. The significance of the Tijeras Arroyo as a source of recharge to the shallow groundwater zone remains undetermined (Kues, 1986).

Albuquerque obtains all of its drinking water from groundwater. Economic growth in the past 30 years and consequent increased water pumping from KAFB and the city's deep municipal supply wells have significantly altered the saturated groundwater flow direction and water level in the vicinity of SNL/NM (SNL/NM, 1991). Over 1.6 billion gallons (6.1 billion liters) of water are pumped from the KAFB production wells annually (Culp et al., 1995). By the year 2000, the water table is expected to undergo considerable decline east of the Rio Grande (COE, 1979). The greatest decline would occur in the southeastern Albuquerque greater urban area, where the water table is expected to fall as much as 120 feet (37 meters) below the original predevelopment level (COE, 1979).

3.5 Air Quality

Ambient air quality is regulated by the Albuquerque Environmental Health Department Air Pollution Control Division, which also monitors compliance with federal and state air quality regulations. The Air Pollution Control Division under the Albuquerque Environmental Health Department has established several ambient air sampling stations throughout the city to monitor total suspended particulates, ozone, particulate matter, carbon monoxide, and nitrous oxide. Sulfur dioxide and VOCs are also regulated by the Division. Station 2ZN, located at 6000 Anderson SE, 2 miles (3 km) northwest of SNL/NM, is the closest ambient air-monitoring station to SNL/NM.

In 1993, an inventory of air emission sources was performed and reported in the 1993 Site Environmental Report (Culp et al., 1994), which was used as the basis for describing the emission sources and their impacts to air quality in the vicinity of the ER Project sites.

3.5.1 Nonradiological Airborne Emissions

Five steam boilers were operated by SNL/NM during 1993. They were the major source of criteria pollutant emissions for the site. A very small contribution was also emitted from an emergency generator plant (less than 1 percent by weight of total boiler sources). The estimated total emissions from the boiler plants are as follows (Culp et al., 1994):

- Nitrous oxide—155.1 tons (140,700 kilograms [kg]) per year.
- Carbon monoxide—16.2 tons (14,700 kg) per year.
- Particulate matter of 10 microns or less in diameter—3.9 tons (3,500 kg) per year.

- Sulfur dioxide—0.3 ton (300 kg) per year.
- Total organic carbon—1.6 tons (1,500 kg) per year.

The only airborne pollutant for which Albuquerque is a "nonattainment area" for the National Ambient Air Quality Standards (NAAQS) is carbon monoxide. However, the city recently became eligible for "attainment" status for this pollutant. To date, the monitored pollutants have not been recorded as exceeding acceptable levels at the station nearest to SNL/NM (Culp et al., 1994).

A preliminary inventory showed that SNL/NM, as a whole, has used a wide variety of chemicals listed in the Clean Air Act Amendments of 1990 (Culp et al., 1994).

Individual emission inventories for specific chemicals have been compiled annually. In 1991, the inventory data were used to evaluate the impact of emissions on local ambient air (excluding radionuclides) from sources within Tech Area I. These emission inventories were evaluated for compliance with applicable air-quality standards by modeling their wind dispersion to site boundaries. The meteorological data were used from the Albuquerque International Airport adjacent to KAFB. These results, as well as monitoring results, were published in the 1992 Environmental Monitoring Report for Sandia National Laboratories, Albuquerque, New Mexico. Pollutant concentrations measured during the 1992 sampling study were considerably lower than any federal, state, or local ambient air quality standards or health-based significance levels (Radian Corporation, 1992).

3.5.2 Airborne Radiological Emissions

Few facilities within SNL/NM routinely generate radioactive emissions. Most facilities that do so are within Tech Area IV and Tech Area V. Facility releases from stacks or vent exhausts occur as the result of operational activities within the SNL/NM facility. In addition, diffuse releases from the Mixed Waste Landfill (ER Site 76) occur in the form of tritium gas. The radiation sources are in Tech Area II, Tech Area III, Tech Area IV, Tech Area V, with some small sources in Tech Area I. In 1993, a total of 3.2 curies (Ci) of argon-41; 0.62 Ci of nitrogen-13; 0.012 Ci of oxygen-15; and 0.294 Ci of tritium as well as other very small quantities of gaseous activation and gaseous fission products and minute quantities of depleted uranium and its decay products were released into the atmosphere (Culp et al., 1994).

The EPA CAP 88 air dispersion modeling code was used to calculate resulting radiation effective dose equivalent for the maximally exposed individual at public access locations. The cumulative radiation dose at each receptor location was calculated to be well below the effective dose equivalent limit of 10 millirem (mrem) per year imposed by EPA in 40 CFR 61 (Culp et al., 1994).

3.6 Biological Resources

A key element in an environmental assessment is the consideration of potential impacts that the proposed actions would have on biological resources, especially on populations of sensitive species. This section describes the biological resources at KAFB and summarizes the documented presence of sensitive species and key habitat areas at ER Project sites located within the KAFB boundaries.

3.6.1 Habitats and Biotic Communities of KAFB

KAFB is divisible into four main habitat types based on physiographic setting. The western half is dominated by a mesa-surface habitat on shallow to nearly level slopes and fine-grained alluvial soils and an arroyo habitat along drainages. The eastern half is dominated by mountain habitat (specifically, the western slopes of the Manzanita Mountains) typified by steep slopes and coarse, rocky soils, and a canyon habitat along drainages between slopes. Although surface-water flows in these drainages are ephemeral and typically exist for only a brief time after intense rainfall events, permanent and semipermanent surface water does occur at a few scattered springs along these drainages. The largest of these is Coyote Springs.

Biogeographically, KAFB is located at the juncture of four major North American biotic provinces: the Great Basin, the Rocky Mountains, the Great Plains, and the Chihuahuan Desert. The influence of each of these is seen at SNL/NM. Based on the Brown (1982) hierarchical system for the classification of biomes in the southwestern United States, each of the four habitat types of KAFB contains a distinctive vegetation formation. Riparian woodland and riparian scrubland are limited to arroyos and canyons; grasslands and woodlands dominate the rest of the area. Figure 3-10 shows the areal extent of these vegetation types.

3.6.2 Threatened, Endangered, and Sensitive Species and Habitats

Under the provisions of the Endangered Species Act of 1973 (16 United States Code §§1531 et seq.), the U.S. Fish and Wildlife Service (USFWS) has the authority to protect species and subspecies of wildlife and plants from threats to their continued existence. The USFWS regulations in 50 CFR 17 contain a list of endangered and threatened species and their critical habitats. The federal definition of an endangered species is any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The USFWS also identifies species that are candidates for possible listing.

The State of New Mexico also provides statutory protection to plant and animal species threatened with extinction or local losses. Under the New Mexico Wildlife Conservation Act (§17-2-41 New Mexico Statutes Authority, as amended in 1978 [NMSA]), the New Mexico Department of Game and Fish is given authority to list endangered species of wildlife. Two

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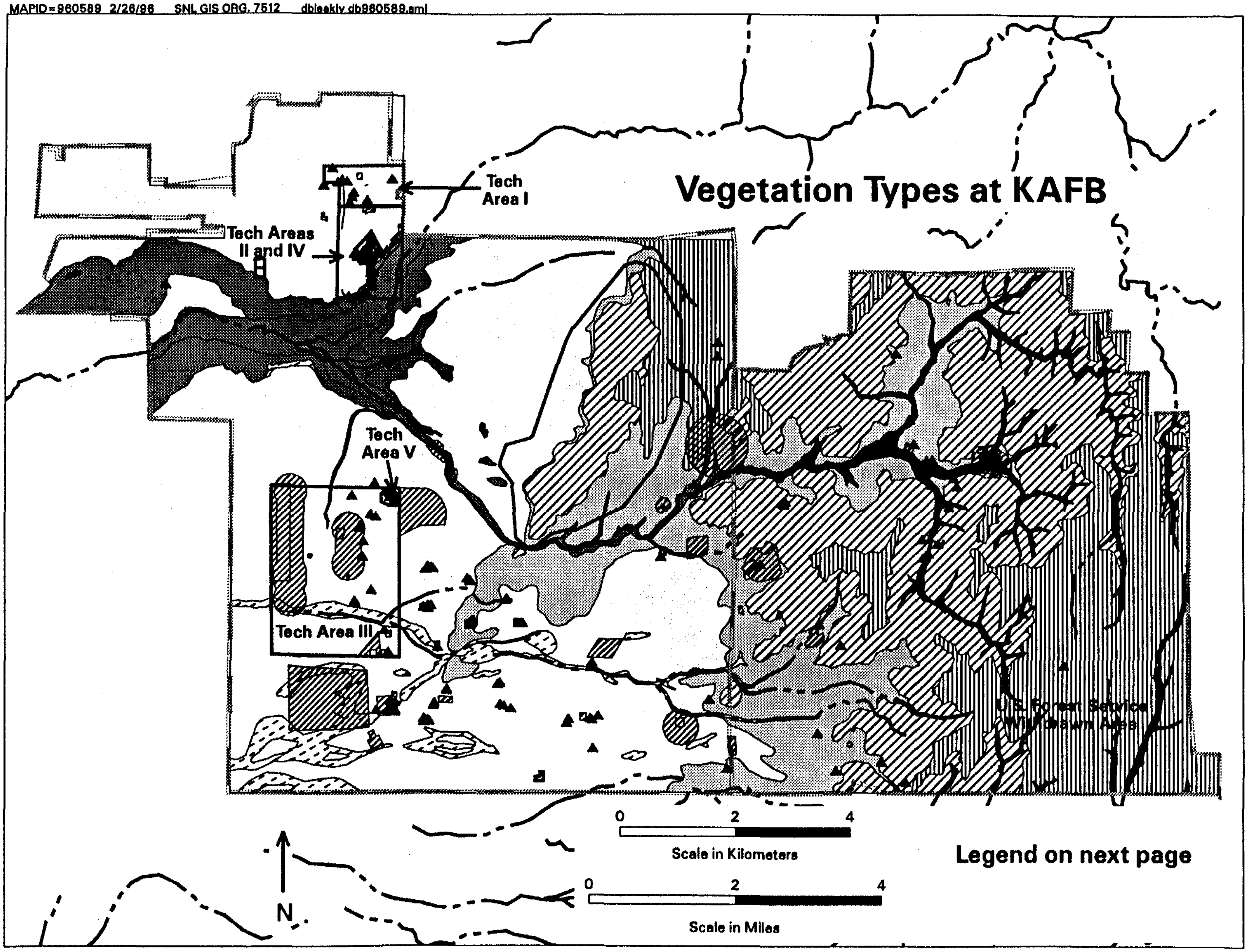

Figure 3-10
Vegetation Types at Kirtland Air Force Base

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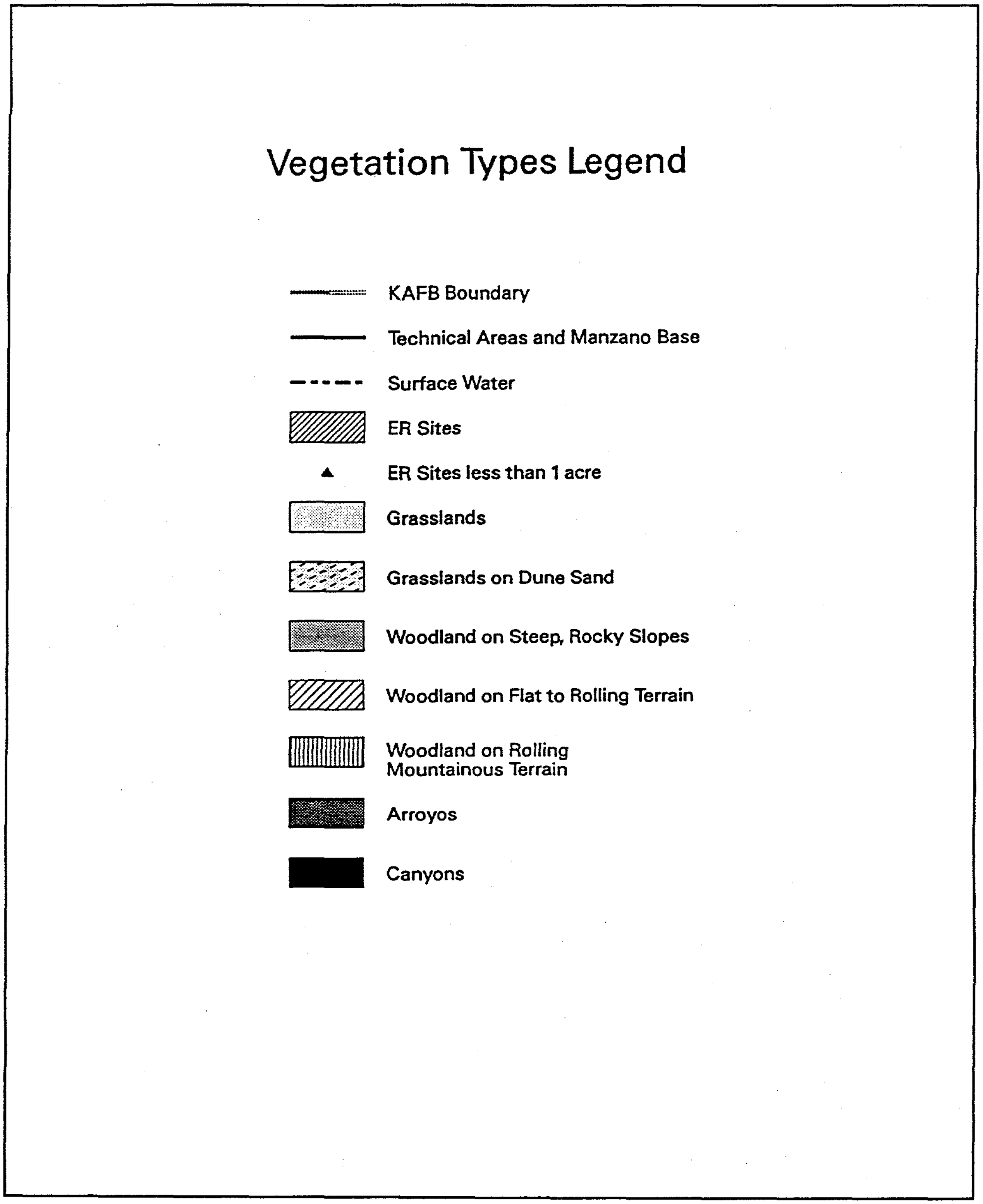

Figure 3-10 (Continued)
Vegetation Types at Kirtland Air Force Base Legend

categories for listing under Regulation No. 657 are used: Endangered Group I, equivalent to the federal endangered list, is species or subspecies whose prospects of survival or recruitment in New Mexico are in jeopardy. Endangered Group 2, equivalent to the federal threatened list, is species or subspecies whose prospects of survival or recruitment in New Mexico are likely to be in jeopardy within the foreseeable future.

- The New Mexico Forestry and Resource Conservation Division of the Department of Energy, Minerals, and Natural Resources designates four categories of plants that are provided protection under §§9-10-5 and 9-10-10 of the NMSA. These four categories are:List 1, federally listed threatened and endangered plant species present in New Mexico.
- List 2, New Mexico rare and sensitive plant species.
- List 3, New Mexico plant review list.
- List 4, plant species dropped from further consideration.

Although only the plant species on List I are given legal protection on State lands and rights-of-way, plant species on Lists 1, 2, and 3 should be considered "sensitive" wherever they occur.

Field surveys of sensitive species and habitats were conducted between March and October 1994 (IT Corporation, 1995). Table 3-2 lists the New Mexico and federally sensitive plant species potentially occurring on KAFB. Table 3-3 lists the New Mexico and federally sensitive wildlife species. Table 3-4 identifies sensitive habitats (flood plains) associated with ER Project sites. The results of site-specific sensitive species surveys for the ER Project are summarized in Table 3-5.

Three New Mexico-listed endangered cacti occur within KAFB: the grama grass cactus (*Pediocactus papyracanthus*), the Wright's pincushion (*Mammillaria wrightii*), and the white visnagita (*Neolloydia intertexta*). The first is found in grassland and open woodland habitats; the latter two exist primarily in woodland habitats. The State of New Mexico has listed (on List 2) the Santa Fe milk vetch (*Astragalus feensis*) as rare or sensitive; this species has been recorded on KAFB. New Mexico rare and sensitive plants (List 2) are not afforded legal protection but are monitored for possible elevation to the federally listed endangered plant list (List 1).

KAFB contains no federally designated critical habitat, as defined under the Endangered Species Act. The most sensitive habitat at KAFB are the wetlands and canyons, which are moister habitats with a greater plant and animal diversity. These areas include ER Project sites located in floodplains and sites having permanent or intermittent surface water sources. ER Project sites located on flood plains are designated on Table 3-4 and in Figure 3-7 and Figure 3-8. The three most significant natural wetland sites remaining on KAFB are Coyote Springs, Sol se Mete Spring, and G Spring (see Figure 3-9). Although the springs are reverting to more natural wetland conditions, the proximity to a major roadway and its easy accessibility for human use would limit the extent to which natural wetland conditions would

Table 3-2
Sensitive Plant Species Potentially Occurring on Kirtland Air Force Base (KAFB), New Mexico

Common Name	Scientific Name	Status*	Comments
Cyanic milk vetch	*Astragalus cyaneus*	L2	Known from Bernalillo County but not recorded on KAFB
Santa Fe milk vetch	*Astragalus feensis*	L2	Known to occur on KAFB
Wright's pincushion cactus	*Mammillaria wrightii* (Englm.)	L1	Known to occur on KAFB
White visnagita cactus	*Neolloydia intertexta* (Englm.)	L1	Known to occur on KAFB
Strong prickly pear	*Opuntia valida*	L3	Status as a species uncertain; known from Bernalillo County but not recorded on KAFB
Grama grass cactus	*Pediocactus* (*Toumeya*) *papyracanthus* (Englm.)	L1, C2, FSS	Known from KAFB
Simpson's cactus	*Pediocactus simpsonii* (Englm.)	L1	Known from Bernalillo County but not recorded on KAFB
Plank's catchfly	*Silene plankii*	L2, 3C	Known from Bernalillo County but not recorded on KAFB
Great Plains lady tresses	*Spiranthes magnicamporum*	L1	Known from Bernalillo County but not recorded on KAFB

*Status codes:
- L1 = New Mexico Forestry and Resource Conservation Division List 1 (Endangered)
- L2 = New Mexico Forestry and Resource Conservation Division List 2 (Rare or Sensitive)
- L3 = New Mexico Forestry and Resource Conservation Division List 3 (Under Review)
- C2 = U.S. Fish and Wildlife Service candidate species
- 3C = U.S. Fish and Wildlife Service dropped from review list
- FSS = U.S. Forest Service sensitive species

References:
IT Corporation (IT), 1995. "Sensitive Species Results, Environmental Restoration Project, Sandia National Laboratories/New Mexico," prepared for Sandia National Laboratories, Albuquerque, New Mexico.

Sivinski, R., and K. Lightfoot, 1992. Inventory of Rare and Endangered Plants of New Mexico, New Mexico Forestry and Resource Conservation Division; Energy, Minerals, and Natural Resources Department, Santa Fe, New Mexico

Table 3-3
Sensitive Wildlife Species Potentially Occurring on Kirtland Air Force Base (KAFB), New Mexico

Common Name	Scientific Name	Status*	Comments
Reptiles			
Texas horned lizard	*Phrynosoma cornutum*	C2	Known to occur on KAFB
Birds			
"Apache" northern goshawk	*Accipiter gentilis apache*	C2	Migrant; known from Bernalillo County but not recorded on KAFB
Ferruginous hawk	*Buteo regalis*	C2	Known from Bernalillo County but not recorded on KAFB
Peregrine falcon	*Falco peregrinus*	FE, G1	Known from Bernalillo County but not recorded on KAFB
Mexican spotted owl	*Strix occidentalis lucida*	FT, G2	Not known from KAFB
Southwestern willow flycatcher	*Empidonax traillii extimus*	C1, G2	Known from Bernalillo County but not recorded on KAFB
Gray vireo	*Vireo vicinior*	G2	Known to occur on KAFB
Baird's sparrow	*Ammodramus bairdii*	G2	Known from Bernalillo County but not recorded on KAFB
Mammals			
Spotted bat	*Euderma maculatum*	C2, G2	Known from Bernalillo County but not recorded on KAFB
Greater western mastiff bat	*Eumops perotis californicus*	C2	Known from Bernalillo County but not recorded on KAFB
Occult little brown bat	*Myotis lucifugus occultus*	C2	Known from Bernalillo County but not recorded on KAFB
Black-footed ferret	*Mustela nigripes*	FE	No recent records from New Mexico
"New Mexican" meadow jumping mouse	*Zapus hudsonius luteus*	C2, G2	Known from Bernalillo County but not recorded on KAFB

*Status codes:
- FE = Federally listed as endangered
- FT = Federally listed as threatened
- C1 = U.S. Fish and Wildlife Service candidate species
- C2 = U.S. Fish and Wildlife Service candidate species
- G1 = New Mexico Department of Game and Fish Endangered Group 1
- G2 = New Mexico Department of Game and Fish Endangered Group 2

References:
IT Corporation (IT), 1995. "Sensitive Species Results, Environmental Restoration Project, Sandia National Laboratories/New Mexico," prepared for Sandia National Laboratories, Albuquerque, New Mexico.

New Mexico Department of Game and Fish, no date. Handbook of Species Endangered in New Mexico, New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Sullivan, R.M., 1994. "Biological Investigations of the Sandia National Laboratories Sol Se Mete Aerial Cable Facility," Contractor Report SAND 93-7093, Sandia National Laboratories, Albuquerque, New Mexico.

Sullivan, R.M., and P.J. Knight, 1994. "Biological Surveys for the Sandia National Laboratories Coyote Canyon Test Complex—Kirtland Air Force Base, Albuquerque, New Mexico," Contractor Report SAND 93-7089, Sandia National Laboratories, Albuquerque, New Mexico.

Table 3-4
Environmental Restoration Project Sites Located on Floodplains, Sandia National Laboratories/New Mexico

ER Site Number	ER Site Name	In Arroyo Floodplain[a]	Straddling Canyon Channel
7	Gas Cylinder Disposal	X[b]	
8	Open Dump		X
9	Burial Site/Open Dump	X[c]	
12	Burial Site/Open Dump (Burn Site)		X
15	Trash Pits (Frustration Site)		X
16	Open Dumps	X[b]	
21	Metal Scrap (Coyote Springs)	X[b]	
23	Disposal Trenches	X[b]	
27	Building 9820 (Animal Disposal Pit)		X
49	Building 9820 drains		X
58	Coyote Canyon Blast Area	X[c]	
59	Pendulum Site		X
62	Graystone Manor Site	X[b]	
65	Lurance Canyon Explosive Test Site		X
71	Moonlight Shot Area	X[b]	
81	New Aerial Cable Site		X
82	Old Aerial Cable Site Scrap		X
87	Building 9990 (Firing Site)		X
147	Building 9925 drain	X[c]	

[a]Arroyo floodplain is a habitat description and does not coincide with the designated 100-year floodplain.
[b]Proposed no further action site
[c]Not in 100-year floodplain.

References:

IT Corporation, 1995. "Sensitive Species Survey Results, Environmental Restoration Project, Sandia National Laboratories/ New Mexico," prepared for Sandia National Laboratories/ New Mexico, Albuquerque, New Mexico.

Table 3-5

Priority Classification[a] of Sensitive Species on Environmental Restoration Project Sites, Sandia National Laboratories/New Mexico

Site Number	Site Name	Grama Grass Cactus[b]	Wright's Pincushion[c]	Visnagita Cactus[d]
8	Open Dump	4	2	4
9	Burial Site/Open Dump	2	2	1
10	Burial Mounds (north of Pendulum)	4	3	3
15	Trash Pits (Frustration Site)	4	3	1
19	TRUPAK Boneyard Storage Area	4	2	4
26	Burial Site	2	4	4
27	Building 9820 (Animal Disposal Pit)	4	3	2
47	Unmanned Seismic Observatory	2	3	3
49	Building 9820 drain	4	2	4
54	Pickax Site	2[e]	4	4
58	Coyote Canyon Blast Area	1	2	1
59	Pendulum Site	4	3	2
60	Bunker Area (north of Pendulum)	4	3	3
62	Graystone Manor Site	2	2	4
66	Boxcar Site	3	2	1
67	Frustration Site	4	3	2
71	Moonlight Shot Area	2	4	4
82	Old Aerial Cable Site Scrap	4	3	2
83	Long Sled Track	1	4	4
87	Building 9990 (Firing Site)	4	3	1
92	Pressure Vessel Test Site	4	2	2
107	Explosive Test Area	2	4	4

[a]Priority classes are as follows:

- Priority 1—Survey results show that the species occurs in vigorous populations at the site.
- Priority 2—Survey results show that only scattered individuals of the species are present, indicating adequate habitat conditions exist to support the species.
- Priority 3—Survey results did not find the species present at the site, although observed habitat conditions are favorable to the species.
- Priority 4—The habitat is not favorable to the species, and none were observed during the site surveys.

[b]*Pediocactus papyracanthus*, State-listed endangered (List 1, New Mexico Forestry and Resource Division [Endangered]); Federal candidate (C2)
[c]*Mammillaria wrightii*, State-listed endangered (List 1)
[d]*Neolloydia intertexta*, State-listed endangered (List 1)
[e]A small area of Priority 1 habitat occurs in the western part of this large site.

References:
IT Corporation, 1995. "Sensitive Species Survey Results, Environmental Restoration Project, Sandia National Laboratories, New Mexico," prepared for Sandia National Laboratories/New Mexico, Albuquerque, New Mexico.

develop through the process of natural succession. Sol se Mete Spring, which is much smaller than Coyote Springs and has been altered by the construction of a stone tub, is more isolated from human activity and generally represents more natural wetland conditions. Little information is available on the ecology of G Spring. With the exception of the growth of an exotic species at this site, the salt cedar (*Tamarix* spp.), G Spring is the most pristine wetland site within KAFB.

Some artificial ponds provide wetland-like habitat to wildlife, although they are within developed areas. Lake Christian is a 2-acre (0.8-hectare) permanent pond adjacent to a KAFB testing facility 1 mile (2 km) northeast of the Inhalation Toxicology Research Institute. Permanent ponds are also found on the golf course 1 mile (2 km) southeast of Tech Area IV. Open ponds may be used by migratory waterfowl in the spring and fall.

The more heavily wooded, undisturbed canyons and their adjacent slopes are also considered highly sensitive wildlife habitat (Biggs, 1991). This classification is based on the quality of the habitat for travel corridors, bedding areas, wintering areas, and foraging areas for large mammals, such as mule deer (*odocoileus hemionus*). Table 3-4 identifies sensitive habitats associated with ER Project sites.

3.7 Cultural Resources

A cultural resources inventory was completed. It included a 100-percent walk-over survey, conducted in 1994, of all ER Project sites on DOE, KAFB, and USFS lands that had not been surveyed since 1988 and of ER Sites 238 and 239, which had never been surveyed. Approximately 1,400 acres (570 hectares) were surveyed or resurveyed. As a result of this and previous surveys, 32 prehistoric sites, 24 historic sites, 5 prehistoric/historic sites, and 1 site of unknown temporal affiliation have been recorded with the State of New Mexico Historic Preservation Division within lands designated as ER Project sites. Thirty-one prehistoric sites, possibly seventeen historic sites, and five prehistoric/historic sites are candidates for inclusion in the NRHP. The NRHP status of one other site is unknown, although it may qualify for NRHP inclusion as well.

Specific cultural resources associated with individual sites are detailed in a cultural resource report made available to the SHPO for their review (Hoagland and Dello-Russo, 1995). This information is protected from public release to control access to cultural resources.

Archaeological sites recorded during the 1994 survey fall into the following cultural periods:

- Archaic sites (3).
- Puebloan/archaic sites (6).
- Puebloan sites (23).
- Puebloan/historic sites (4).

- Puebloan/historic/PaleoIndian sites (1).
- Historic sites (24).
- Sites of unknown temporal affiliation (1).

One hundred fifty-six isolated occurrences were also recorded.

3.8 Noise

Noise sources in the vicinity of SNL/NM can be categorized into two major groups: transportation and stationary-type sources. Transportation sources include aircraft, motor vehicles, and rail operations. Stationary noise sources are those that either do not move or move relatively short distances; at SNL/NM, they include sources such as ventilation systems, air compressors, generators, power transformers, and earth-moving equipment. Construction and industrial-type stationary sources are concentrated mostly near the different tech areas.

Aircraft operations are the most pervasive type of noise found at SNL/NM. Albuquerque International Airport is located due west of SNL/NM. The major east/west runways are adjacent to SNL/NM, and the flight lines pass directly over the site. In addition, KAFB is located on the same property as SNL/NM and uses the airport runways for its operations. Although aircraft noise is the dominant source type, it is also a periodic source, with maximum noise levels associated with take-off and landing.

Highway motor vehicle noise is also prevalent at SNL/NM. On-site traffic as well as traffic on nearby roadways and major highways contribute to the overall noise levels at SNL/NM. The fluctuation of highway noise (over long periods of time) is associated with the time of day in which peak and off-peak traffic occurs. Noise monitoring studies have been conducted on both SNL/NM property and in surrounding areas (Greiner, Inc., 1990; IT Corporation, 1990).

Existing noise level ranges for several areas of SNL/NM have been estimated for the northern section of SNL/NM near Tech Area I, Tech Area II, and Tech Area IV east of the airport east/west runway. According to the monitoring data, the overall noise-level range for the northern section of SNL/NM is 54 to 102 decibels (dBA). Although noise-monitoring data are not available for other areas of SNL/NM, the overall noise level range of 54 to 102 dBA may be considered representative of SNL/NM property.

3.9 Socioeconomics

The population of Bernalillo County, according to the 1992 preliminary census, grew 0.96 percent since 1990, to 499,262, with the Albuquerque city population being 398,492 (Boatman's Sunwest, Inc., 1994). From 1970 to 1980, New Mexico's population grew 28.1 percent. Much of the growth in the 1970s resulted from relatively strong economic expansion, which attracted migrants to the state. Generally, weaker economic conditions in the 1980s lead to decline in growth through emigration, contributing to a considerably smaller

16.2 percent population increase. Growth rates in the 1980s were highest within the metropolitan counties, such as Bernalillo County where SNL/NM is located.

Two major interstate highways meet in the center of Albuquerque: Interstate-40 (I-40), which runs east-west, and Interstate 25 (I-25), which runs north-south. I-40 is approximately 1.5 miles (2.4 km) north of SNL/NM and I-25 is approximately 3 miles (5 km) west. Approximately 129,440 cars a day travel I-25 south of I-40, making this area the most traveled stretch of road in New Mexico. Albuquerque International Airport, immediately adjacent to KAFB, served 5,613,275 passengers in 1993 (Boatman's Sunwest, Inc., 1994).

As a major employer in New Mexico, SNL/NM has a major economic and social impact on the state and, in particular, on the Albuquerque metropolitan area. SNL/NM, the fifth largest employer in New Mexico, employs approximately 7,455 people at several New Mexico locations. In addition, approximately 2,998 retirees reside in New Mexico.

SNL/NM direct expenditures of $392 million for wages and salaries generated $1.1 billion of personal income in the state (Lansford et al., 1995). Actual SNL/NM in-state expenditures were $849 million in FY 1992 and $950 million in FY 1993 for salaries and wages, materials and services, capital equipment, and construction (Adcock et al., 1993). The 1992 direct spending in New Mexico of $849 million was equivalent to slightly over $500 for each resident. SNL/NM funding accounted for about 14 percent of all federal expenditures in New Mexico.

SNL/NM out-of-state purchases and salaries for those living elsewhere amounted to $551 million in 1992. By far, the largest expenditure was on labor, which was almost 57 percent of the total state expenditures, or nearly 34 percent of total operating and capital budget for FY 1992. Another 30 percent ($257 million) was spent locally for trade, services, and utilities, while 1.7 percent ($14.5 million) was spent on manufactured goods. Construction accounted for about 4 percent ($34 million). State and local taxes and government fees accounted for 6.7 percent of the $849 million in local expenditures (Adcock et al., 1992).

3.9.1 Demographics

Albuquerque, the largest population center in Bernalillo County, is the population center closest to KAFB. Tech Area I, in the northeast portion of the facility, is located approximately 1.5 miles (2.4 km) east of the Albuquerque city limits. An estimated total population of 571,677 people live within a 50-mile (80-km) radius of KAFB (DOC, 1992). This population includes permanent residents of KAFB living in the KAFB housing areas. Figure 3-11 shows residential areas within a 1-mile (2-km) radius of the KAFB boundary.

3.9.2 Environmental Justice

Executive Order 12898, titled "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" (issued February 1994) requires federal agencies to identify and appropriately address any disproportionately high and adverse human health or

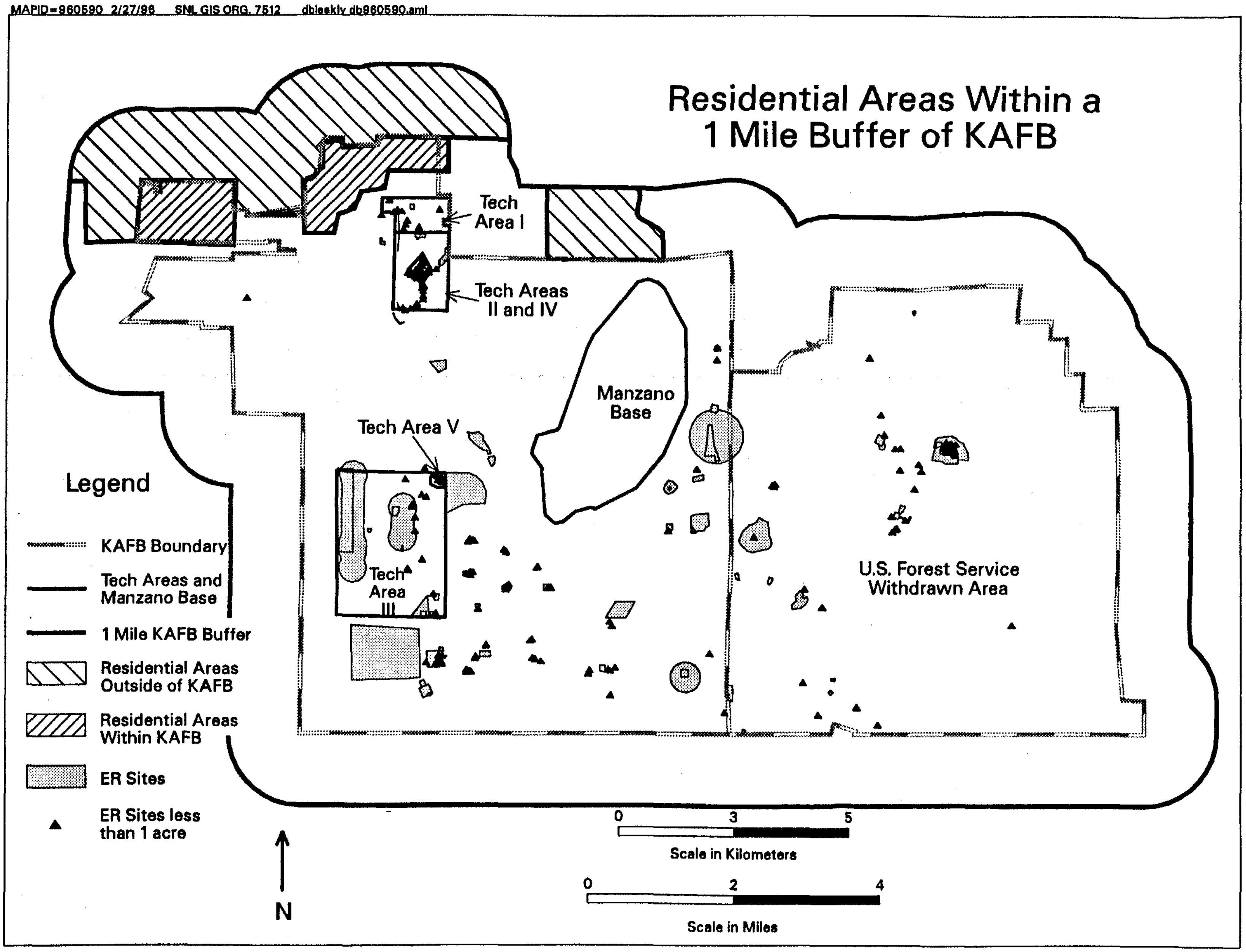

Figure 3-11
Residential Areas Within a 1-Mile Buffer of Kirtland Air Force Base

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environmental effects of their proposed actions on minority or low-income populations. Although environmental justice issues are broader than NEPA, they must be considered in preparation of NEPA documents. Specific DOE guidance for performing assessment of environmental justice issues in NEPA documents is still pending until EPA completes the federal "agency-wide environmental justice strategy."

An approach to assessing the requirements of environmental justice in a DOE NEPA document has been applied in DOE's "Draft Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste" (WM/PEIS) (DOE, 1995a), currently under review by the public. The WM/PEIS addresses all radioactive and hazardous waste management activities at all DOE facilities, including SNL/NM. This programmatic environmental impact statement provides assessment of the waste management aspects of the ER Project. Although the WM/PEIS does specifically address environmental justice considerations of waste management activities at SNL/NM, which include a major component of the ER Project, the document is still in draft form. Environmental justice considerations, therefore, are still discussed in this assessment.

Isleta Pueblo is immediately south of SNL/NM; its border is about 2 miles (3 km) from Tech Area III and 2.5 miles (4.0 km) from the Chemical Waste Landfill [ER Site 74]). The Pueblo property is about 200,000 acres (80,000 hectares) in size, and its 4,000-person population is clustered along the Rio Grande.

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4.0 ENVIRONMENTAL CONSEQUENCES

The major issues associated with the proposed action are public health and safety; occupational worker health and safety; cultural (archaeological and historic) resources; threatened, endangered, or sensitive species; and cumulative impacts. Although potential impacts of proposed corrective measures on other environmental parameters are also analyzed (e.g., land use and socioeconomic), they are believed to involve lesser environmental impacts.

An overview of the environmental effects associated with the proposed action and the no action alternative is provided in Table 4-1. A more detailed discussion of specific impacts related to proposed action options is provided in Section 4.1. A similar discussion of the no action alternative impacts is provided in Section 4.2. Section 4.3 summarizes the risk assessment assumptions and methods used to assess health impacts on humans and ecological receptors. The cumulative impacts associated with the incremental impacts of the proposed action are discussed in Section 4.4.

Based on estimates of the areal extent of the ER Project sites in Appendix A, Table A-2, the proposed action will affect no more than 1,100 acres (450 hectares), which is less than 1.6 percent of the 67,000 acres (27,000 hectares) of land area that comprise KAFB and the USFS Withdrawn lands.

4.1 Effects of Proposed Action

4.1.1 Land Use

Under the proposed action, several remediation options could potentially increase land-use possibilities (see Table 4-1). These remedial options include excavation activities, thermal treatment, in situ bioremediation, soil-washing/stabilization, decontamination, and off-site treatment and disposal. By removing contaminated soils and replacing them with clean backfill or by treating the contamination and returning treated soils to their original ER Project sites, the ER Project sites could qualify for a broader range of land uses. If a TU and/or CAMU is used, it would reduce the total contaminated area by confining contaminated media to one central locale for treatment. This would result in a greater range of land-use options for more sites. Land use at the TU and/or CAMU sites themselves would be limited to uses for which public access is controlled. Using capping and institutional controls may allow for limited public access for recreational purposes although completely unrestricted public access may not be possible.

Currently, the ER Project is proposing either recreational or industrial land uses for all ER Project sites, as recommended by the Kirtland Federal Complex and Logistics Support Working Team, a group responsible for addressing future-use designations for the entire KAFB installation. This is consistent with the existing land-use pattern, with industrial uses occurring primarily on DOE and USAF lands, and with recreational uses occurring on USFS lands. After 100 years of institutional control, other viable land-use scenarios (e.g., residential and commercial) may be considered by whatever regulatory authorities exist at that time.

Table 4-1
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil-Washing/ Stabilization	Carbon Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/Institutional Controls	NFA	No Action
Land Use	Land use options would increase when contamination has been removed and excavations have been properly backfilled.	Land use options would increase when treated clean soils are returned to ER Project sites of origin or disposed of at a CAMU.	Land use options would increase when treated clean soils are returned to ER Project sites of origin or disposed of at a CAMU.	Land use options would increase when debris is removed and [illegible]	The total area where contaminants are present would be reduced through consolidation; a greater range of land use options would become available for more sites. Land use at TU and/or CAMU site would be limited to uses where public access is controlled.	Land use options would increase when excavated contaminated soil has been removed off site and replaced with clean backfill.	Land use options would increase at sites where treatment has been completed.	Land use with unrestricted public access may be restricted at capped sites. Institutional controls could allow limited access for recreational purposes.	No effect. NFA sites would have demonstrated low risk levels.	Land use restricted to current uses or other industrial application and limited access.
Geology and Soils	Contaminated soils would be removed and replaced with clean backfill. Soil composition and texture could be altered. Some short-term soil erosion may occur during excavation.	Soils would be remediated. Soil composition and texture may be altered.	Soils would be remediated. Soil composition and texture may be altered.	No effect.	Soil disturbance and some short-term erosion would result from construction of the TU and/or CAMU.	Contaminated soils would be removed and replaced with clean backfill.	Soils would be remediated.	Soil composition and texture may be altered.	No effect. NFA sites would have demonstrated low risk levels.	Contaminated soils would remain in place.

Table 4-1 (Continued)
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil Washing/ Stabilization	Carbon Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Surface Water	Temporary erosion would increase from runoff. Possible local runoff would decrease, due to ponding.	No effect. Surface-water runoff controls would prevent migration of contaminants from treatment facility.	No effect. Surface-water runoff controls would prevent migration of contaminants from treatment facility.	No effect. Surface-water runoff controls would prevent migration of contaminants from treatment facility.	No effect. Surface-water runoff controls would be part of design to prevent migration of contaminants to surface water features (e.g., arroyos).	No effect. Contaminated soils would be shielded from moisture by being placed in metal containment boxes during transport.	No effect. The In situ bioremediation system would be designed to mitigate surface-water infiltration.	Capping would be designed to prevent surface-water runoff from contacting contaminated areas.	No effect. NFA sites would have demonstrated low risk levels.	Surface water could come into contact with contaminants.
Groundwater	Source removal would have beneficial effect.	Source removal would have beneficial effect.	Excavation for soil-washing would remove contaminant sources. Stabilization would have a beneficial effect.	Contaminant removal would have a beneficial effect.	No effect.	Source removal would have a beneficial effect.	Source removal would have a beneficial effect.	Capping would have a beneficial effect, reducing likelihood of contaminant migration into groundwater.	No effect. NFA sites would have demonstrated low risk levels.	Contaminants could potentially migrate downward into groundwater.
Air Quality	Possible impacts from dispersion of contaminants released from ER Project sites during dirt-moving. Impacts would be mitigated by use of fugitive dust controls, such as soil-wetting. Emissions from diesel engine combustion products would result. Emissions would be well below air quality control limits.	VOCs would be removed without release. Carbon monoxide release would be well below regulatory standards. VOCs available for release from contaminated sites would be destroyed.	Metals and radionuclides available for release, either by air emission or by airborne fugitive dust, would be removed and immobilized.	Removal of contaminants would prevent their release to air. Carbon dioxide blasting decontamination process would be carried out in enclosed space with air filters to eliminate emissions.	The TU and/or CAMU design would incorporate controls to mitigate potential air emissions; therefore operation of the TU and/or CAMU would have no effect. Construction of the TU and/or CAMU would have similar impacts as for excavation.	Transport vehicle engine emissions would result. Treatment emissions would be relocated to off-site location.	VOC contaminants would not be available for release from contaminated sites.	Contaminants could not be blown from the surface once it is capped. VOC emissions would be mitigated.	NFA designation would only be available for sites with low demonstrated health risks from exposure to contaminant emissions through air pathway.	Natural wind dispersion of contaminants could degrade air quality.

Table 4-1 (Continued)
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil-Washing/ Stabilization	Carbon Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Biologic Resources	Existing biota would be disturbed, moved, or possibly destroyed. Revegetation would be performed to mitigate habitat impacts.	After clean soils are returned to ER Project sites, revegetation would be performed to mitigate habitat impacts.	After clean soils are returned to ER Project sites, revegetation would be performed to mitigate habitat impacts.	Removal of debris for treatment may disturb or destroy existing biota. Revegetation would be performed.	Existing biota would be disturbed, moved, or destroyed. Revegetation would be performed after TU and/or CAMU closure to mitigate habitat impacts.	Excavation impacts would still occur.	Existing biota may be disturbed or moved. Revegetation would be performed to mitigate habitat impacts.	Existing biota would be disturbed, moved, or destroyed. Capping would include revegetation to mitigate habitat impacts.	No effect.	Contaminants may negatively impact biota in long term.
Cultural Resources	Subsurface resources may be disturbed. Cultural resources sites would be avoided, if possible, and ground-disturbing activities would be monitored.	No effect.	No effect.	Removal of debris may disturb subsurface resources. Cultural resource sites would be avoided, if possible, and ground-disturbing activities would be monitored.	Subsurface resources may be disturbed or destroyed. Cultural resource sites would be avoided, if possible, and ground-disturbing activities would be monitored.	No effect, other than excavation impacts.	No effect, because no ER Project sites with surface resources have been identified and because ground disturbing activities would be monitored.	No effect, because no ER Project sites with surface resources have been identified and because subsurface resources would not be disturbed.	No effect.	No effect.
Noise	Excavation equipment would create noise on site.	Low to no effect.	Low to no effect.	Low to no effect.	Earth-moving equipment would create noise on site.	Transport vehicles would create noise off site.	No effect.	Earth-moving equipment would create noise on site.	No effect.	No effect.

Table 4-1 (Concluded)
Summary of Impacts Associated with the Proposed Action Options and No Action Alternative

Issue	Excavation	Thermal Desorption	Soil-Washing/ Stabilization	Carbon-Dioxide Blasting	TU and/or CAMU	Off-Site Treatment	In Situ Bioremediation	Capping/ Institutional Controls	NFA	No Action
Socioeconomic Effects	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	There would be a slight, temporary increase in employment from either the existing SNL/NM contractors or Albuquerque area residents.	No effect.	No effect.
Transportation	Excavation/ earth-moving *equipment would be* required. Vehicle accident probability would increase.	Soil transport to treatment area *would be* required. Vehicle accident probability would increase.	Soil transport to treatment area *would be* required. Vehicle accident probability would increase.	Soil transport to treatment area *would be* required. Vehicle accident probability would increase.	Earth-moving equipment and *transport* trailers would be required. Vehicle accident probability would increase.	Off-site incident free *transportation* risks and impacts, which are small, would be bounded by existing DOE risk analyses. Off-site transportation accident impacts are consistent with the SNL/NM on-site transportation accident analysis.	Equipment for system would need *to be transported to* site. On-site transportation accident probability would increase.	Earth-moving equipment *would be* required. Vehicle accident probability increases.	No effect.	No effect.
Human Health Effects from Releases	Impacts could occur from dispersion of contaminants during excavation. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	Workers could be impacted by exposure to accidentally released contaminants. However, there would be a very low probability of increased cancer.	There would be an increased possibility of injury or fatality from vehicle accident during transport. There would be an extremely low probability of adverse effect from releases.	Workers could be impacted by exposure to contaminants during ER efforts. There would be a very low probability of adverse effect due to health and safety protection measures.	Workers could be impacted by exposure to contaminants during ER efforts. There would be a very low probability of adverse effect due to health and safety protection measures.	No effect. NFA sites would have demonstrated low risk levels.	Impacts would remain at present levels, with a low probability increased cancer, but greater potential for long-term exposures from contaminant migration.

CAMU Corrective action management unit
ER Environmental restoration
NFA No further action
TU Temporary unit
VOC Volatile organic compound

Section 3.2 describes and Figures 3-3 and 3-11 show existing land uses within properties currently occupied by SNL/NM facilities as well as residential areas within 1 mile (1.6 km) of the KAFB boundary. Figures 3-3 and 3-11 also show that lands within the KAFB boundary where ER Project sites are located are federal lands under the jurisdiction of DOE, the USAF, or the USFS. Although some lands southwest of the KAFB boundary are leased by DOE from the State of New Mexico or from the U.S. Department of Interior Bureau of Indian Affairs (Isleta Pueblo), no ER Project sites exist on these lands. There are no national parks, state parks, wilderness areas, or national monuments in the vicinity of the ER Project sites. A major recreation area, the Cibola National Forest, would not be affected. Public use of this resource would continue without new limitations. Thus, no change would result from the proposed action in federal, regional, state, local, and Indian tribe land use plans, policies, and controls. Land-use impacts associated with the proposed action options are summarized in Table 4-1.

4.1.2 Geology and Soils

The major impacts to the geology and soils at most of the individual ER Project sites would result from excavation activities associated with corrective measures (see Table 4-1). Except for the capping options and sites designated for NFA status, proposed site actions would involve removing soils and either transporting them off site or remediating them at TUs. Excavation of surface and subsurface soils at some ER Project sites would temporarily affect local topography. Removing contaminated soil would create local areas that are lower in elevation than the original surface. Stockpiling topsoil could create soil mounds on what may have been relatively flat land surfaces. In no case would the change in topography be substantial or permanent. All excavations would be backfilled and compacted after ER Project efforts were completed. Backfill would consist of either soils from SNL/NM designated "fill and borrow areas" or original soils that were treated and returned to their ER Project sites of origin. Or, if deemed appropriate, commercially purchased materials may be used. Sites would also be contoured to prevent erosion and would be revegetated as necessary.

The proposed treatment for soils contaminated with RCRA hazardous metals or radionuclides could cause segregation and removal of a large percentage of the finer soils. In this case, treated soils returned to their ER Project site of origin would be supplemented by additional backfill. To minimize settling and the formation of depressions in the backfilled excavations, soils would be placed into the area in small amounts and compacted.

Soil disturbances from excavation would result in a small increase in local erosion potential, where uncontaminated soil was stockpiled and the surface vegetation removed. However, local erosion and sediment transport in the SNL/NM area would be minor because of low average annual precipitation (8 inch [20 cm]) and the nature of precipitation events. If major storm events or flash floods occurred before disturbed sites were reclaimed, some soil erosion could occur.

Treated soil would have a slightly different mineral composition and grain-size distribution. This would be likely to occur with the thermal treatment, soil-washing/stabilization, and decontamination options of the proposed action. The most important alteration would likely be a decrease in fine-grained material, principally silt and clay. The principal effects of this change to soil composition would be a potential increase in infiltration rates and a decrease in the water-erosion hazard. Increased infiltration through local soils could enhance groundwater recharge in some areas. Soil suitability as a plant-growth medium could potentially be impacted, if the soil profile is substantially disturbed. Future impacts related to soil erosion and vegetation would be minimized by following standard reclamation practices, including contouring, erosion control, reseeding, mulching, and adding soil amendments (see Section 2.1.4.1 and Figure 2-10). Impacts to geology and soils associated with the proposed action options are summarized in Table 4-1.

4.1.3 Surface-Water and Groundwater Contamination

No long-term adverse impacts to surface waters are anticipated from any of the proposed action options or NFA designation. Constructing a waste treatment facility could produce localized soil erosion; however, this would tend to be mitigated because the soils at the sites are sandy and would rapidly soak up rainwater. The erosion could be expected to have temporary peaks during heavy rainfall events. Surface-water runoff controls would be integrated into the designs for the treatment facility and facilities performing thermal treatment, soil-washing, stabilization, and decontamination. Capping could prevent the infiltration of surface water into contaminated soils; likewise, in situ bioremediation would also incorporate design controls to prevent the infiltration of surface water. Impacts to surface waters and groundwaters associated with proposed action options are summarized in Table 4-1.

CoCs detected in groundwater could be reduced by the proposed action options, including source removal, vadose-zone vapor extraction, and soil remediation and pump-and-treat system. These measures would reduce groundwater concentrations to below regulatory limits over a period of months to a few years.

DOE regulations set forth in 10 CFR 1022 require that any proposed action taken in a floodplain be evaluated and that flood hazards and floodplain management be considered. Approximately 32 ER Project sites are found in the eastern area of USFS withdrawn lands of SNL/NM, where the floodplain of Arroyo del Coyote has not been defined or mapped (see Figure 3-7). Generally, the arroyo has no clearly distinguishable floodplain in the mountain areas and is limited to the immediate channel where it passes through KAFB. Corrective measures conducted at ER Project sites in the USFS withdrawn area would have no impact on floodplains.

Flashflooding is possible in the channel of Arroyo del Coyote and impacts from flooding could be expected at sites located in the arroyo channel. Excavation activities performed in the few sites located in floodplains (ER Sites 7, 16, and 23) could temporarily impact surface-water quality for a short distance downstream from the excavation area by transporting excavated soil downstream (excavation at ER Sites 7 and 23 would not occur if proposed NFA status is approved by EPA). These three sites, located within or adjacent to the main channel of Arroyo del Coyote (see Figure 3-7), could be subject to flooding during heavy precipitation events. The impact would be limited because flow in Arroyo del Coyote rarely reaches the confluence with the larger Tijeras Arroyo. Gauging stations in place since 1980 have recorded no confluent flow (SNL/NM, 1993a). ER Site 23 has a very low flooding potential because it is located away from the main arroyo in an adjoining tributary. Potential soil losses from flooding would be reduced by conducting corrective measures during periods when precipitation and runoff are minimal.

Depth to groundwater near the base of the Manzano Mountains is shallow. However, the underlying alluvial water-bearing zone is very thin and is not used for water supply. Low precipitation and a low recharge rate make the transport of contaminants to groundwater in the mountain areas unlikely. In other areas, groundwater is generally greater than 350 feet (110 meters) deep. The low annual precipitation, the negligible recharge rates, and the very thick vadose zone greatly reduces potential contaminant migration to groundwater.

The cap design for the capping option would prevent infiltration of water and the resulting downward migration of contaminants. The arid climate and the distance to the vadose zone contribute to the ability of capping to control infiltration.

4.1.4 Air Quality

Impacts on air quality might be associated with the proposed action options. Air quality can be affected by dispersion of contaminants, either as VOC emissions from waste excavation, treatment, or transport activities or as fugitive dust emissions. Impacts with respect to meeting environmental regulations related to air quality associated with proposed action options are summarized in Table 4-1.

Each site will undergo an evaluation for the applicability of the National Emissions Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR 61) and of other potentially applicable regulations prior to any excavation or remediation activities.

4.1.4.1 Excavation

Excavation activities for the purpose of removing contaminated soil from ER Project sites for treatment or on-site transport and for construction of TU and/or CAMU facilities could result in airborne fugitive dust, which can be mitigated by implementing dust controls. Frequent watering with watering trucks and use of tree-sap-based products such as Enduro Seal® would be used to control fugitive dust emissions. A soil-disturbance permit required under the local Albuquerque Environmental Health Department Air Pollution Control Division (implemented by 20 New Mexico Administrative Code [NMAC] 11.20) would be obtained if more than 0.75 acre (0.30 hectare) or 32,670 square feet (3,035 square meters) were to be disturbed. Despite use of soil-watering during excavation, based on EPA estimates of fugitive dust emissions associated with similar types of construction excavation activities, an estimated 1.2 tons of soil per acre per month (1.0×10^{-4} grams per square meter per second) would be suspended in the air at sites where waste is removed for treatment (EPA, 1988).

For the purpose of evaluating risk from air emissions during excavation, gaseous VOC and SVOC contaminants in soils were assumed to be attached to soil particles. Because VOCs and SVOCs are present in contaminated soils at some sites, small quantities might be released in gaseous form when the soil is disturbed. Applicable air quality permits would be obtained prior to any excavation activities.

The only radioactive gaseous contaminant release from excavation could be tritium gas. The Radioactive Waste Landfill (ER Site #1) is known to contain uranium, thorium, mixed fission products and possibly transuranic waste material in solid form. These radioisotopes are not believed to be in a physical/chemical form that is readily suspendable and were not considered in analyzing releases from this site. No other gaseous radioactive contaminants or decay products are considered a potential source of exposure. For tritium and particulate radioactive emissions, applicable National Emission Standards for Hazardous Air Pollutants (NESHAPS) permits and notifications required under 40 CFR 61 and other applicable regulations would be obtained prior to excavation or construction activities at individual ER Project sites.

In order to conservatively estimate air impacts associated with emissions from heavy equipment used for excavation and transport activities, it was assumed that the following diesel-powered heavy equipment would be used at each site:

- One tracked backhoe for site excavation.
- One front-end loader for loading contaminated soil into transport containers and backfilling clean soil.
- One trailer truck with a 32-cubic-yard (24-cubic-meter) capacity and an average speed of 25 mph (40 km/hr) for hauling excavated waste to a TU and/or CAMU.
- One water truck for fugitive dust mitigation at the excavation site.
- One water truck for fugitive dust mitigation along on-site transport routes.
- One 30-ton (30,000-kg) rough terrain crane for loading waste bins on transport trailers.

All equipment types were assumed to operate for 8 hours a day, 260 days per year (2,080 hours per year) for a ten-year period. The total operation time for each type of equipment was based on the time needed to excavate and transport total volume of soil to be excavated and the total volume of clean fill expected to be returned to the ER Project sites as backfill. Additional information on volume and transport data can be found in Appendix A, Table A-3.

Soil volumes, when discussed in the context of their relationship to excavation equipment, are generally presented in cubic yards. The estimation of total time required to complete the task was based on previous field experience, which showed that using one backhoe and one front-end loader, 100 cubic yards (77 cubic meters) of contaminated soil could be excavated, and 200 cubic yards (153 cubic meters) could be backfilled per day. The total time in use for the trailer truck was based on mileage from each ER Project site to the CAMU and/or TU, which was assumed to be located near the Chemical Waste Landfill (ER Site 74). The total distance to be traveled was estimated at about 79,000 miles (about 130,000 kilometers) (see Table A-3, Appendix A).

The number of vehicles needed annually to accomplish ER cleanup goals was based on total soil volume to be handled and an assumed 10 year period to complete corrective actions. (For example, if the excavation of all sites using one backhoe would take 25 years, 2.5 backhoes were assumed to be operating for ten years.)

The heavy equipment would emit to the atmosphere small quantities of criteria pollutants subject to the NAAQS as adopted by the State of New Mexico in its State Implementation Plan and implemented by the Albuquerque Environmental Health Department Air Pollution Control Division as Ambient Air Quality Standards (AAQS) (nitrous oxides, sulfur oxides, particulates, and ozone). Lead is a criteria pollutant also regulated under NAAQS; however, the use of unleaded fuel would not result in lead emissions. In addition, the Albuquerque Environmental Health Department Air Pollution Control Division regulates carbon monoxide emissions because of the Albuquerque metropolitan area's current nonattainment status.

EPA air-emission factors for mobile heavy equipment with diesel engines rated at less than 447 horsepower were used to estimate emissions (EPA, 1988). The emission factors used were based on the estimated horse power ratings and fuel consumption rates obtained from equipment manufacturers and operators shown on Table 4-2. Based on comparison of EPA emission factors for diesel versus gasoline powered engines, emissions from a few cars used for personnel transport to and from the site are considered negligible in comparison to the low emissions from heavy equipment (EPA, 1988).

Table 4-2
Estimated Engine Types and Fuel Consumption Rates for Heavy Diesel Equipment

Heavy Diesel Equipment Type	Unit/Engine Type and Approximate Horse Power (hp)	Fuel Consumption (gallons/hour [liters/hour])
Backhoe (tracked)	Caterpillar™ L325 ~175	5.0 (18.9)
Front-end loader	Caterpillar™ 966 ~135	7.3 (27.4)
Truck (trailer and water	3406 Caterpillar™ or Cummins™ engine ~400	5.5 (20.8)
Crane (30-ton, rough terrain)	Cummins™ or Detroit™ engine ~100 to ~250	1.7 (6.4)

References:
Powers, M., Telephone conversation with D. Talaber, IT Corporation, September 14, 1994.
Trimble, W., Telephone conversation with D. Talaber, IT Corporation, September 14, 1994.
Sanders, I.A., Telephone conversation with D. Talaber, IT Corporation, September 14, 1994.
Ross, E., Telephone conversation with D. Talaber, IT Corporation, September 13, 1994.

The average concentrations of air emissions were estimated using EPA's ISC2 model. Because specific sequencing of corrective actions has not been determined, all emissions were assumed to occur from a central onsite location at a steady rate. The emissions were assumed to be dispersed by wind, and concentrations at progressively farther locations were modeled using EPA's ISC2 air dispersion model. The estimated concentrations nearest the point of emission were the highest and are reported in Table 4-3. Concentrations at the point of emission and at a distance of 1 mile (1.6 kilometers) away are shown in Table 4-4.

The total emissions of criteria pollutants and other air emissions associated with the operation of heavy diesel equipment are also shown in Table 4-3. Heavy equipment was estimated to

Table 4-3
Total Air Pollutant Emissions[a] from Excavating and Transporting Contaminated Soils from Environmental Restoration Project Sites at Sandia National Laboratories/New Mexico[b] (by equipment type)

	Backhoe Emissions		Front-end Loader Emissions		Emissions from 2 Water Trucks		Transportation Truck Emissions		30-ton Crane Emissions		Total Annual Emissions from ER Project Sites		Average Annual
Criteria Pollutant	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	$\mu g/m^3$
NOx	3.0	3.1	4.8	5.0	7.3	7.6	0.5	0.5	3.3	3.4	18.9	19.6	22.7
CO	0.7	0.7	1.0	1.0	1.6	1.7	0.1	0.1	0.7	0.7	4.1	4.3	4.92
SOx	0.2	0.2	0.3	0.3	0.5	0.5	0.03	0.03	0.2	0.2	1.2	1.3	1.49
PM-10	0.2	0.2	0.3	0.3	0.5	0.5	0.03	0.03	0.2	0.2	1.2	1.3	1.54
CO_2	113.0	117.6	180.3	187.5	273.5	284.4	18.7	19.5	124.3	129.3	709.8	738.2	850.47
Air Toxics	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	$\mu g/m^3$
Benzene	0.0006	0.0006	0.001	0.0010	0.0016	0.0017	0.0001	0.0001	0.0007	0.0007	0.004	0.0042	0.0015
Toluene	0.0003	0.0003	0.0004	0.0004	0.0006	0.0006	0	0	0.0003	0.0003	0.0016	0.0017	0.0019
Xylenes	0.0002	0.0002	0.0003	0.0003	0.0004	0.0004	0	0	0.0002	0.0002	0.0011	0.0011	0.0013
Propylene	0.0018	0.0019	0.0028	0.0029	0.0042	0.0044	0.0003	0.0003	0.0019	0.0020	0.011	0.0114	0.013
1,3-Butadiene	0.00003	0.00003	0.00004	0.00004	0.00006	0.00006	0.000004	0.000004	0.00003	0.00003	0.00016	0.00017	0.0002
Formaldehyde	0.0008	0.0008	0.0013	0.0014	0.002	0.002	0.0001	0.0001	0.0009	0.0009	0.0051	0.0053	0.0061
Acetaldehyde	0.0005	0.0005	0.0008	0.0008	0.0012	0.0012	0.0001	0.0001	0.0006	0.0006	0.0032	0.0033	0.0038
Acroleidene	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0	0	0.0001	0.0001	0.0005	0.0005	0.00063
Total PAH	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0	0	0.0001	0.0001	0.0006	0.0006	0.0007
Other	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	(lbs/hr)	(tons/yr)	$\mu g/m^3$
Aldehydes	0.05	0.05	0.08	0.08	0.12	0.12	0.008	0.008	0.05	0.05	0.30	0.32	0.36
Total	0.25	0.26	0.39	0.41	0.60	0.62	0.04	0.04	0.27	0.28	1.57	1.63	1.86

[a]Estimates of criteria pollutant releases incorporated the operational schedule (8 hours per day, 260 days per year) fuel consumption rates from Table 4-2 and published emission factors for diesel engines using No. 2-grade diesel fuel. Concentrations of criteria pollutant releases are measured at the point of emission and are not assumed to be additive.
[b]Estimates were based on waste volume data available at the time of the analysis in 1994. Use of more recent volume information does not change conclusions of this analysis.

CO = Carbon monoxide
CO_2 = Carbon dioxide
NOx = Nitrous oxide
PAH = Polyaromatic hydrocarbons
PM-10 = Particulate matter nominally 10 microns or less
$\mu g/m^3$ = Microgram per cubic meter
SOx = Sulfur oxide

Reference:

U.S. Environmental Protection Agency, 1988. "Compilation of Air Pollutant Emission Factors," EPA AP-42, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

Table 4-4
Estimated Annual Heavy-Diesel Equipment Air Emissions at Sandia National Laboratories/New Mexico Compared with National and Albuquerque Environmental Health Department Ambient Air-Quality Standards[a]

Air Pollutant Criteria	Potential Emissions Tons/Year LKLLL	Estimated Concentrations[b] ($\mu g/m^3$)		NAAQS ($\mu g/m^3$)	AAQS (Albuquerque Environmental Health Department Limits)	
		Maximum	1 mile away		($\mu g/m^3$)	tons/year[c]
Nitrous oxides	19.7	22.7[d]	1.4[d]	100[d]	100[d]	NA
Carbon monoxide	4.3	4.9[e] 83[f] 176[g]	0.3[e] 4.2[f] 1.3[g]	 10,000[e] 40,000[f]	4,600[e]	100
Sulfur oxides	1.3	1.5[e]	0.9[e]	80[c]	11[e]	NA
Particulates <10 micron diameter	1.3	1.5[e]	0.9[e]	50[c]	60[e]	NA
Carbon dioxide	738.2	850.5[e]	51.3[e]	NA	NA	NA
Photooxidation Products (e.g., ozone)		Not calculated[h]				
Air Toxics[d]						
Benzene	0.004	0.0015	0.00005	NA	NA	
Toluene	0.002	0.0019	0.00006	NA	NA	
Xylenes	0.001	0.0013	0.00004	NA	NA	
Propylene	0.011	0.013	0.00042	NA	NA	
1,3 Butadiene	0.0002	0.0002	0.00001	NA	NA	
Formaldehyde	0.005	0.0061	0.00020	NA	NA	
Acetaldehyde	0.003	0.0038	0.00013	NA	NA	
Acrolein	0.0005	0.0006	0.00002	NA	NA	
Total polyaromatic hydrocarbons	0.0006	0.0007	0.00002	NA	NA	
Other[d]						
Aldehydes	0.32	0.36	0.012	NA	NA	
Total Hydrocarbons	1.6	1.9	0.062	NA	NA	

[a]Estimates were based on waste volume data available at the time of the analysis in 1994. Use of more recent volume information does not change conclusions of this analysis.
[b]Maximum concentrations for total sitewide mobile-source emission contributions. Emissions are assumed to originate from a central point on site. Maximum concentrations occur at this assumed single-release point. This is a conservative model, because actual emissions would be originating at individual ER Project sites spread throughout the SNL/NM facility and would be subject to greater dispersion.
[c]Any one or total of all air pollutants must be less than 100 tons/year.
[d]Annual arithmetic mean.
[e]Annual average.
[f]8-hour average concentration not to be exceeded more than once per year.
[g]1-hour average concentration not to be exceeded more than once a year.
[h]Depending upon local conditions and not readily predictable for total emissions. Because photochemical oxidants are a result of oxidation of nitrous oxides and carbon monoxide products, these emissions would also be expected to be below AAQS; nitrous oxides and carbon monoxide are below limits.

AAQS = Ambient air quality standard.
NA = Not applicable.
NAAQS = National Ambient Air Quality Standards.
$\mu g/m^3$ = Microgram per cubic meter

contribute greater emissions than other vehicles due to the types of engines and their respective emissions factors.

Table 4-4 shows that at the point of highest estimated concentrations, all air emissions associated with operation of equipment for ER Project site excavation and transportation of contaminated soil to the treatment facility would be below ambient air-quality standards. The Albuquerque Environmental Health Department Air Pollution Control Division implements issued Air Quality Control Board regulations of 20 NMAC 11.04, titled "General Conformity," in response to the Federal Clean Air Act Regulations for Non-Attainment and Maintenance Areas. Section 2, paragraph B.1, of this regulation established the emissions threshold of 100 tons/year (90,700 kg/yr) for carbon monoxide for any source in the local area. A total of 4.3 tons (3,900 kg) per year of carbon monoxide is estimated for all diesel equipment (see Table 4-4). Therefore, carbon monoxide air emissions associated with ER Project activities would not exceed limits for the nonattainment area. There are no mobile source emission standards that apply to other air emissions. Other air emissions concentrations would be negligible, as shown in Table 4-4. As required by Section 176(c) of the 1990 Clean Air Act amendments, the proposed action options would conform to the New Mexico state implementation plan, which is designed to achieve NAAQS.

4.1.4.2 Waste-Treatment Emissions

Impacts to air quality were also evaluated by assuming that the total contaminated waste volume would be treated at a central location near the Chemical Waste Landfill (ER Site 74). This assumption provides a maximum emission source term. Emissions from treatment of contaminants at any individual ER Project site would be lower. All treatment options would be designed to virtually eliminate VOC and SVOC air emissions using state-of-the-art control technologies (see Section 2.1.4.3). The thermal destruction of VOCs would result in the formation of carbon monoxide, which would then be converted to carbon dioxide in the catalytic converter. Emissions of carbon dioxide are assumed to occur from a 30-foot- (9.1-meter-) high stack. The total carbon dioxide emissions would depend upon specific treatment facility design capacity, but are estimated not to exceed 0.03 tons (27 kg) per year for a facility with a capacity to treat 2200 pounds (1,000 kg) of waste per day, consistent with typical thermal desorber design (Feizollahi and Shropshire, 1994). There are no air quality regulation standards for carbon dioxide emissions.

Radionuclides would be the proposed treatment facility's only potential routine releases of hazardous air pollutants regulated under the Albuquerque Environmental Health Department Air Pollution Control Division 20 NMAC 11.64, which implements 40 CFR 61 (i.e., NESHAP requirements). Particulate radionuclide emissions regulated under 40 CFR Part 61, Subpart H, would be controlled using HEPA filters with a minimum-design removal efficiency of 99.99 percent. No tritium emissions would be associated with treatment because tritium-contaminated wastes from the Radioactive Waste Landfill would not undergo treatment. Emissions of radionuclides would neither violate the EPA NESHAP requirement that radiation doses to the public from air emissions be below 10 mrem per year nor exceed the EPA source-monitoring threshold level of 0.1 mrem per year. Based on EPA's CAP-88 model and assuming a maximum inventory of 0.358 picocuries per gram available for release from soil near the Radioactive Waste Landfill (ER Site 1) (Aas, 1995), doses at the KAFB site boundary, the closest point of public access, are estimated to be below 0.005 mrem. Nevertheless, radionuclide emissions would continue to be monitored and reported as a part of SNL/NM's ongoing air monitoring program. Human health effects are discussed in Section 4.1.10.

Prior to construction of a treatment facility, authority to construct notifications and required permits for stationary sources required by the Albuquerque Environmental Health Department Air Pollution Control Division will be obtained.

4.1.5 Biological Resources

The existing biotic communities, sensitive species, and sensitive habitats at the ER Project sites are described in Section 3.6.2. Three sensitive species (all species of cacti) are known to occur within the boundaries of designated ER Project sites. Only ER Site 21 includes wetland habitat; 21 sites contain riparian or floodplain habitat. Because there exists only a very small potential for adverse impacts exists from potential releases, the primary focus of this section is on impacts resulting from the physical disturbance or removal of habitat and associated organisms from the overall natural environment currently existing at KAFB. Of special concern are impacts to sensitive species and the habitat types that support them.

It was generally assumed that the proposed corrective measures would result in an overall reduction of exposure to chemical and radiological contaminants in ecological receptors, thereby reducing the long-term risk of adverse effects in populations exposed to these contaminants. Paradoxically, the cost of this reduced risk would be the loss of habitat quality directly resulting from implementation of corrective measures, particularly soil excavation and topsoil removal.

The physical impacts associated with proposed action options would vary from excavation of large, contiguous areas that would be subsequently backfilled with uncontaminated soil to light vehicle or foot traffic associated with removal of scattered debris and particles. Some destruction of habitat would be likely occur with excavation, construction of treatment facilities, capping and possibly other institutional controls, and off-road vehicle traffic. Disturbance and/or destruction of habitat due to excavation would result in the local displacement of wildlife. Although reclamation of disturbed sites (refer to Section 2.1.4.1) would aid in the recovery of ecological structures and functions, this recovery would take time as natural succession proceeds from artificially revegetated surfaces. Therefore, within excavation areas, the short-term impacts to biological resources would be high; however, the long-term effects could be beneficial.

In situ bioremediation, TEVES, and other in situ treatments were assumed not to entail excavation and removal of soil, although some habitat disturbance would result from this option through construction of roads, drill pads, and associated surface facilities. The area of disturbance associated with bioremediation is expected to be small and the total impact from this corrective measure is expected to be minor.

Both the grama grass cactus and the Wright's pincushion cactus were usually found as widely scattered individuals or as clusters of several individuals (2 to about 15) in close proximity to each other. The visnagita cactus was found as scattered individuals at some sites, but in favorable habitat, it was sometimes found in large populations, reaching densities exceeding

80 plants per acre (200 plants per hectare). In most cases, the populations of these species are in isolated areas, comprising only a fraction of the entire site.

The locations of isolated individuals or clusters of individuals and the boundaries of known habitat areas for these three species have been put into the ER Project geographical information system database. This information would be used to mitigate impacts to individuals or populations when corrective action was taken. For example, if surface-picking were to be used in an area with a known population of sensitive cacti, the field personnel would be instructed to avoid damage to all cacti in the area. If excavation were required in such an area, transplanting of individuals would be performed, provided that this could be done without disrupting existing populations that would otherwise not be affected by the excavation. It is expected that the number of individuals affected by corrective actions would be very small and insignificant with respect to the extent of the habitat and the numbers of individuals that are present on KAFB. Further, because all three of these species have highly dynamic natural populations (especially being prone to predation by small mammals and insects), any incidental losses incurred by the ER Project corrective actions would not be expected to affect the long-term survival of these species on the base, provided that the physical disruption of favorable habitat was minimized.

As described in Section 3.6.2, the sensitive species survey for the ER Project (IT Corporation, 1995) identified 22 proposed ER Project sites that have one or more of the three species of cacti listed as endangered in New Mexico present within the site boundary. Of these, 8 have been designated NFA or have been removed from the list, and 14 are eligible for proposed for excavation and treatment corrective action options. The boundaries of the last group encompass a total area of about 890 acres (360 hectares).

Although not listed as a sensitive species, the burrowing owl (*Speotyto cunicularia*) is a species of concern on KAFB as a breeding raptor. This species is particularly vulnerable to excavation activities because of its habit of nesting in underground burrows, which are often enlarged from small mammal burrows. On KAFB, burrowing owls are particularly common in association with Gunnison prairie dog towns. These are found at scattered locations about the base, and often occur on the outer edges of developed area. Because no prairie dog towns were found at any ER Project sites during the sensitive species survey and no burrowing owl nest burrows were observed (although one burrowing owl was observed at Pickax Site [ER Site 54] in the late summer), the excavation activities actions are not expected to impact this species.

Despite the planned actions to reclaim disturbed habitats (see Section 2.1.4.1), it was not assumed that the habitat would be restored to its original quality or that it would it return to its original quality through natural succession for many years, if ever.

Impacts to biotic communities would be reduced or mitigated by including the following activities in project planning:

(1) Avoid, where possible, disturbing of ER Project sites at which populations of sensitive species have been identified.

(2) Avoid disturbing of sensitive or unique habitats, such as wetlands and areas occupied by vigorous populations of sensitive species.

(3) Where possible avoid disturbing less sensitive habitats or develop specific mitigation measures to reduce damage to the resource.

(4) Where disturbing of sensitive biota is unavoidable, transplant individual plants to suitable habitats outside the area to be disturbed. Impacts to sensitive plant species at the bioremediation sites, for example, would be mitigated by siting the well pads to avoid sensitive habitats and transplanting individual plants if avoidance is not possible.

Impacts to biologic resources resulting from site disturbance associated with proposed action options are summarized in Table 4-1. The following agencies were contacted in order to facilitate the discussion of impacts to biological resources:

- U.S. Fish and Wildlife Service.
- New Mexico Energy, Minerals, and Natural Resource Department.
- New Mexico Department of Game and Fish.

Correspondence with these agencies, including consultation letters from the USFWS, can be found in Appendix C. Short-term impacts that could result from contaminant releases during operations would have minimal impact on biotic communities on KAFB (see Section 4.1.11 and Appendix D2, Section D2.9). Impacts to biologic resources resulting from site disturbance associated with proposed action options are summarized in Table 4-1.

4.1.6 Cultural Resources

A total of 32 prehistoric sites, 24 historic sites, 5 prehistoric/historic sites, and 1 site of unknown temporal affiliation have been recorded within lands designated as ER Project sites (see Section 3.7). Section 3.7 discusses the cultural resources that have been recorded. Thirty-one prehistoric sites, possibly seventeen historic sites, and five prehistoric/historic sites are candidates for possible inclusion in the NRHP. The NRHP status of one other site is unknown.

Because no cultural resources locations are listed in the NRHP within the ER Project at this time and ER Project activities would be planned to avoid significant cultural resources, there would be no adverse impacts to sites listed in the NRHP as a result of the proposed action options. Several buildings of potential historic significance have been recorded in Tech Area II. These buildings would not be impacted by proposed ER Project activities.

Subsurface cultural resources have not been mapped at ER Project sites. There could be adverse impacts to any subsurface cultural remains that may be eligible for inclusion in the NRHP but were not identified during the surface survey. If there were indications of subsurface cultural resources encountered during site excavation, activities would be planned to preserve potential resources.

Impacts to cultural resources from proposed action activities may be minimized or mitigated by doing the following:

(1) Providing ER Project Task Leaders with detailed maps indicating cultural resources areas to be avoided while conducting excavation or other intrusive remediation or characterization activities.

(2) Avoiding cultural resources as much as possible when implementing corrective measures such as excavation.

(3) Where avoidance of cultural resources is not possible, instituting subsurface testing and data recovery or monitoring during ground-disturbing activities.

(4) If archaeological or historical artifacts are discovered during site excavation activities, delaying further surface or subsurface disturbance and contacting a qualified archeologist to assess the finds. The State of New Mexico Office of Cultural Affairs, Historic Preservation Division, would also be contacted.

There would be essentially no impacts to cultural resources as a result of the NFA designation. Impacts to cultural resources associated with proposed action options are summarized in Table 4-1. Consultation letters with SHPO are located in Appendix C.

A consultation letter dated January 18, 1996 was received from the State Historic Preservation Officer (SHPO) for the Section 106 consultation process under the National Historic Preservation Act. The SHPO concurs that of the 166 ER sites examined, 128 do not contain eligible or potentially eligible sites. There are no additional preservation requirements for these 128 ER sites. Because decisions have not been made about what actions may occur within the remaining sites, the potential effects on historic properties within these sites can not be evaluated yet. Further consultation with the SHPO will occur as needed to complete the Section 106 process.

4.1.7 Noise

The primary noise sources associated with the proposed action would be normal construction noise from heavy equipment, excavation equipment (backhoes and front-end loaders), and truck traffic. There would be an increase in truck-traffic volume to and from the treatment facility. The number of truck trips would vary depending on the amount of soil to be excavated. The truck would still need to go back for another load, but the only difference would be whether the return trip was full or empty. A total of less than 11,000 truck trips has been estimated for transport of waste volumes assumed to be excavated for treatment and the transport of clean soil for backfill at excavated sites as shown in Appendix A, Table A-3. The truck traffic would occur during daylight hours only and be of short duration over the 10 or fewer years of project life. It would be confined to the SNL/NM facility and be negligible as a long-term adverse impact.

Truck traffic would not travel on public highways or streets outside the KAFB-controlled access area and would affect only SNL/NM and KAFB personnel. Most public receptors at the KAFB boundary would be 1 mile (1.6 km) or more from the major remediation activities. Thus, ambient noise levels resulting from the proposed action options would have only localized short-term adverse impacts on site. Impacts from noise associated with proposed action options are summarized in Table 4-1.

4.1.8 Socioeconomic Impacts

4.1.8.1 Demographics

The population distribution in Bernalillo County is not expected to change as a result of the proposed action. It is unknown at this time whether restoration activities would be conducted at single sites on a sequential basis or whether activities would occur at multiple sites concurrently. If the latter were to occur, short-term employment numbers would increase accordingly.

Based on the projected waste volumes used in this EA, it is estimated that the performance of the ER Project could create short-term employment for up to an estimated 40 heavy equipment operators, treatment system operators, and truck drivers during the excavation, treatment, and reclamation portions of the project. A thermal desorption treatment facility could require up to 20 full-time operators and waste handlers. Excavation, truck transport, and reclamation activities alone at any given ER Project site could require up to ten full-time employees. At a site where solidification and stabilization are included in the treatment option, six full-time employees could be needed; at sites where in situ bioremediation would be implemented, one full-time employee could be required.

Most of the workers required for excavating, transporting, and treating contaminated soils already reside and are employed in the Albuquerque area or would be assimilated from the labor pool of contractor employees currently assigned to SNL/NM tasks. Considering that the total number of SNL/NM employees is approximately 7,455 (see Section 3.9), net increases in the local employment and payroll, if any, would be negligible. During the 10-year restoration period, additional revenues would be provided to local contractors, constituting a short-term, minor beneficial economic impact. Impacts to socioeconomics associated with proposed action options are summarized in Table 4-1.

4.1.8.2 Environmental Justice

For environmental justice concerns, an assessment of the potential environment effects of the proposed action must consider the possibility of disproportionately high or adverse effects on minority or low-income populations. Incident-free and normal operations under the proposed action include only small potential risks that do not constitute adverse impacts to the surrounding population. These risks and impacts, summarized in Table 4-5, would be small in all environmental and human health areas of assessment. Risks due to accidents and impacts associated with accidents under the proposed action would be dominated by the physical risks of vehicle transportation accidents. The potential impacts from accidental releases of contaminants under the proposed action would be small. Any impacts to specific populations would be subject to random meteorological conditions on the day of the accident, so risks would be randomly distributed.

Table 4-5
Total Human-Health Effects from Proposed Action Options of the Sandia National Laboratories/New Mexico Environmental Restoration Project

	Health Effect				
Release Type	Total Incremental Cancer Risk[a]	Hazard Index[b]	Injury	Fatality	Appendix D2, Table
Corrective measures, routine operations releases	4.2×10^{-5} [c]	3.0×10^{-1}	NA	NA	D2-14
Corrective measures, accidental releases	1.8×10^{-5}	7.4×10^{-6}	NA	NA	D2-15, D2-16
Corrective measures, accidents	NA	NA	8.4	1.1	D2-17
Summary Proposed Action Impacts	1.0×10^{-4}	3.0×10^{-1}	8.4	1.1	D2-19

[a]Incremented cancer risks and the EPA acceptable range 10^{-4} to 10^{-6} (55 FR 30796) discussed in Section 4.1.10.1
[b]EPA acceptable threshold hazard index <1.
[c]If the assumed volatile organic compound contribution is eliminated, the incremental cancer risk would be 7.5×10^{-7}.

NA = Not applicable

As has been described in the regulatory and permitting processes associated with the ER Project, proposed environmental restoration activities at SNL/NM would be conducted in strict compliance with federal, state, and local laws and regulations to protect air, water, and other environmental resources. Cleanup operations under the proposed action would, in the long-term, reduce the risks of environmental contamination and human health effects for the entire Albuquerque region. Therefore, no foreseeable disproportionate or adverse health and environmental impacts would be expected from any particular segment of the surrounding population, including minority and low-income populations.

4.1.9 Transportation

Incident-Free Transportation Analysis. On-site transport of untreated waste from excavated sites to a TU and/or CAMU or other treatment facilities and transport of clean waste back to ER Project sites for backfill would result in some environmental and human health impacts. These impacts have been factored into the estimates of air quality and human health impacts discussed in Sections 4.1.4 and 4.1.10, respectively. The total on-site transport distance estimated in Table A-3, Appendix A, to be traveled by waste-hauling trucks directly engaged in ER Project activities is about 79,000 miles (130,000 km).

Additionally, some waste generated by the ER Project may require shipment to permitted disposal areas off site. The exact amounts of waste to be shipped and the disposal sites have not been determined, but for the purpose of evaluating potential environmental impacts, sufficient information is available to put a realistic upper bound on this aspect of the analysis. Parameters important to the analysis of transportation impacts, such as source term information (type and form of hazardous material, concentration, total amount), mix of roadway types, population exposed and total mileage are compared between the SNL/NM ER Project and other similar actions analyzed recently by DOE. Since analyses of transportation impacts typically show very small risks, this comparative approach can readily be used to illustrate the relative magnitude of impacts for this aspect of the program.

For purposes of this comparison, all sites in SNL's ER Project, except the mixed waste landfill, were assumed to be excavated and all of the waste thereby generated was assumed to be shipped off site. Given these conservative assumptions, the ER Project was projected to generate a maximum of 2.2 million cubic feet of LLW and LLMW (this is a subset of the total volume of ER waste shown in Appendix A, Table A-3). The maximum estimate of the shipping distance for this waste was 4.4 million miles.

The Waste Isolation Pilot Plant Supplemental Environmental Impact Statement (WIPP/SEIS) (DOE, 1990) described a shipping campaign to be conducted over 20 years and encompassing about 5.5 million cubic feet of waste, which is at least twice the maximum volumes of low level and mixed waste expected from the ER Project. In the WIPP/SEIS, the shipping campaign with the longest transportation distance was from the Savannah River Site (SRS) to New Mexico, with a prospective 3000 shipments (approximately 4.5 million miles) over twenty years. This campaign resulted in an expected occurrence of 0.01 latent cancer fatalities (LCFs) over the entire campaign. In another example, the Draft Nevada Test Site Environmental Impact Statement (NTS/EIS) (DOE, 1996a) predicted a similar LCF occurrence for the shipping campaign from SRS to the Nevada Test Site (NTS) (approximately 16.5 million miles), of 0.02 LCFs over 10 years.

The Draft Waste Management Programmatic Environmental Impact Statement (WM/PEIS) (DOE, 1996b) also analyzed transportation of LLW and LLMW projected for the entire DOE complex for the next 20 years (a waste volume at least 10 times higher than expected from the ER Project) over 500 million miles. A maximum 9.3 LCF occurrence for the public was predicted. The WM/PEIS (DOE, 1996b) analysis found that the risk from transportation is largely linear, based on a per mile basis (i.e., transportation risk is a function of travel distance).

The programmatic documents discussed above considered low level waste from all sources, including process wastes, which generally contain higher concentrations of radioactive material than ER wastes. For example, the average drum shipped to WIPP was expected to contain $0.5 \times 10^{+2}$ Ci/per drum of radioactive material compared to 8.6×10^{-5} Ci/per drum projected for ER wastes (Brown, 1996).

An additional comparison was made of the LLW generated by the environmental restoration projects at the Fernald Operating Units (OU) 3 and 5. These shipments originated at Fernald, Ohio, and were transported by highway to Envirocare in Clive, Utah. The analyses used for comparison were the Fernald Feasibility Studies (DOE, 1995b and DOE, 1995c) and are considered more directly analogous, except larger in scope, to the SNL/NM ER Project than the DOE programmatic documents. The incident-free impacts and accident risks were estimated using the RADTRAN 4 code. The maximum projected impact from the transportation of OU 3 and 5 wastes was $4.5x10^{-5}$ LCFs per year.

The risk from transporting LLMW include risk from exposure to the chemical component of the wastes. The health hazards of concern in assessing risk from transportation of chemicals do not include cancer because the only plausible mechanism for exposure of the public is a one-time exposure due to accidents. whereby acute health effects would predominate. Noncarcinogenic health effects are considered to have a threshold dose below which there is no adverse effect. This threshold for evidence of systemic toxicity is assigned a hazard index (HI) of one. An analysis yielding an HI of less than one indicates no significant health effects. In the analyses for LLMW performed in the WIPP/SEIS (DOE, 1990), the assumed concentrations of volatile chemicals were at least as high or higher than the 1 ppm concentrations assumed for the ER LLMW. A high concentration of lead (2.2 gm per drum) was assumed for the WIPP analysis. The analyses of all considered shipping campaigns in the WIPP/SEIS (DOE, 1990) yielded an HI from chemical exposure at least one hundred times less than one.

The impacts from a proposed SNL/NM ER Project shipping campaign would be well below the impacts determined by analyses in the WIPP/SEIS (DOE, 1990), the NTS/EIS (DOE, 1996a), and the WM/PEIS (DOE, 1996b) documents because the volumes proposed to be shipped are smaller, the source term is smaller, and the distances to be shipped are shorter. Therefore, transportation of relatively small volumes of waste expected from SNL/NM ER Project are projected to have negligible LCF and other health impacts based on the comparison with analyses of transport of the LLW and LLMW generated by the entire DOE complex over several decades.

Transportation Accident Analysis. The risk assessment shows that transportation accident risks dominate all other types of risks for the proposed ER Project activities (see Appendix D2, Tables D2-5 and D2-17). Transportation accident risks are about one million times greater than health risks associated with potential releases.

Injuries and fatalities resulting from on-site and off-site transport accidents are estimated to be the greatest contributor to public and worker health risks. The total expected impact for injuries from on-site transportation accidents for the ER Project is 6.2, which may be interpreted to mean that, according to accident statistics, approximately six injuries can be expected to result from the proposed transport activities. The estimated risk of a traffic accident fatality is 0.62.

Most on-site or off-site transport accidents would not be severe enough to result in a release of hazardous waste. Risks associated with emission of hazardous waste during a transport accident would be extremely small. For carcinogen releases, risks would be comparable with risks deemed acceptable in EPA guidance. The EPA defines acceptable risk levels for exposure to carcinogens in a range of 10^{-4} to 10^{-6}, or one in 10,000 to 1 in 1,000,000 increased probability of contracting cancer (55 FR 30796) (see Section 4.1.10.1 for further discussion of risk levels). Fatal and non-fatal cancer risks from exposure to hazardous waste released in an on-site transportation accident are discussed in Appendix D, Section D2.7.2 and shown on table D2-15, and are estimated to be:

- 6.5×10^{-6} for ER Project site workers
- 8.2×10^{-6} for site workers not involved in ER Project activities
- 4.9×10^{-7} for members of the public located off site

Risk associated with exposure to accidental releases of noncarcinogenic hazardous waste is estimated to be at 5 orders of magnitude (100,000 times) below exposures associated with any observable adverse health effects (see Appendix D, Table D2-16). Transportation impacts associated with the proposed action options are summarized in Table 4-1.

4.1.10 Human-Health Effects of the Proposed Action

Estimates of human-health impacts were based on existing information about the ER Project sites. Table 4-5 shows the health effect risks for proposed action options. As discussed in Section 2.1.2, site characterization is still in progress, and there are limited data on actual contaminant concentrations or volumes of soil to be remediated. Uncertainty is not quantifiable at this time because site characterizations are still being performed. However, best technical judgment has been used to provide an adequate margin of conservatism in the assumptions, so that the risk assessments tend to provide an upper limit of impacts. The risk information provided here should not be mistaken for the type of risk analyses performed in support of a CMS or a baseline risk assessment to evaluate remedial alternatives.

It should be noted that the risk from the no action and proposed action were calculated differently in that the no action risk included baseline exposure to contaminants from various sources throughout the Albuquerque area while the proposed action risks were based solely on projected cleanup activities. The former was not included in the proposed action because the baseline risk is larger than the proposed action risk and including the baseline in the proposed action estimates would have had the effect of masking the impact of the proposed action.

This preliminary risk evaluation is performed only to provide a conservative estimate of the range of risks associated with the proposed action options and no action alternative for this EA. A separate assessment using site-specific characterization data would be used to select appropriate remedial action alternatives under EPA's corrective action program. An overview of risk assessment assumptions is provided in Appendix D1. Details on risk assessment methods, models, and results are presented in Appendix D2.

4.1.10.1 Definition of Health-Effects Evaluation Criteria

Human-health effects were evaluated for this analysis by estimating human-health risks resulting from the proposed action options and the no action alternative. Human-health risk assessment characterizes two general kinds of effects separately:

- Potential cancer risks as described by the incremental cancer risk.
- Potential effects of exposure to hazardous noncarcinogens as described by the systemic toxicity hazard index.

These two types of health effects are evaluated in fundamentally different ways (EPA, 1989a). Because cancer risks and systemic toxicity hazards are not considered to be additive, they are evaluated separately (EPA, 1989b).

Carcinogens such as radiation or carcinogenic chemicals are considered to have no threshold dose. Thus, any increase in dose leads to increased probability of cancer induction but not to increased cancer severity. Further, risks from exposure to mixtures of carcinogens are considered to be additive.

To evaluate the significance of carcinogenic risk, EPA relates calculated incremental cancer risk values to a risk of one cancer case in a potentially exposed population of one million people. This risk standard is often described as the "one-in-one-million-risk," the "ten to the minus 6 risk," or the "10^{-6} risk." Because quantitative risk assessment is one of many factors considered in making remediation decisions, a risk of 10^{-6} does not define the highest risk that can be considered acceptable. EPA specifies that a risk range of "one-in-one-million" up to "one-in-ten-thousand" (10^{-6} to 10^{-4}) can be considered for selection of remediation alternatives (55 FR 30796).

The health hazards associated with exposure to noncarcinogens such as toluene are considered to have a threshold dose below which there is no adverse effect. Increased exposures above this threshold of systemic toxicity is assigned a hazard index of 1. Exposures above a hazard index of 1 can lead to increased severity of the harmful effect. Effects of exposure to hazardous chemicals are also considered to be additive for the same type of human health effect, such as kidney damage. Some carcinogens, such as carbon tetrachloride, also pose a noncarcinogenic hazard, usually at higher doses than required for cancer induction. Thus, these potential hazards are characterized in the same manner as other noncarcinogens.

To evaluate worker exposures to radioactive contaminants, it is appropriate to compare exposures with existing occupational health and safety exposure protection limits. Under normal operations, worker exposures to radiation would be controlled under established DOE Orders and SNL/NM standard operating procedures to limit exposures to 5 rem per year and, further, to be at "as low as reasonably achievable" (ALARA) levels. Workers would not be expected to incur any harmful health effects from radiation exposures they receive during normal operations conducted according to these limits. Similarly, worker exposures to hazardous chemical contaminants would be controlled so that they would be below established safe limits such as the Threshold Limit Values published by the American Conference of Governmental Industrial Hygienists (ACGIH, 1995).

4.1.10.2 Human-Health Risk

Human-health risks associated with proposed ER Project activities are estimated to be very small and well within the risk range generally found acceptable by EPA. The projected risks from accidents unrelated to the hazardous nature of the waste would be more significant than the risks associated with routine or accidental emissions. Accident risks would be pertinent primarily to workers involved in the ER Project activities and would not be different in type or severity from those encountered by workers performing similar industrial activities using heavy equipment, transporting materials, or performing construction and maintenance tasks. Human-health risks for the proposed action options are summarized on Table 4-5. Detailed information on how risks were estimated is presented in Appendix D2.

Human-health risks associated with routine excavation activities are very small, conservatively estimated at about 4.2 in 100,000 (4.2×10^{-5}) increased probability (incremental increase) of cancer. Because VOC contaminants were assumed to be present at every site, even sites at which no indication of their presence has been noted, the contribution from VOC exposure risks at sites with no data is thought to be overestimated. No human health effects would be associated with routine treatment activities because emissions would be controlled.

For routine ER Project activities, the hazard index of systemic toxicity due to exposure to noncarcinogenic contaminants was estimated to be 0.30, below the threshold where adverse health impacts would be observed (defined as a hazard index of 1).

Risks from exposures to projected accidental releases were lower than those estimated for routine activities. Health risks from carcinogen exposure were projected to be 1.8×10^{-5}. The hazard index from accidental exposures was projected to be much less than 1, at 7.4×10^{-6}. These are also considered to be very small risks within a range defined as acceptable by EPA and the American Conference of Governmental Industrial Hygienists.

Although the greatest contributors to the human-health impacts for ER Project activities were estimated to be accidental injuries and fatalities associated with corrective measures operations, these risks would be reduced through implementation of operational safety, health, and environmental protection programs. These programs would be documented in site-specific health and safety plans approved by SNL/NM Industrial Hygiene, Safety Engineering, and Environmental Restoration Departments. Hazardous waste workers would be trained in accordance with OSHA requirements in 29 CFR 1910.120, RCRA personnel training requirements in 40 CFR 264.16, DOE Orders, and SNL/NM safe operating requirements.

4.1.11 Exposure of Biological Receptors

The airborne releases of contaminants and their subsequent deposition could result in exposures to plant and animal receptors similar to those of humans. Because releases would be very small, no adverse health effects to biological receptors are anticipated.

4.2 No Action Alternative

Under the no action alternative, existing radiological and chemical contamination would remain in place at the ER Project sites (see Table 4-1), site characterization would not be undertaken, and no remedial action would be performed. Because acceptable reduction of risks from contaminants of concern is a condition of the SNL/NM RCRA Part B permit and other applicable regulations, permit or regulation violations could occur if remediation activities prescribed by the applicable regulators were not undertaken.

Some types of institutional controls, signs, and fencing to restrict access would be in place to protect human health and the environment from releases in the short term. Over a longer period of time, at some sites, there would be a potential for increased releases of contaminants to air, groundwater, and surface water that could result in increased risks to human health and the environment. The potential for increased releases would be associated with erosion, surface-water runoff, percolation of contaminants to groundwater, other natural processes, and human intrusions. Impacts of the no action alternative are summarized below and in Table 4-1.

4.2.1 Land Use

Without the ER Project, DOE would be responsible for controlling access to contaminated sites. Land use under the no action alternative would be restricted to current usage or to similar DOE industrial and limited recreational applications with limited public access. Under deed restrictions in effect, DOE-controlled land leased from the USAF could not be returned for KAFB reuse without undertaking completion of the ER Project cleanup actions. Other commercial industrial uses would also be precluded.

4.2.2 Surface-Water and Groundwater Hydrology and Quality

Surface waters could come into contact with contaminants if the no action alternative is implemented. Eventual contamination of surface waters cannot be ruled out. Although most ER Project sites are not located in or adjacent to the arroyos, surface-water quality could be slightly impacted for short durations where ER Project sites are located directly in or near the arroyo channels.

Contaminant migration would be extremely slow at most ER Project sites due to the depth to groundwater and low precipitation. Without the ER Project, the nature and extent of contamination would not be characterized nor would contaminant sources be removed. Adverse impacts on groundwater quality could eventually occur.

4.2.3 Geology and Soils

Under the no action alternative, existing contaminated soils would be left in place at the estimated 157 ER sites. This could reduce future land use options. It could also result in a small incremental human health risk to both SNL/NM workers and the public.

4.2.4 Air Quality

Under the no action alternative, air quality could continue to be impacted in the future by wind dispersion of contaminants. The short-term air quality impacts of the ER Project would exceed those for the no action alternative. Long-term impacts without ER Project contamination source removal could not be readily assessed.

4.2.5 Biological Resources

Under the no action alternative, the presence of contaminants in the ecosystem could negatively impact biologic resources. However, impacts, should they occur, are estimated to be very small. Although no sensitive species or sensitive species habitat would be disturbed under the no action alternative, long-term impacts on biological resources could occur without ER Project contaminant source removal.

4.2.6 Cultural Resources

No impacts to cultural resources are anticipated under the no action alternative.

4.2.7 Noise

No impacts from noise are anticipated under the no action alternative.

4.2.8 Socioeconomic Impacts

No socioeconomic impacts are anticipated under the no action alternative.

4.2.9 Transportation

No transportation activities are associated with the no action alternative. No effects from transportation are anticipated.

4.2.10 Human Health Effects of the No Action Alternative

The human health risk from the proposed action may be compared to a baseline of 0.00047 (4.7×10^{-4}) incremental cancer risk to both SNL/NM workers and the public from general levels of contaminants existing on site and in the Albuquerque metropolitan area. These estimates were based on levels of soil contaminants on and near KAFB and locations in the greater Albuquerque metropolitan area (Culp et al., 1994). Contamination from ongoing operations and existing ER Project sites contributes to this risk, but the relative contribution is unknown. Therefore, the baseline provides an upper estimate of the risk associated with no action.

The incremental cancer risk (estimated as described above) was somewhat greater than that estimated for routine corrective measures operations (4.7×10^{-4} versus 4.2×10^{-5}, respectively) (see Appendix D2, Table D2-19). The higher apparent risk from the no action alternative is probably due to the contribution to environmental contaminants from ongoing SNL/NM site operations and other sources within the Albuquerque metropolitan area. Also, the no action risk assessment included data from sites known to be contaminated. The currently estimated upper bound for health risks is still within a range considered acceptable according to EPA guidance (55 FR 30796).

The systemic toxicity hazard index for the no action alternative is about the same as that for the proposed action (0.16 versus 0.30, respectively).

Under the no action alternative, no adverse human health impacts would occur from industrial accidents or accidental releases.

4.3 Risk Analysis Proposed Action and No Action

The risks to human health were assessed in this EA using accepted methods described in EPA guidance (EPA, 1989a) for assessing risk from releases of hazardous wastes. EPA guidance, however, does not address risk to human health from accidental injuries or fatalities unrelated to releases. An overview of the risk assessment process is provided in Appendix D, Part D1. A detailed description of the risk assessment methods and results are presented in Appendix D, Part D2. These risks were assessed using U.S. Department of Labor statistics for similar industrial operations.

To support a conservative estimate of risk, those ER Project sites with the most extensive data available on contaminate concentrations were examined. These sites are identified as "example sites" in the analysis. *(Five categories of example sites were selected to represent the general categories of ER Project sites being considered for cleanup.)* Concentrations of specific contaminants measured at these sites are detailed in Appendix D2, Tables D2-1 through D2-5. Based on sampling data from these example sites, a set of chemical and radionuclide "indicator" contaminants was identified as *characteristic* of the contaminants present at all ER Project sites. These indicator contaminants and the basis for their selection are discussed in detail in Appendix D, Section D2.2.2. *(For sites where VOCs were not detected, an average concentration of VOCs of 1 ppm was assumed.)* This approach is consistent with EPA risk assessment guidance for sites for which only incomplete data are available (EPA, 1989a).

Where possible, ER Project sites with known historical use and contamination data similar to an example site were grouped with their example site. These groups of similar sites are referred to as "comparable" sites. Risk to human health were assessed for each of these groups using contaminant concentrations at the example sites multiplied by the total waste volume estimated for each group of comparable sites. These comparable ER Project sites, grouped with their example sites, are listed in Appendix D2, Tables D2-6 through D2-10. Table D2-11 shows those ER Project sites assumed to require excavation but for which there is no example site. For these sites, an average concentration of 1 ppm was assumed for each indicator contaminant, which is consistent with EPA risk assessment guidance for sites at which data are incomplete (EPA, 1989a).

Modeling of human health and ecological effects associated with potential contaminant releases from excavation and treatment was based on an assumption that, on average, each site would require one year to remediate. The contaminant concentrations were assumed to be released during excavation, in spite of fugitive-dust emission mitigation measures. For accidents, the contaminant concentrations were multiplied by the soil volumes released to obtain an exposure source term. The assumptions used during this process are detailed in Appendix D2. The risks of human health and ecological effects were evaluated from both routine and accidental exposures through the following possible routes: inhalation, ingestion, dermal contact, and direct exposure to radiation.

As previously stated, the risk from the no action and proposed action were calculated differently because the no action risk included exposure to contaminants from various sources throughout the Albuquerque area while the proposed action risks were based solely on projected cleanup activities. The former was not included in the proposed action because the calculated no-action risk is larger than the proposed action risk. Therefore, including the no action risk in the proposed action estimates would have had the effect of masking the impact of the proposed action.

4.3.1 Populations Considered for Risk Assessment

This risk analysis provides estimates of potential human health effects from radiological and chemical exposures to individuals in three populations groups:

- Workers involved in the proposed action (assumed to be wearing required protective clothing and respiratory protection equipment).
- SNL/NM workers not involved in ER Project activities (i.e., not wearing protective equipment).
- Members of the general public residing or present outside the KAFB boundary.

4.3.2 Accidental Risks

Assessment of the risks to human health from accidents was not limited to accidental releases of contaminants. The risks included:

- Occupational risks.
  - Traffic accidents from waste transport within SNL/NM.
  - Waste handling and heavy equipment operation.
  - Treatment plant operation (construction, maintenance, decontamination decommissioning and closure).
- Accidental exposure risks.
  - Waste handling accident.
  - Transportation accident.

- Abnormal event risks.

  – Aircraft crash.
  – Seismic or high wind events.

As with the risks associated with routine actions, accident risks were assessed for each of three categories:

- Workers involved with the proposed action (the maximum number of persons identified in staffing estimates for the proposed action is 60).

- SNL/NM workers not involved with the proposed action (an estimated 60 persons at an assumed central waste treatment facility).

- Members of the general public whose exposure to accidental releases would depend upon where the release occurred as well as random meteorological conditions on the day of the accident.

4.3.3 Risks From Exposure

The risk from exposure to radionuclides and carcinogenic chemicals is reported as the potential additional risk of cancer incidence (fatal and nonfatal) during the lifetime of an exposed individual. These are calculated as an increasing probability of contracting cancer over and above the risks of any individual's contracting cancer during his or her lifetime. This risk is defined as excess cancer risk. At present, the individual risk of anyone contracting cancer in the United States during his or her lifetime is reported as 1 in 5 (DOC, 1989).

Risks to human health from exposures to hazardous chemicals that are not cancer-causing agents are reported in terms of a hazard index. EPA has established threshold limits for exposure to a chemical that results in adverse physical symptoms or long-term effects. These chemical effects are said to have a hazard index of 1. Thus, chemical hazard indices of less than 1 indicate there would be no known adverse effects resulting from the exposure. Human health and ecological risks associated with proposed disposal activities were based on the assumption that mixed and hazardous wastes would be treated prior to disposal.

4.3.4 Risks Associated with the No Action Alternative

To assess the short-term risks associated with the no action alternative, it was assumed that current waste management practices would continue without modification and that existing environmental monitoring measurements would reflect future contaminant concentrations. "No action" means that no ER Project would be undertaken and that the risks would be the same as those presently incurred. Data on contaminants in soil reported in the SNL/NM Environmental Monitoring Report were used to assess potential risks associated with taking no action at ER Project sites (Culp et al., 1994).

4.4 Cumulative Effects

The Council on Environmental Quality regulations define "cumulative impact" as that which results from the incremental effects of an action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). Cumulative impacts could result from "individually minor but collectively significant" actions. Thus, cumulative impacts were assumed to be additive. For example, the impacts of corrective action-related waste management could be connected to management of waste from day-to-day routine operations, particularly if the same waste management facilities were used. Further, estimated cumulative impacts estimated were conservatively derived and are intended to represent the human health and environmental impact range associated with specifically proposed actions or similar types of actions that may be undertaken eventually, in accordance with EPA-approved RFI/CMS implementation.

The greatest contributor to the human health impacts from proposed ER Project treatment options was estimated to be accidental injuries and fatalities associated with corrective measures operations (see Table 4-6). The incremental cancer risk associated with the no action alternative was estimated to be somewhat greater than the incremental cancer risk for routine corrective measures operations. However, this risk estimate is quite conservative because it is based on measured environmental concentrations that include contributions from operational releases and contaminants at ER Project sites. When risks from corrective measures accidents were included, however, the cancer risks from both taking no action and implementing routine corrective measures were far less than the total risk of at least one fatality and nine lost-time accidents projected to occur during corrective measures. The possibility of accidents would be reduced through driver and operator training programs that emphasize safe practices.

The cumulative estimated hazard index for all potential exposure groups was less than 1. As a result, no systemic toxicity is expected for either the no action alternative or the proposed corrective measures.

Therefore, in general, the environmental and human health impacts associated with ER Project cleanup activities are small, short-term impacts associated mainly with contamination exposures during cleanup activities. Under normal operations, the greatest risks are the risk of physical injuries from transportation accidents transporting contaminated materials on site or off site for treatment and disposal. Although small, short-term impacts would occur, the long-term effects of ER Project cleanup activities would reduce the potential risk of contamination spreading to areas where it does not already exist.

Currently, the USAF has its own restoration program called the Installation Restoration Project, in operation at KAFB, with cleanup activity occurring at some 53 sites. SNL/NM has cooperated with the USAF Installation Restoration Project by sharing information and by integrating planning efforts. Both programs would provide long-term beneficial impacts through the reduction of risks from contamination.

Table 4-6
Comparison of Cumulative Risks to Human Health from the Sandia National Laboratories/New Mexico Environmental Restoration Project and the No Action Alternative[a]

	Health Effect				
Action	Total Incremental Cancer Risk[b]	Hazard Index[c]	Number of Injuries[d]	Number of Fatalities[d]	Appendix D2, Table
Corrective measures, routine operations releases	4.1×10^{-5}	3.2×10^{-1}	NA	NA	D2-14
Corrective measures, accidental releases	1.8×10^{-5}	7.4×10^{-6}	NA	NA	D2-15, D2-16
Corrective measures, accidents	NA	NA	8.4	1.1	D2-17
Summary Proposed Action Impacts	1.0×10^{-4}	3.2×10^{-1}	8.4	1.1	D2-19
No action	5.0×10^{-4} [e]	2×10^{-1} [f]	0	0	D2-18

[a]Risk estimates were made based on data available at the time of the analysis (IT Corporation, 1994). Use of more recent information does not change conclusions in this analysis.
[b]EPA acceptable range 10^{-4} to 10^{-6} (55 FR 30796).
[c]EPA acceptable threshold hazard index <1.
[d]Statistically probable total over assumed 10-year ER project duration based on Department of Transportation statistics for industrial and transportation accidents.
[e]The no action alternative shows a higher estimated health effect risk than the proposed action due to contributions from ongoing SNL/NM operations and contaminants in the Albuquerque metropolitan area.

NA = Not applicable.

Currently, all SNL/NM programs operate within regulatory requirements. The proposed action is an extension of SNL/NM operations. It is expected that the cumulative effects would be commensurate with existing effects. DOE and SNL/NM are pursuing an active program of reducing potential health risk through an ALARA policy for all personnel and the public. In addition to the reduction of cumulative effects associated with the proposed project, reduction of cumulative effects would be anticipated through meeting ALARA standards, preventing pollution, and minimizing waste.

5.0 APPLICABLE ENVIRONMENTAL REGULATIONS, PERMITS, AND DOE ORDERS

The investigation and cleanup of ER Project sites at SNL/NM are primarily regulated by EPA Region 6. The corrective action authority of EPA was granted by Congress through the HSWA of 1984, a statute that amended RCRA. The HSWA requires that any facility seeking a RCRA Part B permit for hazardous waste treatment, storage, or disposal must also undertake corrective action for all releases of hazardous wastes or hazardous constituents from SWMUs at the facility. The following discussion describes the RCRA process. Other applicable local, state, and federal regulations may have additional requirements and follow a different, but equivalent, process.

EPA first proposed regulations to govern RCRA corrective action in 1990 as Proposed Subpart S (55 FR 30798), which have not been finalized but continue to function as guidance for RCRA cleanups. HSWA Module IV of the SNL/NM RCRA Part B permit contains the same structure for cleanups as in Proposed Subpart S. Under the corrective action regime of Proposed Subpart S, cleanup takes place in phases:

- An RCRA Facility Investigation (RFI) defines the nature and extent of contamination, identifies environmental pathways, and evaluates potential threat to human health and the environment.
- A Corrective Measures Study (CMS) is conducted for those sites that pose a threat to human health and the environment and evaluates alternative approaches to clean up.
- A Corrective Measures Implementation (CMI) implements the selected remedy, including design, construction, operation, maintenance, and monitoring stages.

After public input is received on future land use, acceptable cleanup levels are established by EPA on a site-specific basis. Many of the decisions on cleanup levels are based on risk calculations. EPA generally considers a risk range of 1×10^{-6} to 1×10^{-4} (1 in a million to 1 in ten thousand) to be an acceptable range (55 FR 30796). Site-specific decisions incorporate future land use and other site-specific conditions to evaluate the acceptability of the risk calculated.

In some cases, sites that have been identified as SWMUs are later determined, following site investigations, not to pose a threat to human health and environment. For these sites, the Proposed Subpart S provides a mechanism for terminating any further corrective action. This mechanism is called the no further action (NFA) process under which the permittee may propose sites for NFA status. After a rigorous permit modification process with significant public input, EPA will make a determination on the request.

Proposed Subpart S offers a number of provisions aimed at increasing flexibility in RCRA cleanups. One such concept is that of VCMs, which are partial or complete cleanups undertaken at the initiative of the permittee rather that in response to permit compliance schedules. VCMs are intended to save time and money by quickly cleaning up sites for which a remedy is obvious. The SNL/NM RCRA Part B permit contains a specific section on the use of VCMs and many cleanup actions at SNL/NM are performed as a VCM. Prior to performing a VCM, SNL/NM presents the planned work to the public and applicable regulatory authorities.

Another section of Proposed Subpart S that was intended to add flexibility to cleanups is the CAMU option. The CAMU provisions were finalized as a separate rule in February 16, 1993 (57 FR 8658). A CAMU is a new hazardous waste management unit to be used only for treating and/or disposing of remediation wastes (i.e., those wastes resulting from cleanups). EPA has stated that the CAMU provisions were designed to "reduce or eliminate certain waste management requirements of the current RCRA Subtitle C regulations, which, when applied to remediation wastes, impede the ability of [EPA] to select and implement reliable, protective, and cost-effective remedies at RCRA facilities" (57 FR 8658). A CAMU allows remediation waste to be consolidated, treated, and disposed of on site at a facility under standards developed specifically for that facility through the permit modification process.

The activities associated with RCRA corrective actions invoke many other regulations covering air quality, water quality, waste management, threatened and endangered species, cultural resources, and health and safety. Most of these additional requirements are imposed by federal or state agencies and are issued in the form of regulations or Executive Orders. Some additional requirements are imposed by DOE Orders. Table 5-1 presents a representative list of consultations, permits, and compliance requirements that may apply to the SNL/NM ER Project.

Table 5-1
Representative List of Consultations, Permits, and Compliance Requirements that May Be Applicable to the Sandia National Laboratories/New Mexico Environmental Restoration Project

Consultation, Permit, or Compliance Requirement	Granting or Approving Agency	Statute or Regulation	Activity
Waste Management			
Requirement; RCRA permit	NMED	20 NMAC 4.1, Subpart II, 40 CFR 261	Hazardous waste identification.
Requirement; RCRA permit	NMED	20 NMAC 4.1, Subpart III, 40 CFR 262	Generator requirements for packaging, labeling, marking, placarding, manifesting, accumulating, and recordkeeping.
Requirement; RCRA permit	NMED	20 NMAC 4.1, Subpart V, 40 CFR 264; 20 NMAC 4.1, Subpart IX, 40 CFR 270	Technical and permitting requirements for owners and operators of treatment, storage, and disposal facilities.
Requirement; RCRA permit	NMED	20 NMAC 4.1, Subpart VIII, 40 CFR 268	Land disposal restrictions for the storage, treatment, and disposal of hazardous waste.
Requirement	EPA Region 6	40 CFR 264.552	Requirements for implementing temporary units and/or corrective action management units.
Requirement	DOE	DOE Order 5820.2A	Policies, guidelines, and minimum requirements for managing radioactive and mixed waste at DOE facilities.
Requirement	DOE	DOE Order 5400.3	Policies and requirements to implement the RCRA.
Requirement	DOE	DOE Order 5400.5	Standards for radiation protection of the public and the environment.

Refer to footnotes at end of table.

Table 5-1 (Continued)
Representative List of Consultations, Permits, and Compliance Requirements that May Be Applicable to the Sandia National Laboratories/New Mexico Environmental Restoration Project

Consultation, Permit, or Compliance Requirement	Granting or Approving Agency	Statute or Regulation	Activity
Air Quality			
Requirement	EPA Region 6	Clean Air Act (42 U.S.C. §§.7401 et seq. and amendments)	Federal air quality program.
Requirement	NMED (with the Albuquerque Environmental Health Department, Air Pollution Control Division having local authority)	New Mexico Air Quality Control Act	Air quality standards for New Mexico.
Permit	City of Albuquerque Environmental Health Department, Air Pollution Control Division	ABC Air Quality Control Regulations	Construction permit for potential emission of hazardous air pollutants or contaminants; control of particulate emissions; or demonstration through modeling and analysis that emissions will violate air standards.
Threatened, Endangered, and Sensitive Species			
Consultation	USFWS	Endangered Species Act	Consultation(s) with the USFWS Regional Director to determine impacts (if any) on proposed or listed threatened or endangered species or their critical habitats; preparation of a biological assessment if any protected species will be affected.
Consultation	New Mexico Department of Game and Fish	The New Mexico Endangered Wildlife Act	Protected wildlife for New Mexico.
Consultation	The New Mexico Forestry and Resource Conservation Division of the Energy, Minerals, and Natural Resources Department	The New Mexico Endangered Plant Species Act	Protected endangered plants for New Mexico.

Refer to footnotes at end of table.

Table 5-1 (Continued)
Representative List of Consultations, Permits, and Compliance Requirements that May Be Applicable to the Sandia National Laboratories/New Mexico Environmental Restoration Project

Consultation, Permit, or Compliance Requirement	Granting or Approving Agency	Statute or Regulation	Activity
		Cultural Resources	
Consultation	New Mexico State Historic Preservation Office and the ACHP	National Historic Preservation Act and Executive Order 11593	Identification of historic properties that may be potentially affected by a proposal action; determination of the effects of the action on such properties; consultation(s) (at an early date) among the federal agency, the State Historic Preservation Office, and others to identify ways to mitigate potential effects on such properties; and a reasonable opportunity for ACHP to comment on the undertaking.
Permit	Department of Interior National Park Service	The Antiquities Act of 1906 (16 U.S.C. §§432 et seq.)	Protection of historic and prehistoric remains and monuments on federal lands; permitting system for conducting scientific archaeological investigations.
Requirements	Department of Interior National Park Service	The Historic Sites Act of 1935 (16 U.S.C. §§461 et seq.)	Historic Sites Surveys, Historic American Buildings Surveys, and the National Architectural and Engineering Record
Requirements	Department of Interior National Park Service	The Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469 et seq.)	Nationwide program for the recovery, protection, and preservation of scientific, prehistoric, and archaeological data that would otherwise be damaged or destroyed through federal action.
Permit	Department of Interior National Park Service	The Archaeological Resources Protection Act of 1979 (16 U.S.C. §§470aa-27)	Comprehensive framework for protecting and regulating the use of archaeological resources on federal and Indian lands; permit for excavating and removing archaeological resources prior to the occurrence of surface-disturbing activities.

Refer to footnotes at end of table.

Table 5-1 (Continued)
Representative List of Consultations, Permits, and Compliance Requirements that May Be Applicable to the Sandia National Laboratories/New Mexico Environmental Restoration Project

Consultation, Permit, or Compliance Requirement	Granting or Approving Agency	Statute or Regulation	Activity
Consultation	Department of Interior National Park Service	The American Indian Religious Freedom Act of 1978 (42 U.S.C. §§1996 et seq.)	Consultation with potentially affected Native Americans (e.g., Sandia and Isleta Pueblo Indians) if an action constitutes an infringement on religious rites or ceremonial sites.
Consultation	Department of Interior National Park Service	The Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §§3001 et seq.)	Protection of Native American graves, burial grounds, human remains, and funerary objects.
Floodplains and Wetlands			
Requirement	DOE (as lead agency)	Executive Order 11988	Evaluation of the potential effects of any activity to be undertaken in a floodplain to consider floodplain hazards and management.
Requirement	DOE (as lead agency)	Executive Order 11990	Procedures for implementing floodplain and wetland management requirement.
Requirement	NEPA	40 CFR 1502.25	Integrate preparation of NEPA documents with other environmental review requirements and Executive Orders.
Requirement	DOE (as lead agency)	10 CFR Part 1022	Requirements for floodplain management and wetlands protection.
Operations Health and Safety			
Requirement	DOE (as lead agency)	29 CFR Parts 1900 through 1926; DOE Order 5482.1B	Health and safety requirements for workers at a hazardous waste site; safe operating procedures for health and safety during facility construction and operations.

Refer to footnotes at end of table.

Table 5-1 (Continued)
Representative List of Consultations, Permits, and Compliance Requirements that May Be Applicable to the Sandia National Laboratories/New Mexico Environmental Restoration Project

Consultation, Permit, or Compliance Requirement	Granting or Approving Agency	Statute or Regulation	Activity
Requirement; RCRA permit	NMED	20 NMAC 4.1, Subpart V, 40 CFR 264.16	Training requirements for corrective action personnel.
Requirement; RCRA permit	NMED	20 NMAC 4.1, Subpart V, 40 CFR Part 264, Subpart D	Emergency response requirements.
Requirement	EPA	Comprehensive Environmental Response, Compensation, and Liability Act §102(a) and 40 CFR Part 302	Reporting requirements for releases of hazardous substances.
Requirement	EPA	40 CFR 112	Requirements for Spill Prevention, Controls, and Countermeasures Plan defines processes for reporting and cleanup of releases of hazardous substances.
Requirement	DOE	10 CFR 835	Occupational radiation protection standards.
Requirement	DOE	DOE Order 5480.1B	Requirements for: radiation protection for occupational workers; an environment, safety, and health program; the packaging and transportation of hazardous materials, hazardous substances, and hazardous wastes; environmental protection, safety, and health protection and reporting; general environmental protection; and contractor industrial hygiene.

Refer to footnotes at end of table.

Table 5-1 (Concluded)
Representative List of Consultations, Permits, and Compliance Requirements that May Be Applicable to the Sandia National Laboratories/New Mexico Environmental Restoration Project

Consultation, Permit, or Compliance Requirement	Granting or Approving Agency	Statute or Regulation	Activity
Water Quality			
Permit	City of Albuquerque Publicly Owned Treatment Works	City Ordinance Sewer Use and Wastewater Control	Pretreatment Standards for discharges to the sanitary sewer.
Permit	EPA Region 6	40 CFR 122-124	Stormwater discharge monitoring. Permit application under review.
Requirement	NMED	New Mexico Water Supply Regulations 202-207	Maximum contaminant levels for public water supplies.
Requirement	New Mexico Water Quality Control Commission	New Mexico Water Quality Regulations parts 1 thru 5	Prior authorization for discharges to the land surface, or any discharges that may affect groundwater; unplanned discharges. Additional remedial actions may be required through the abatement plan process.

ACHP = Advisory Council on Historic Preservation
CFR = Code of Federal Regulations
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
NEPA = National Environmental Policy Act
NMAC = New Mexico Administrative Code
NMED = New Mexico Environment Department
RCRA = Resource Conservation and Recovery Act
U.S.C. = United States Code
USFWS = U.S. Fish and Wildlife Service

6.0 LIST OF AGENCIES AND PERSONS CONTACTED

Agency	Address	Contact	Phone Number
Federal Agencies Contacted			
U.S. Department of Defense, U.S. Air Force, Kirtland Air Force Base 377th Air Bomber Wing	200 Wyoming Boulevard SE, Suite 5659 Kirtland Air Force Base, NM 87117	Chris Tuttle Environmental Protection Specialist	(505) 846-0029/0042 (505) 846-9001
U.S. Fish and Wildlife Service	Ecological Services Suite D 3530 Pan American Highway NE Albuquerque, NM 87107	Jennifer Fowler-Propft Field Supervisor	(505) 761-4525
U.S. Forest Service Cibola National Forest	Sandia Ranger District 11776 Highway 337 Tijeras, NM 87059	John Hayden Ranger Tom Cartledge Archaeologist	(505) 281-3304 (505) 761-4650
U.S. Geological Survey	4501 Indian School Road NE Albuquerque, NM 87110	Pat Boreland Hydrologist	(505) 262-5328
State of New Mexico Agencies Contacted			
New Mexico Bureau of Business and Economic Research Databank	University of New Mexico 1919 Las Lomas NE Albuquerque, NM 87131-6021	Guy Dameron Economist	(505) 277-2216
New Mexico Historic Preservation Division State of New Mexico	Office of Cultural Affairs Villa Rivera 228 E. Palace Avenue Santa Fe, NM 87503	David Cushman Archaeologist Michael Romero Taylor State Historic Preservation Officer	(505) 827-6320
New Mexico Department of Game and Fish	Villagra Building Santa Fe, NM 87503	Jerry Maracchini Director	(505) 841-8881
New Mexico Energy, Minerals, and Natural Resources Department Forestry and Resources Conservation Division	Villagra Building Santa Fe, NM 87503 P.O. Box 1948 Santa Fe, NM 87504-1948	Toby Martinez Director Robert Sivinski or Karen Lightfoot	(505) 827-5832 (505) 827-7865

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APPENDIX A

Information Tables
Sandia National Laboratories/New Mexico
Environmental Restoration Sites

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LIST OF TABLES

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Table A-1
Sandia National Laboratories/New Mexico Environmental Restoration Sites

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
1	1	Radioactive Waste Landfill (TA-II)—low-level radioactive waste disposal	**Nearest Well:** KAFB #6 0.3 mi NW **Surface Water:** Tijeras Arroyo 0.4 mi E **Fault:** Sandia 1.3 mi E **Depth to GW:** 500 ft	KAFB boundary 0.25 mi E KAFB Eubank Gate 0.95 mi NE	12,000 ft^2 (1,110 m^2) 12,000 ft^3 (340 m^3)	DU IO M (D) RAD VOC	BW Soil
2	2	Classified Waste Landfill (TA-II)—*classified waste disposal*	**Nearest Well:** KAFB #6 0.3 mi NNW **Surface Water:** Tijeras Arroyo 0.4 mi E **Fault:** Sandia 1.3 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.7 mi E KAFB Eubank Gate 0.9 mi NNE	110,000 ft^2 (9,962 m^2) 110,000 ft^3 (3,115 m^3)	DU HE (D) M (D) PCB RAD VOC	BW Soil Debris
3	3	Chemical Disposal Pit (TA-II)—nonradioactive chemical disposal	**Nearest Well:** KAFB #6 0.2 mi NW **Surface Water:** Tijeras Arroyo 0.4 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.3 mi E KAFB Eubank Gate 0.9 mi N	12,000 ft^2 (1,148 m^2) NFA	Non-RAD	BW Soil
4	4	LWDS Surface Impoundments—for wastewater discharged from TA-V holding tank	**Nearest Well:** KAFB #10 (inactive) 0.2 mi S KAFB #9 1.3 mi ENE KAFB #8 2.1 mi NW **Surface Water:** Arroyo del Coyote 0.8 mi E **Fault:** Sandia 1.25 mi E **Depth to GW:** 450 ft	KAFB boundary 1.7 mi W KAFB Eubank Gate 3.6 mi N	36,000 ft^2 (3,304 m^2) NFA	PCB RAD	Soil
5	5	LWDS Drainfield (TA-V)—for liquid wastes discharged from TA-V holding tanks	**Nearest Well:** KAFB #10 (inactive) 0.25 mi SW KAFB #9 1.25 mi ENE KAFB #8 2.3 mi NW **Surface Water:** Arroyo del Coyote 0.75 mi E **Fault:** Sandia 1 mi E **Depth to GW:** 490 ft	KAFB boundary 1.8 mi W KAFB Eubank Gate 3.7 mi NE	4,700 ft^2 (435 m^2) NFA	RAD VOC	Soil GW
6	6	Gas Cylinder Disposal Pit (Bldg. 9966)	**Nearest Well:** KAFB #10 (inactive) 2.5 mi NNW KAFB #9 3.2 mi NE **Surface Water:** Arroyo del Coyote 2.4 mi NE **Fault:** Hubbell Springs 0.25 mi E **Depth to GW:** 500 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.25 mi N	800 ft^2 (74 m^2) NFA	M (D)	BW Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
7	7	Gas Cylinder Disposal (Arroyo del Coyote)	**Nearest Well:** KAFB #9 0.3 mi NE KAFB #10 (inactive) 1.5 mi SW **Surface Water:** Site in Arroyo del Coyote **Fault:** Sandia 0.2 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2.6 mi W KAFB Eubank Gate 3.5 mi N	310,000 ft^2 (28,900 m^2) 310,000 ft^3 (8,778 m^3)	DU HE (D) SVOC VOC	BW Debris Soil SW
8	8	Open Dump (Coyote Canyon Blast Area)—general debris from explosive packing crates	**Nearest Well:** Graystone Manor 0.8 mi SW KAFB #9 2.6 mi W **Surface Water:** Arroyo del Coyote 0.3 mi S **Fault:** Manzano 0.5 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 1 mi N KAFB Eubank Gate 4.75 mi NW	580,000 ft^2 (53,775 m^2) 58,000 ft^3 (1,642 m^3)	DU HE (D)	Debris Soil
9	9	Burial Site/Open Dump (Schoolhouse Mesa)—miscellaneous solid waste disposal	**Nearest Well:** Schoolhouse Mesa 0.1 mi W KAFB #9 2.6 mi WNW **Surface Water:** Arroyo del Coyote 0.5 mi N **Fault:** Manzano <0.1 mi E **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2.25 mi NE KAFB Eubank Gate 5.5 mi NW	81,000 ft^2 (7,517 m^2) 4,700 ft^3 (133 m^3)	HE (D) DU VOCs SVOCs Metals	BW Debris Soil
10	10	Burial Mounds (Bunker Area)—3 mounds plus a burial area containing test debris and covered with soil	**Nearest Well:** Graystone Manor 1.8 mi SSW KAFB #9 3 mi SW **Surface Water:** Arroyo del Coyote 1.5 mi SW **Fault:** Between Tijeras Arroyo and Manzano **Depth to GW:** >200 ft	KAFB boundary 0.2 mi E KAFB Eubank Gate 4.25 mi NW	3,100,000 ft^2 (288,603 m^2) 310,000 ft^3 (8,778 m^3)	DU Metals	BW Debris Soil
11	11	Explosive Burial Mounds—3 waste mounds possibly containing HE or radioactive materials	**Nearest Well:** Schoolhouse Mesa 2.25 mi NE KAFB #9 2.25 mi NW **Surface Water:** Arroyo del Coyote 2 mi N **Fault:** Manzano 2.2 mi E **Depth to GW:** 50 ft	KAFB boundary 0.75 mi S KAFB Eubank Gate 6.75 mi NW	68,000 ft^2 (6,328 m^2) 6,800 ft^3 (193 m^3)	PHC HE Metals	BW Debris Soil
12	12	Burial Site/Open Dump (Lurance Canyon)—in arroyo under parking area explosives testing	**Nearest Well:** Graystone Manor 4 mi WSW KAFB #9 6 mi W **Surface Water:** Arroyo del Coyote 1.1 mi NW **Fault:** Manzano 3.8 mi W **Depth to GW:** 230 ft	USFS Withdrawn Area boundary 1.9 mi N KAFB Eubank Gate 7.75 mi NW	580,000 ft^2 (53,848 m^2) 58,000 ft^3 (1,642 m^3)	DU HE (D) M (D) VOC	BW Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
13	13	Oil Surface Impoundment (Lurance Canyon Burn Site)—P4 jet fuel	**Nearest Well:** Graystone Manor 4 mi WSW KAFB #9 6 mi W **Surface Water:** Arroyo del Coyote 1.1 mi NW **Fault:** Manzano 3.8 W **Depth to GW:** 230 ft	USFS Withdrawn Area boundary 1.9 mi N KAFB Eubank Gate 7.75 mi NW	7,800 ft^2 (729 m^2) 240,000 ft^3 (6,795 m^3)	PHC	Soil
14	14	Burial Site (Bldg. 9920)—3 pits for Be firing tests, DU tests, and fluorescent bulbs	**Nearest Well:** KAFB #10 1.4 mi NW KAFB #9 1.8 mi NE **Surface Water:** Arroyo del Coyote 1.2 mi NE **Fault:** Sandia 0.25 mi E **Depth to GW:** 450–500 ft	KAFB boundary 2.3 mi W KAFB Eubank Gate 5 mi N	63,000 ft^2 (5,844 m^2) 500,000 ft^3 (14,158 m^3)	DU M (D)	BW Soil
15	15	Trash Pits (Frustration Site)—3 shallow pits that may contain ordnance from the mortar practice range	**Nearest Well:** Schoolhouse Mesa 3 mi NW KAFB #9 5.4 mi NW **Surface Water:** Arroyo del Coyote 4.5 mi NNW **Fault:** Manzano 1.4 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 0.5 mi S KAFB Eubank Gate 8.5 mi NNW	110,000 ft^2 (9,861 m^2) NFA	HE (F)	BW Debris Soil
16	16	Open Dumps (Arroyo del Coyote)—waste piles containing rebar, concrete, wood, oil-contaminated soil, rocket debris, potting compounds	**Nearest Well:** KAFB #9 0.5 mi E KAFB #10 1 mi SW **Surface Water:** Site in Arroyo del Coyote **Fault:** Sandia 0.4 mi E **Depth to GW:** 490 ft	In progress.	860,000 ft^2 (80,148 m^2) 86,000 ft^3 (2,435 m^3)	DU HE (D,F) PHC SVOC VOC	Debris BW Soil
17	17	Scrap Yards/Open Dump (Thunder Range)—test materials	**Nearest Well:** KAFB #10 (inactive) 2.5 mi NNW KAFB #9 3.2 mi NE **Surface Water:** Arroyo del Coyote 2.4 mi NE **Fault:** Hubbell Springs 0.25 E **Depth to GW:** 500 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.25 mi N	330,000 ft^2 (30,520 m^2) NFA	Asbestos DU M (D) PCB PHC	BW Debris Soil
18	18	Concrete Pad—sled track equipment storage and scrap material	**Nearest Well:** KAFB #10 (inactive) 1 mi N KAFB #9 2.2 mi NE: KAFB #8 3 mi NNW **Surface Water:** Arroyo del Coyote 1.8 mi NE **Fault:** Sandia 1.25 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.3 mi W KAFB Eubank Gate 4.6 mi NNE	49,000 ft^2 (4,584 m^2) 5,000 ft^3 (142 m^3)	HE (D) M (D) PCB PHC	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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19	19	TRUPAK Boneyard Storage Area—storage of field test activity materials	**Nearest Well:** Schoolhouse Mesa 1.5 mi NW KAFB #9 4 mi NW **Surface Water:** Arroyo del Coyote 1.6 mi N **Fault:** Manzano 1.2 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2 mi S KAFB Eubank Gate 7 mi NW	170,000 ft^2 (15,897 m^2) 5,000 ft^3 (142 m^3)	HE (D) M (D) RAD	Soil Debris
20	20	Schoolhouse Mesa Burn Site—fire testing	**Nearest Well:** Schoolhouse Mesa <0.2 mi E KAFB #9 2.4 mi NW **Surface Water:** Arroyo del Coyote 0.25 mi N **Fault:** Manzano 0.4 mi E **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2.25 mi NE KAFB Eubank Gate 5.5 mi NW	7,900 ft^2 (733 m^2) NFA	M (D) PHC	Soil
21	21	Metal Scrap (Coyote Canyon)—empty 55-gal drum and metal scrap	**Nearest Well:** Graystone Manor 0.3 mi WSW KAFB #9 2.5 mi WNW **Surface Water:** Arroyo del Coyote 0.1 mi S **Fault:** Manzano <0.1 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 1.4 mi N KAFB Eubank Gate 5 mi NW	43,000 ft^2 (3,961 m^2) NFA	Metals PHC PCBs	Debris Soil
22	22	Storage/Burn Site (West of DEER)—contains a 55-gal drum and several wooden pallets	**Nearest Well:** Schoolhouse Mesa 1.75 mi NNW KAFB #9 3.8 mi NW **Surface Water:** Arroyo del Coyote 2 mi NW **Fault:** Manzano 0.25 mi W **Depth to GW:** 50 ft	KAFB boundary 1 mi S KAFB Eubank Gate 7.1 mi NW	1,800 ft^2 (166 m^2) NFA	Unknown	Debris Soil
23	23	Disposal Trenches (Near Tijeras Arroyo)—training exercises	**Nearest Well:** KAFB #8 1 mi NW KAFB #4 1.5 mi NW **Surface Water:** Tijeras Arroyo 0.5 mi N **Fault:** Sandia 1 mi E **Depth to GW:** 400–500 ft	KAFB boundary 1.5 mi N KAFB Eubank Gate 2 mi N	700,000 ft^2 (65,166 m^2) <35 ft^3 (<1 m^3)	RAD	BW Soil
24	25	Burial Site (South of TA-I)—explosives research building debris placed in a trench exact location unknown	**Nearest Well:** NA **Surface Water:** NA **Fault:** NA **Depth to GW:** NA This site has not been found at SNL/NM.	NA	NA NFA	HE (D)	BW Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
25	26	Burial Site (West of TA-III)—scrap metal and wood, rocket bodies and motors from the Long Sled Track	**Nearest Well:** KAFB #10 (inactive) 1.25 mi ENE KAFB #9 2.75 mi ENE KAFB #8 2.5 mi N **Surface Water:** Arroyo del Coyote 2 mi NE **Fault:** Sandia 2.25 mi E **Depth to GW:** 450–490 ft	KAFB boundary 0.5 mi W KAFB Eubank Gate 4.5 mi NE	1,800,000 ft^2 (168,087 m^2) NFA	HE (D) M (D)	BW Soil
26	27	Bldg. 9820 Animal Disposal Pit—12 donkeys used in a radiation study	**Nearest Well:** Graystone Manor and Schoolhouse Mesa 1.4 mi WNW and WSW, respectively KAFB #9 4.5 mi WNW **Surface Water:** Arroyo del Coyote 0.3 mi N **Fault:** Manzano 1 mi W **Depth to GW:** < 50 ft	USFS Withdrawn Area boundary 1.5 mi N KAFB Eubank Gate 6 mi NW	5,700 ft^2 (528 m^2) NFA	RAD Unknown	BW Soil GW
27	28	Mine Shafts—used for waste and debris storage	**Nearest Well:** Graystone Manor 3.1 mi WSW KAFB #9 5.25 mi W **Surface Water:** Arroyo del Coyote 0.5 mi NW **Fault:** *Manzano 3 mi W* **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2.3 mi N KAFB Eubank Gate 7.1 mi NW	7,000 ft^2 (653 m^2) NFA	Unknown	Soil
28	30	PCB Spill (Reclamation Yard)	**Nearest Well:** KAFB #6 0.1 mi S **Surface Water:** Tijeras Arroyo 0.6 mi SE **Fault:** Sandia 1.5 mi E **Depth to GW:** 400 ft	KAFB Eubank Gate 0.5 mi NE KAFB boundary 0.3 mi E	240,000 ft^2 (21,861 m^2) 1,200,000 ft^3 (33,980 m^3)	PCB	Soil
29	31	Electrical Transformer Oil Spill (TA-II)	**Nearest Well:** KAFB #10 0.2 mi NNW KAFB #9 1.5 mi ENE KAFB #8 2.5 mi NW **Surface Water:** Arroyo del Coyote *1 mi ENE* **Fault:** Sandia 1.1 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.75 mi W KAFB Eubank Gate 4 mi NNE	1,400 ft^2 (128 m^2) NFA	PCB PHC	Soil
30	32	Steam Plant Oil Spill (TA-I)	**Nearest Well:** KAFB #6 0.7 mi SE **Surface Water:** Tijeras Arroyo 1.3 mi SE **Fault:** Sandia 1.1 mi E **Depth to GW:** 554 ft	KAFB Wyoming Gate 1 mi NNE KAFB boundary 1 mi E	9,600 ft^2 (894 m^2) NFA	PHC	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
31	33	Motor Pool Oil Spill (TA-I)	**Nearest Well:** KAFB #6 0.5 mi S KAFB #1.3 mi NW **Surface Water:** Tijeras Arroyo 1 mi SE **Fault:** Sandia 1.5 mi E **Depth to GW:** 400 ft	KAFB boundary 0.5 mi E KAFB Eubank Gate 1 mi NW	81,000 ft^2 (7,544 m^2) 40 (1.1 m^3)	PHC	Soil
32	34	Centrifuge Oil Spill (TA-III)	**Nearest Well:** KAFB #10 (inactive) 0.2 mi NNW KAFB #9 1.5 mi NE KAFB #8 2.5 mi NW **Surface Water:** Arroyo del Coyote 1.1 mi NE **Fault:** Sandia 1 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.75 mi W KAFB Eubank Gate 4 mi NNE	7,000 ft^2 (649 m^2) <35 ft^3 (<1 m^3)	PHC	Soil
33	35	Vibration Facility Oil Spill (TA-III)	**Nearest Well:** KAFB #10 (inactive) 0.5 mi N KAFB #9 1.8 mi NE KAFB #8 2.75 mi NW **Surface Water:** Arroyo del Coyote 1.25 mi NE **Fault:** Sandia 1.1 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.6 mi W KAFB Eubank Gate 4.25 mi N	1,000 ft^2 (97 m^2) NFA	PHC	Soil
34	36	Oil Spill—HERMES (TA-V)	**Nearest Well:** KAFB #10 (inactive) 0.3 mi WSW KAFB #9 1.5 mi ENE KAFB #8 2.3 mi NW **Surface Water:** Arroyo del Coyote 0.6 mi NE **Fault:** Sandia 0.9 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.9 mi W KAFB Eubank Gate 3.75 mi N	2,000 ft^2 (186 m^2) 160,000 ft^3 (4,530 m^3)	PCB PHC	Soil
35	37	PROTO Oil Spill (TA-V)	**Nearest Well:** KAFB #10 (inactive) 0.3 mi W KAFB #9 1.25 mi ENE KAFB #8 2.3 mi NW **Surface Water:** Arroyo del Coyote 0.75 mi ENE **Fault:** Sandia 0.8 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2 mi W KAFB Eubank Gate 3.75 mi N	990 ft^2 (92 m^2) NFA	PHC	Soil
36	38	Oil Spills (Bldg. 9920)	**Nearest Well:** KAFB #10 (inactive) 1.5 mi NW KAFB #9 2.9 mi NNE **Surface Water:** Arroyo del Coyote 2.2 mi NE **Fault:** Sandia 0.3 mi E **Depth to GW:** 90–500 ft	KAFB boundary 2.1 mi S KAFB Eubank Gate 5.25 mi N	600 ft^2 (56 m^2) 7,200 ft^3 (204 m^3)	PHC	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
37	39	Oil Spill Solar Facility	**Nearest Well:** Schoolhouse Mesa 2.7 mi NE KAFB #9 2.9 mi NNW **Surface Water:** Arroyo del Coyote 2.3 mi N **Fault:** Hubbell Springs 1.1 mi W **Depth to GW:** 50 ft	KAFB boundary 1 mi S KAFB Eubank Gate 6.3 mi NNW	700 ft^2 (65 m^2) NFA	PHC	Soil
38	40	Oil Spill (Area 6,000 Igloo)	**Nearest Well:** KAFB #2 0.5 mi N **Surface Water:** Tijeras Arroyo 0.4 mi SSE **Fault:** Sandia 3.8 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.4 mi NE KAFB Eubank Gate 2.75 mi NE	700 ft^2 (65 m^2) NFA	PHC	Soil
39	41	Bldg. 838 Mercury Spill (TA-I)	**Nearest Well:** KAFB #6 0.6 mi SE **Surface Water:** Tijeras Arroyo 1.3 mi SE **Fault:** Sandia 1.8 mi E **Depth to GW:** 400 ft	KAFB boundary 0.8 mi E KAFB Eubank Gate 0.7 mi E	6,100 ft^2 (569 m^2) NFA	M (D)	Soil
40	42	Acid Spill Water Treatment Facility (TA-I)	**Nearest Well:** KAFB #6 0.3 mi S KAFB #1.5 mi NW **Surface Water:** Tijeras Arroyo 0.8 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 400 ft	KAFB boundary 0.4 mi E KAFB Eubank Gate 0.5 mi NE	20,200 ft^2 (1,877 m^2) 530 ft^3 (15 m^3)	IO	Soil
41	43	Radioactive Material Storage Yard	**Nearest Well:** KAFB #6 0.4 mi SSW **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.5 mi NE KAFB Eubank Gate 1 mi NE	4,900 ft^2 (453 m^2) 1,700 ft^3 (48 m^3)	M (D) RAD	Soil
42	44	Decontamination Site and Uranium Calibration Pits (TA-II)—weapons components and related test materials from NTS testing and calibration of downhole radiometric tools	**Nearest Well:** KAFB #6 0.25 mi SSW **Surface Water:** Tijeras Arroyo 0.4 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 450+ ft	KAFB boundary 0.4 mi E KAFB Eubank Gate 0.9 mi NE	29,000 ft^2 (2,669 m^2) 1,400 ft^3 (40 m^3)	IO M (D) RAD	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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43	45	Liquid Discharge (Behind TA-IV)—from a truck backed up to the arroyo bank	**Nearest Well:** KAFB #6 0.5 mi N **Surface Water:** Tijeras Arroyo 0.3 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.6 mi NE KAFB Eubank Gate 1.2 mi NE	78,000 ft^2 (7,257 m^2) 7,800 ft^3 (221 m^3)	Unknown	Soil
44	46	Old Acid Waste Line Outfall (Tijeras Arroyo)	**Nearest Well:** KAFB #8 0.5 mi SW KAFB #4 0.8 mi W **Surface Water:** Tijeras Arroyo 0.4 mi S **Fault:** Sandia 1.75 mi E **Depth to GW:** 300–500 ft	KAFB boundary 1 mi NE KAFB Eubank Gate 1.5 mi NE	48,000 ft^2 (4,482 m^2) 48,000 ft^3 (1,359 m^3)	IO M (D) VOC	Soil
45	47	Unmanned Seismic Observatory—seismic vaults	**Nearest Well:** Schoolhouse Mesa 2.9 mi NNW KAFB #9 5 mi NW **Surface Water:** Arroyo del Coyote 3.75 mi N **Fault:** Manzano 0.4 mi W **Depth to GW:** 50 ft	On southern USFS Withdrawn Area boundary KAFB Eubank Gate 8.25 mi NW	2,100 ft^2 (196 m^2) NFA	Unknown	Debris Soil
46	48	Bldg. 904 Septic System	**Nearest Well:** KAFB #6 0.35 mi N **Surface Water:** Tijeras Arroyo 0.3 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.3 mi E KAFB Eubank Gate 1.25 mi NNE	20,000 ft^2 (1,892 m^2) NFA	HE (D) PHC VOC	Soil
47	49	Drains Bldg. 9820 (HE synthesis)	**Nearest Well:** Schoolhouse Mesa and Graystone Manor 1.5 mi W KAFB #9 3.5 mi W **Surface Water:** Arroyo del Coyote 0.3 mi N **Fault:** Coyote 0.5 mi NW Manzano 1 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 1.6 mi N KAFB Eubank Gate 6 mi WNW	8,700 ft^2 (801 m^2) NFA	HE (D) IO M (D) VOC	Air Soil
48	50	Old Centrifuge Site (Tijeras Arroyo)—rocket-propelled centrifuge	**Nearest Well:** KAFB #6 0.35 mi NW **Surface Water:** Tijeras Arroyo 0.25 mi E **Fault:** Sandia 1.2 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.25 mi NNE KAFB Eubank Gate 0.8 mi NNE	17,000 ft^2 (1,570 m^2) NFA	IO PCB	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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49	51	Bldg. 6924 Pad, Tank, Pit—HE synthesis	**Nearest Well:** KAFB #10 (inactive) 1.5 mi NNW KAFB #9 2.3 mi NE KAFB #8 3.75 mi NW **Surface Water:** Arroyo del Coyote 1.75 mi NE **Fault:** Sandia 0.8 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.9 mi S KAFB Eubank Gate 5.25 mi N	6,700 ft^2 (624 m^2) 9,100 ft^3 (258 m^3)	HE RAD	Soil
50	52	LWDS Holding Tanks (TA-V)	**Nearest Well:** KAFB #10 (inactive) *0.25 mi SW KAFB #9 1.25 mi ENE* KAFB #8 2.3 mi NW **Surface Water:** Arroyo del Coyote 0.75 mi E **Fault:** Sandia 1 mi E **Depth to GW:** 490 ft	KAFB boundary 1.8 mi W KAFB Eubank Gate 3.7 mi NE	25,000 ft^2 (2,344 m^2) NFA	Unknown	Soil
51	53	Bldg. 9923 Storage Igloo—radioactive materials from NTS neutron activation experiments	**Nearest Well:** **Surface Water:** **Fault:** **Depth to GW:** Determination in progress.	Determination in progress.	1,500 ft^2 (137 m^2) NFA	RAD	Soil
52	54	Pickax Site (Thunder Range)—HE testing	**Nearest Well:** KAFB #10 (inactive) 2 mi N KAFB #9 2.9 mi NE **Surface Water:** Arroyo del Coyote 2.2 mi NE **Fault:** Hubbell Springs 0.3 mi E **Depth to GW:** 450–500 ft	KAFB boundary 0.75 mi S KAFB Eubank Gate 5.9 mi NNE	18,000,000 ft^2 (1,715,139 m^2) 1,800,000 ft^3 (50,471 m^3)	HE (D) IO RAD	Soil
53	55	Red Towers Site (Thunder Range)—*tower for simulated weapons testing* with up to 50 lb of explosives	**Nearest Well:** KAFB #10 (inactive) *2.7 mi N KAFB #9 3.5 mi NE* **Surface Water:** Arroyo del Coyote 2.75 mi NE **Fault:** Hubbell Springs 0.2 mi E **Depth to GW:** 500 ft	KAFB boundary 0.5 mi S KAFB Eubank Gate 6.6 mi N	73,000 ft^2 (6,768 m^2) 7,300 ft^3 (207 m^3)	DU HE (D) M (D)	Soil
54	56	Old Thunderwells (Thunder Range)—impact of shock waves on test units	**Nearest Well:** KAFB #10 (inactive) 2.5 mi NNW KAFB #9 3.2 mi NE **Surface Water:** Arroyo del Coyote 2.4 mi NE **Fault:** Hubbell Springs 0.25 mi E **Depth to GW:** 500 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.25 mi N	1,800 ft^2 (165 m^2) NFA	Asbestos DU HE M (D) PCB PHC	BW Soil Debris

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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55	57	Workman Site—proximity fuse development	**Nearest Well:** Schoolhouse Mesa 2.2 mi NNE KAFB #9 4.25 mi NW **Surface Water:** Arroyo del Coyote 2.75 mi N **Fault:** Manzano 0.25 mi E **Depth to GW:** 50 ft	KAFB boundary 0.6 mi S KAFB Eubank Gate 7.5 mi NW	430,000 ft^2 (40,105 m^2) 43,000 ft^3 (1,218 m^3)	M (F) SVOCs Metals HE PCBs	Debris Soil
56	58	Coyote Canyon Blast Area—explosive tests (largest test used 11,500 lb of TNT)	**Nearest Well:** Graystone Manor 0.5 mi SW KAFB #9 2.4 mi W **Surface Water:** Arroyo del Coyote <0.1 mi S **Fault:** Manzano 0.3 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 0.6 mi N KAFB Eubank Gate 4.6 mi NW	1,700,000 ft^2 (153,629m^2) 170,000 ft^3 (4,814 m^3)	HE (D) VOC	Soil
57	59	Pendulum Site—effects of acceleration forces on weapons components	**Nearest Well:** Graystone Manor 1.75 mi SSW KAFB #9 3 mi WSW **Surface Water:** Arroyo del Coyote 1.8 mi S **Fault:** Between Tijeras Arroyo and Manzano **Depth to GW:** 50 ft	KAFB boundary <0.2 mi E KAFB Eubank Gate 4.25 mi NW	8,800 ft^2 (817 m^2) NFA	Unknown	Soil
58	60	Bunker Area (North of Pendulum Site)—2 bunkers building plus blast radius	**Nearest Well:** Graystone Manor 1.9 mi SSW KAFB #9 3 mi WSW **Surface Water:** Arroyo del Coyote 1.5 mi S **Fault:** Between Tijeras Arroyo and Manzano **Depth to GW:** 50 ft	Extends to E KAFB boundary KAFB Eubank Gate 4 mi NW	10,000 ft^2 (924 m^2) 990 ft^3 28 m^3	DU HE (D) M (D) RAD	Soil
59	61	Schoolhouse Mesa Test Site—war games, storage, machine shop	**Nearest Well:** Schoolhouse Mesa 200 ft NE KAFB #9 2.25 mi NW **Surface Water:** Arroyo del Coyote 0.1 mi N **Fault:** Manzano 0.1 mi E **Depth to GW:** 50 ft	KAFB boundary 2.3 mi S KAFB Eubank Gate 5.5 mi NW	4,200,000 ft^2 (393,438 m^2) NFA	HE (D) DU Metals SVOCs	Soil
60	62	Graystone Manor Site (Coyote Springs)—explosive gas testing	**Nearest Well:** Graystone Manor <100 ft NE KAFB 9 2 mi WNW **Surface Water:** Arroyo del Coyote 0.1 mi SE **Fault:** Manzano 0.25 mi E **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 1.75 mi NE KAFB Eubank Gate 4.75 mi NW	50,000 ft^2 (4,607 m^2) NFA	HE (D)	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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61	63	Balloon Test Area—antitank submunitions testing	**Nearest Well:** Graystone Manor 2.8 mi WSW KAFB #9 4.8 mi WNW **Surface Water:** Arroyo del Coyote <0.2 mi NW **Fault:** Manzano 2.6 mi W **Depth to GW:** >200 ft	USFS Withdrawn Area boundary 1.5 mi NW KAFB Eubank Gate 6.75 mi NW	540,000 ft^2 (49,779 m^2) 54,000 ft^3 (1,529 m^3)	DU HE (D) M (D)	Soil
62	64	Gun Site (Madera Canyon)—155-mm shell components testing	**Nearest Well:** Graystone Manor 4 mi SW KAFB #9 5.75 mi WSW **Surface Water:** Arroyo del Coyote 0.3 mi SE **Fault:** Tijeras Arroyo 2.1 mi W **Depth to GW:** >200 ft	USFS Withdrawn Area boundary 0.3 mi N KAFB Eubank Gate 6.75 mi W	110,000 ft^2 (10,645 m^2) NFA	Metals	Soil
63	65	Lurance Canyon Explosive Test Site—HE tests using up to 1,000 lb charges	**Nearest Well:** Graystone Manor 3.9 mi W KAFB #9 5.9 mi W **Surface Water:** Arroyo del Coyote 1.1 mi NW **Fault:** Manzano 3.6 mi W **Depth to GW:** >230 ft	USFS Withdrawn Area boundary 2.3 mi NW KAFB Eubank Gate 7.75 mi NW	2,900,000 ft^2 (273,879 m^2) 290,000 ft^3 (8,212 m^3)	DU Metals HE	Soil
64	66	Boxcar Site—firing site to study detonation of a weapon unit in a railroad car	**Nearest Well:** Schoolhouse Mesa 0.8 mi NW Graystone Manor 1.4 mi NW KAFB #9 3.3 mi NW **Surface Water:** Arroyo del Coyote 1.5 mi N **Fault:** Manzano 0.6 mi W **Depth to GW:** >200 ft	USFS Withdrawn Area boundary 2.2 mi S KAFB Eubank Gate 6.3 mi NW	280,000 ft^2 (26,001 m^2) NFA	DU M (D)	Soil
65	67	Frustration Site—seismic station, ordnance testing	**Nearest Well:** Schoolhouse Mesa 3 mi NW KAFB #9 5.3 mi NW **Surface Water:** Arroyo del Coyote 3.2 mi N **Fault:** Manzano 1.9 mi W **Depth to GW:** 230 ft	USFS Withdrawn Area boundary 0.7 mi S KAFB Eubank Gate 8.5 mi NW	700 ft^2 (65 m^2) <35 ft^3 (<1 m^3)	M (D) DU	Debris Soil
66	68	Old Burn Site—fire testing of weapons components	**Nearest Well:** Schoolhouse Mesa 2 mi N KAFB #9 3.8 mi NW **Surface Water:** Arroyo del Coyote 2.1 mi NNW **Fault:** Manzano 0.1 mi E **Depth to GW:** 50 ft	KAFB boundary 0.75 mi S KAFB Eubank Gate 7.25 mi NW	280,000 ft^2 (26,228 m^2) 1,700 ft^3 (48 m^3)	PHC Metals DU Thorium	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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67	69	Old Borrow Pit—contained old firing cables, shrapnel, wooden table	**Nearest Well:** Schoolhouse Mesa 2.5 mi NNW KAFB #9 4.5 mi NW **Surface Water:** Arroyo del Coyote 3 mi NNW **Fault:** Manzano 0.25 mi W **Depth to GW:** 50 ft	KAFB boundary 0.25 mi S KAFB Eubank Gate 8 mi NW	42,000 ft^2 (3,924 m^2) NFA	Unknown	Soil Debris
68	70	Explosives Test Pit (Water Towers)—*explosives metal-forming experiments*	**Nearest Well:** Schoolhouse Mesa *2.5 mi NE KAFB #9 3.6 mi NNW* **Surface Water:** Arroyo del Coyote 2.3 mi N **Fault:** Manzano 2.3 mi E **Depth to GW:** 50 ft	KAFB boundary 0.5 mi S KAFB Eubank Gate 7 mi NNW	17,000 ft^2 (1,547 m^2) NFA	HE (D) Metals	Soil
69	71	Moonlight Shot Area—radionuclide dispersion studies	**Nearest Well:** Schoolhouse Mesa 1.8 mi N KAFB #9 3.75 mi NW **Surface Water:** Arroyo del Coyote 2 mi NNW **Fault:** On Manzano **Depth to GW:** 50 ft	KAFB boundary 0.5 mi S KAFB Eubank Gate 7 mi NW	3,600,000 ft^2 (*336,328* m^2) NFA	DU M (D) HE	Soil
70	72	Operation Beaver Site—clearing of land area using helicopter-dropped device	**Nearest Well:** Schoolhouse Mesa 5 mi NW KAFB #9 7.5 mi NW **Surface Water:** Arroyo del Coyote 3.25 mi NW **Fault:** Manzano 4.5 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 1.5 mi E and S KAFB Eubank Gate 9.75 mi NW	31,000 ft^2 (2,904 m^2) NFA	HE (D)	Soil
71	73	Bldg. 895 Hazardous Waste Repackaging/Storage	**Nearest Well:** KAFB #6 0.25 mi SE **Surface Water:** Tijeras Arroyo *0.8 mi* SE **Fault:** Sandia 1.6 mi E **Depth to GW:** 400 ft	KAFB boundary 0.6 mi E KAFB *Eubank* Gate *0.6 mi* ENE	16,000 ft^2 (1,449 m^2) NFA	IO M (S) SVOC VOC	Soil
72	74	Chemical Waste Landfill—chemical waste disposal	**Nearest Well:** KAFB #10 (Inactive) 1.75 mi N KAFB #9 2.6 mi NE **Surface Water:** Arroyo del Coyote 2 mi NE **Fault:** Hubbell Springs fault 0.9 mi E **Depth to GW:** 485 ft	KAFB boundary 1.6 mi S KAFB Eubank Gate 5.6 mi N	83,000 ft^2 (7,686 m^2) 10,800,000 ft^2 (305,823 m^2)	IO M (D,F,S) SVOC VOC	BW Soil Debris

Refer to footnotes at end of table.

Table A-1 (Continued)
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73	76	Mixed Waste Landfill (TA-III)—radioactive and mixed waste disposal	**Nearest Well:** KAFB #10 (inactive) 0.6 mi NE KAFB #9 2 mi NE **Surface Water:** Arroyo del Coyote 1.5 mi NE **Fault:** Sandia 1.25 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.3 mi W KAFB Eubank Gate 4.4 mi N	110,000 ft^2 (9,948 m^2) 1,650,000 ft^3 (46,717 m^3)	PHC RAD	BW Soil Debris
74	77	Oil Surface Impoundment (Tijeras Arroyo)—accelerator facilities containing transformer oil	**Nearest Well:** KAFB #8 0.5 mi SW KAFB #4 0.8 mi W **Surface Water:** Tijeras Arroyo 0.4 mi S **Fault:** Sandia 1.75 mi E **Depth to GW:** 300–500 ft	KAFB boundary 1 mi NE KAFB Eubank Gate 1.5 mi NE	7,600 ft^2 (704 m^2) NFA	PHC	Soil
75	78	Gas Cylinder Disposal Pit (TA-III)	**Nearest Well:** KAFB #10 (inactive) 1.75 mi NNW KAFB #9 2.6 mi NE KAFB #8 4 mi NW **Surface Water:** Arroyo del Coyote 1.8 mi NE **Fault:** Hubbell Springs, Sandia, Tijeras Arroyo intersection 0.8 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.6 mi S KAFB Eubank Gate 5.5 mi N	20,000 ft^2 (1,862 m^2) 60,000 ft^3 (1,699 m^3)	HE (D) IO	Soil
76	81	New Aerial Cable Site/Burial Site/ Dump/Test Area—DU dispersion tests and impact area	**Nearest Well:** Graystone Manor 3.25 mi WNW Schoolhouse Mesa 3 mi W KAFB #9 7.6 mi NW **Surface Water:** Arroyo del Coyote 2.25 mi NW **Fault:** Manzano 2.75 mi W **Depth to GW:** Not available	USFS Withdrawn Area boundary 2.6 mi E KAFB Eubank Gate 7.6 mi NW	1,100,000 ft^2 (104,505 m^2) 110,000 ft^3 (3,115 m^3)	DU Metals Rocket propellant	BW Soil
77	82	Old Aerial Cable Site Scrap—weapons-related explosive and impact tests	**Nearest Well:** Schoolhouse Mesa 1.8 mi NW KAFB #9 4 mi NW **Surface Water:** Arroyo del Coyote 1.8 mi N **Fault:** Manzano 1.5 mi W **Depth to GW:** 50–250 ft	USFS Withdrawn Area boundary 1.75 mi S KAFB Eubank Gate 7.2 mi NW	1,300,000 ft^2 (118,696 m^2) 130,000 ft^3 (3,681 m^3)	DU HE (D) M (D)	BW Debris Soil
78	83	Long Sled Track (TA-III)—rocket motor testing	**Nearest Well:** KAFB #10 (inactive) 0.8 mi E KAFB #9 2.25 mi E KAFB #8 1.8 mi N **Surface Water:** Arroyo del Coyote 2 mi NE **Fault:** Sandia 1.8 mi E **Depth to GW:** 450–490 ft	KAFB boundary 0.5 mi W KAFB Eubank Gate 3.75 mi NE	10,200,000 ft^2 (944,318 m^2) 5,000 ft^3 (142 m^3)	DU HE (D) M (D) PHC RAD	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
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79	84	Gun Facilities (TA-III)—study of impact phenomena	**Nearest Well:** KAFB #10 (inactive) 1 mi NE KAFB #9 2.5 mi NE KAFB #8 2.75 mi N **Surface Water:** Arroyo del Coyote 2 mi NE **Fault:** Sandia 1.75 mi E **Depth to GW:** 450–490 ft	KAFB boundary 0.9 mi W KAFB Eubank Gate 4.5 mi NE	62,000 ft^2 (5,715 m^2) 6,200 ft^3 (176 m^3)	DU M (D) RAD	Soil
80	85	Firing Site (Bldg. 9920)—explosives tests	**Nearest Well:** KAFB #10 (inactive) 1.4 mi NW KAFB #9 1.8 mi NE **Surface Water:** Arroyo del Coyote 1.2 mi NE **Fault:** Sandia 0.25 mi E **Depth to GW:** 450–500 ft	KAFB boundary 2.3 mi W KAFB Eubank Gate 5 mi N	580,000 ft^2 (54,084 m^2) 58,000 ft^3 (1,642 m^3)	DU M (D) VOC	Soil
81	86	Firing Site (Bldg. 9927)—HE development and testing	**Nearest Well:** KAFB #10 (inactive) 1.8 mi NW KAFB #9 2.3 mi NNE **Surface Water:** Arroyo del Coyote 1.5 mi NE **Fault:** Hubbell Springs, Tijeras Arroyo, Sandia intersection 0.25 mi E **Depth to GW:** 450–500 ft	KAFB boundary 1.7 mi S KAFB Eubank Gate 5.4 mi NNW	8,000 ft^2 (743 m^2) <35 ft^3 (<1 m^3)	DU HE (D) M (D)	Soil
82	87	Bldg. 9990 Firing Site—large-scale explosives tests	**Nearest Well:** Schoolhouse Mesa 1 mi WNW Graystone Manor 1.5 mi NW KAFB #9 3.5 mi NW **Surface Water:** Arroyo del Coyote 1.1 mi N **Fault:** Manzano 0.8 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2.25 mi N KAFB Eubank Gate 6.25 mi NW	7,100 ft^2 (656 m^2) 250,000 ft^3 (7,059 m^3)	DU HE (D) IO M (D) VOC	Soil
83	88	Firing Site (Southwest of Coyote Springs)—explosives test area	**Nearest Well:** Graystone Manor 0.1 mi NE KAFB #9 2.2 mi WNW **Surface Water:** Arroyo del Coyote 0.1 mi SE **Fault:** Manzano 0.4 mi E **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2.8 mi NE KAFB Eubank Gate 4.9 mi NW	680,0000 ft^2 (62,849 m^2) NFA	HE (D) M (F)	Soil
84	89	Shock Tube Site (Thunder Range)—explosion shock wave effects on test units	**Nearest Well:** KAFB #10 (inactive) 2.3 mi NNW KAFB #9 3 mi NE **Surface Water:** Arroyo del Coyote 2.25 mi NE **Fault:** Hubbell Springs 0.25 mi E **Depth to GW:** 500 ft	KAFB boundary 1 mi S KAFB Eubank Gate 6.2 mi N	120,000 ft^2 (11,534 m^2) NFA	DU HE (D)	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
85	90	Beryllium Firing Site (Thunder Range)—testing of W33, 8-in. artillery shells	**Nearest Well:** KAFB #10 (inactive) 2.7 mi NNW KAFB #9 3.2 mi NNE **Surface Water:** Arroyo del Coyote 2.2 mi NE **Fault:** Hubbell Springs 0.25 mi W **Depth to GW:** 90–500 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.5 mi NNW	6,900 ft^2 (638 m^2) 6,900 ft^3 (195 m^3)	DU HE (D)	Soil
86	91	Lead Firing Sites (Thunder Range)—3,000-4,000 lb of lead per shot (20 shots)	**Nearest Well:** KAFB #10 (inactive) 2.5 mi NNW KAFB #9 3.2 mi NE **Surface Water:** Arroyo del Coyote 2.4 mi NE **Fault:** Hubbell Springs 0.25 mi E **Depth to GW:** 500 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.25 mi N	43,000 ft^2 (3,958 m^2) 4,300 ft^3 (122 m^3)	HE (D) M (D)	Soil
87	92	Pressure Vessel Test Site (Coyote Canyon Blast Area)—for prototype scale model reactor vessels constructed of mild steel and concrete	**Nearest Well:** Graystone Manor 1 mi SW KAFB #9 2.75 mi WSW **Surface Water:** Arroyo del Coyote 0.75 mi S **Fault:** Tijeras Arroyo and Manzano intersection 0.5 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 0.6 mi NE KAFB Eubank Gate 4.5 mi NW	50,000 ft^2 (4,690 m^2) NFA	None	Soil Debris
88	93	Madera Canyon Rocket Launcher Pads—antiaircraft missile firing site	**Nearest Well:** Graystone Manor 3.1 mi SW KAFB #9 5 mi WSW **Surface Water:** Arroyo del Coyote 0.3 mi SE **Fault:** Manzano 2 mi W **Depth to GW:** >200 ft	USFS Withdrawn Area boundary 0.25 mi NW KAFB Eubank Gate 6.25 mi NW	66,000 ft^2 (6,135 m^2) NFA	HE (D) IO Metals	Soil
89	94	Lurance Canyon Burn Site—fire testing of weapons components	**Nearest Well:** Graystone Manor 4 mi WSW KAFB #9 6 mi W **Surface Water:** Arroyo del Coyote 1.1 mi NW **Fault:** Manzano 3.8 mi W **Depth to GW:** 230 ft	USFS Withdrawn Area boundary 1.9 mi N KAFB Eubank Gate 7.75 mi NW	750,000 ft^2 (69,221 m^2) 75,000 ft^3 (2,124 m^3)	DU HE (D) M (D) PHC VOC	Soil
90	96	Storm Drain System—discharge to Tijeras Arroyo	**Nearest Well:** **Surface Water:** **Fault:** **Depth to GW:** 400 ft Determination in progress.	Determination in progress.	27,000 ft^2 (2,508 m^2) 27,000 ft^3 (765 m^3)	Unknown	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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91	98	Bldg. 863—TCA photochemical Silver Catch Boxes	**Nearest Well:** KAFB #6 0.5 mi SSE **Surface Water:** Tijeras Arroyo 1 mi SE **Fault:** Sandia 1.7 mi E **Depth to GW:** 400 ft	KAFB boundary 0.7 mi E KAFB Eubank Gate 0.7 mi NNE	16,000 ft^2 (1,486 m^2) 1,600 ft^3 (45 m^3)	M (D) VOC	Soil
92	100	Bldg. 6620 HE Sump/Drain—HE unit assembly	**Nearest Well:** KAFB #10 (inactive) 0.7 mi N KAFB #9 1.9 mi NE: KAFB #8 2.9 mi NW **Surface Water:** Arroyo del Coyote 1.5 mi NE **Fault:** Sandia 1.1 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.5 mi W KAFB Eubank Gate 3.5 mi N	1,600 ft^2 (148 m^2) NFA	HE (D) PHC VOC	Soil
93	101	Explosive Contaminated Sumps and drains (Bldg. 9926)—Explosives Research Laboratory)	**Nearest Well:** KAFB #10 (inactive) 1.5 mi NW KAFB #9 1.9 mi NNE **Surface Water:** Arroyo del Coyote 2.2 mi NNE **Fault:** Sandia 0.4 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2.2 mi S KAFB Eubank Gate 5 mi N	1,700 ft^2 (158 m^2) NFA	HE (D) IO M (D) VOC	Soil
94	102	Radioactive Disposal (East of TA-III)	**Nearest Well:** KAFB #10 (inactive) 0.8 mi WNW KAFB #9 0.8 mi NNE KAFB #8 3 mi NW **Surface Water:** Arroyo del Coyote 0.3 mi NE **Fault:** Sandia 0.25 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2.5 mi W KAFB Eubank Gate 4 mi NW	6,900,000 ft^2 (636,693 m^2) NFA	RAD	BW Soil
95	103	Scrap Yard (Bldg. 9939)—testing materials from Molten Core Facility	**Nearest Well:** KAFB #9 2 mi NNW **Surface Water:** Arroyo del Coyote 0.8 mi N **Fault:** Tijeras Arroyo 0.5 W **Depth to GW:** 50 ft	KAFB boundary 2 mi S KAFB Eubank Gate 5.3 mi NNW	1,300 ft^2 (122 m^2) 13,000 ft^3 (373 m^3)	DU M (D) PCB RAD SVOC	Debris Soil
96	104	PCB Spill, Computer Facility	**Nearest Well:** **Surface Water:** **Fault:** **Depth to GW:** 400 ft Determination in progress.	Determination in progress.	AOC NFA	PCB	Soil

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Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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97	105	Mercury (Bldg. 6536) (TA-III)—testing aerospace nuclear safety systems	**Nearest Well:** **Surface Water:** **Fault:** **Depth to GW:** 450–490 ft Determination in progress.	Determination in progress.	AOC NFA	M (D)	Soil
98	107	Explosive Test Area (Southeast of TA-III)—HE testing using 10-20 lb of metal plus explosive compound	**Nearest Well:** KAFB #10 (inactive) 1.8 mi N KAFB #9 2.3 mi NE KAFB #8 4 mi NW **Surface Water:** Arroyo del Coyote 2 mi NE **Fault:** Hubbell Springs, Sandia, Tijeras Arroyo intersection 1.1 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.6 mi S KAFB Eubank Gate 5.5 mi N	1,100,000 ft^2 (105,578 m^2) NFA	HE M (D, F)	Soil
99	108	Firing Site (Bldg. 9940)—explosives tests	**Nearest Well:** KAFB #10 (inactive) 1.5 mi NW KAFB #9 1.5 mi NNE **Surface Water:** Arroyo del Coyote 0.6 mi NE **Fault:** Hubbell Springs, Tijeras Arroyo, Sandia intersection 0.8 mi S **Depth to GW:** 50–500 ft	KAFB boundary 2.5 mi S KAFB Eubank Gate 4.75 mi NNW	76,000 ft^2 (7,045 m^2) 7,600 ft^3 (215 m^3)	DU HE (D) M (D)	Soil
100	109	Firing Site (Bldg. 9956)—explosives tests	**Nearest Well:** KAFB #10 (inactive) 1.1 mi NW KAFB #9 1.5 mi NE **Surface Water:** Arroyo del Coyote 0.8 mi ENE **Fault:** Sandia 0.3 mi E **Depth to GW:** 450–500 ft	KAFB boundary 2.3 mi W KAFB Eubank Gate 4.6 mi NNW	2,300 ft^2 (218 m^2) 23,000 ft^3 (651 m^3)	HE (D) M (D)	BW Soil
101	111	Bldg. 6715 Sump/Drains (TA-III)—light-initiated HE development	**Nearest Well:** KAFB #10 (inactive) 0.25 mi E KAFB #9 1.6 mi ENE KAFB #8 2.2 mi NNW **Surface Water:** Arroyo del Coyote 1 mi NE **Fault:** Sandia 1.4 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.4 mi W KAFB Eubank Gate 3.75 mi NE	450 ft^2 (42 m^2) NFA	HE (D) M (D) SVOC	Soil
102	112	Explosive Contaminated Sump (Bldg. 9956)—rinse water containing black powder	**Nearest Well:** KAFB #10 (inactive) 1.1 mi NW KAFB #9 1.5 mi NE **Surface Water:** Arroyo del Coyote 0.8 mi ENE **Fault:** Sandia 0.3 mi E **Depth to GW:** 450–500 ft	KAFB boundary 2.3 mi W KAFB Eubank Gate 4.6 mi NNW	9,100 ft^2 (846 m^2) NFA	DU HE (D) M (D) PHC VOC	Soil

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Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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103	113	Area II Firing Sites (3)—explosives testing of small charges (<0.5 lb)	**Nearest Well:** KAFB #6 0.1 mi N **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.35 mi E KAFB Eubank Gate 0.8 mi NNE	17,000 ft^2 (1,574 m^2) NFA	DU HE (D) M (D)	Soil
104	114	Explosive Burn Pit (Area II)—burning of HE residues produced during bomb assembly	**Nearest Well:** KAFB #6 0.3 mi NE **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.6 mi NE KAFB Eubank Gate 1.1 mi NE	12,000 ft^2 (1,114 m^2) NFA	HE (D) M (D)	Soil
105	115	Firing Site (Bldg. 9930)—explosives tests	**Nearest Well:** KAFB #10 (inactive) 1.75 mi NW KAFB #9 1.9 mi N **Surface Water:** Arroyo del Coyote 1 mi NE **Fault:** Hubbell Springs, Tijeras Arroyo, Sandia intersection 0.3 mi S **Depth to GW:** 50–500 ft	KAFB boundary 2 mi S KAFB Eubank Gate 5.25 mi NNW	7,400 ft^2 (687 m^2) 7,400 ft^3 (210 m^3)	DU HE (D) M (D)	Soil
106	116	Bldg. 9990 Septic System—Electroexplosive Research Facility	**Nearest Well:** Schoolhouse Mesa Well 1 mi E KAFB #9 3.5 mi ENE **Surface Water:** Arroyo del Coyote 1 mi N **Fault:** Manzano 0.8 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2.25 mi N KAFB Eubank Gate 6.25 mi NW	2,700 ft^2 (249 m^2) <35 ft^3 (<1 m^3)	BN/A DU IO M (D) PCB PHC VOC	Soil SSG
107	117	Trenches (Bldg. 9939)—Sodium and uranium dispersal	**Nearest Well:** KAFB #9 2 mi NNW **Surface Water:** Arroyo del Coyote 0.8 mi N **Fault:** Tijeras Arroyo 0.5 mi W **Depth to GW:** 50 ft	KAFB boundary 2 mi S KAFB Eubank Gate 5.3 mi NNW	22,000 ft^2 (2,068 m^2) 12,000 ft^3 (340 m^3)	DU M (D)	Debris Soil
108	135	Bldg. 906 Septic System—used for storage and to clean test materials from NTS testing	**Nearest Well:** KAFB #6 0.25 mi N **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.4 mi E KAFB Eubank Gate 1 mi NE	1,333 ft^2 (124 m^2) NFA	BN/A HE (D) M (D) PCB RAD VOC	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

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109	136	Bldg. 907 Septic System—Explosive Application Facility	**Nearest Well:** KAFB #6 0.2 mi N **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.3 mi NE KAFB Eubank Gate 1 mi NE	32,000 ft^2 (2,991 m^2) NFA	HE (D) IO M (D) PHC RAD VOC	Soil
110	137	Bldg. 6540/6542 Septic System—darkroom	**Nearest Well:** KAFB #10 (inactive) 0.4 mi NE KAFB #9 1.7 mi NE **Surface Water:** Arroyo del Coyote 1.2 mi NE **Fault:** Sandia 1.2 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.5 mi W KAFB Eubank Gate 4 mi N	53,000 ft^2 (4,969 m^2) NFA	IO M (D) RAD VOC	Soil SSG
111	138	Bldg. 6630 Septic System—Climatic Test Facility aka Melting/Solidification Facility	**Nearest Well:** KAFB #10 (inactive) 1 mi N KAFB #9 2 mi NE **Surface Water:** Arroyo del Coyote 1.7 mi NE **Fault:** Sandia 1 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.7 mi W KAFB Eubank Gate 4.75 mi NE	11,000 ft^2 (1,025 m^2) NFA	DU IO M (D) PCB PHC SVOC VOC	Soil SSG
112	139	Bldg. 9964 Septic System—Instrument Bldg. for the Shock Facility	**Nearest Well:** KAFB #10 (inactive) 2.7 mi NW KAFB #9 4.1 mi NE **Surface Water:** Arroyo del Coyote 2.3 mi NE **Fault:** Hubbell Springs 0.25 mi W **Depth to GW:** 450–490 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 5.1 mi N	3,400 ft^2 (314 m^2) NFA	DU M (D) VOC	Soil
113	140	Bldg. 9965 Septic System—Shock Facility Remote Control Bldg. (darkroom)	**Nearest Well:** KAFB #10 (inactive) 2.5 mi NW KAFB #9 3 mi NE **Surface Water:** Arroyo del Coyote 2 mi N **Fault:** Hubbell Springs 0.1 mi N **Depth to GW:** 450–500 ft	KAFB boundary 1 mi S KAFB Eubank Gate 6.2 mi N	3,300 ft^2 (308 m^2) <35 ft^3 (<1 m^3)	IO M (D)	Soil SSG
114	141	Bldg. 9967 Septic System—HE Assembly Bldg.	**Nearest Well:** KAFB #10 (inactive) 2.4 mi NW KAFB #9 2.75 mi N **Surface Water:** Arroyo del Coyote 1.75 mi NE **Fault:** Hubbell Springs 0.2 mi W **Depth to GW:** 450–500 ft	KAFB boundary 1.2 mi S KAFB Eubank Gate 6 mi N	4,000 ft^2 (369 m^2) <35 ft^3 (<1 m^3)	HE (D)	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
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115	142	Bldg. 9970 Septic System—Antenna Pattern Range	**Nearest Well:** Schoolhouse Mesa 2.5 mi NE KAFB #9 3.25 mi NW **Surface Water:** Arroyo del Coyote 0.2 mi N **Fault:** Hubbell Springs 2 mi W Manzano 2 mi E **Depth to GW:** 50 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.75 mi NW	2,800 ft^2 (258 m^2) NFA	VOC	Soil SSG
116	143	Bldg. 9972 Septic System—radar development	**Nearest Well:** Schoolhouse Mesa 2.4 mi NE KAFB #9 3.25 mi NW **Surface Water:** Arroyo del Coyote 2 mi N **Fault:** Hubbell Springs 1.9 mi W Manzano 1.5 mi E **Depth to GW:** 50 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.8 mi NW	21,000 ft^2 (1,906 m^2) NFA	VOC	Soil SSG
117	144	Bldg. 9980 Septic System—5-megawatt Solar Power Tower	**Nearest Well:** KAFB #10 (inactive) 2.8 mi NW KAFB #9 2.8 mi NNW **Surface Water:** Arroyo del Coyote 1.8 mi N **Fault:** Hubbell Springs 1 mi W **Depth to GW:** 50 ft	KAFB boundary 1 mi S KAFB Eubank Gate 6.5 mi NW	18,000 ft^2 (1,660 m^2) NFA	BN/A IO M (D) SVOC	Soil SSG
118	145	Bldg. 9981/9982 Septic System—5-megawatt Solar Control/Solar Assembly (equipment repair)	**Nearest Well:** Schoolhouse Mesa 2.5 mi NE KAFB #9 2.8 mi N **Surface Water:** Arroyo del Coyote 1.6 mi N **Fault:** Hubbell Springs 1 mi W **Depth to GW:** 50 ft	KAFB boundary 1.2 mi S KAFB Eubank Gate 6.2 mi NW	28,000 ft^2 (2,605 m^2) NFA	IO PCB SVOC VOC	Soil SSG
119	146	Bldg. 9920 Septic System—Explosive Test Facility (explosives testing, darkroom)	**Nearest Well:** KAFB #10 (inactive) 1.5 mi NW KAFB #9 1.9 mi NNE **Surface Water:** Arroyo del Coyote 1.2 mi NE **Fault:** Sandia 0.3 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2.2 mi S KAFB Eubank Gate 4.8 mi N	2,000 ft^2 (184 m^2) NFA	IO M (D)	Soil
120	147	Bldg. 9925 Septic System—Coyote Test Field Headquarters	**Nearest Well:** Schoolhouse Mesa 1.6 mi NE KAFB #9 2.75 mi NW **Surface Water:** Arroyo del Coyote 1.4 mi N **Fault:** Manzano 1 mi E **Depth to GW:** 50 ft	KAFB boundary 1.5 mi S KAFB Eubank Gate 6.2 mi NW	35,000 ft^2 (3,221 m^2) <35 ft^3 (<1 m^3)	DU HE (D) VOC	Soil SSG

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Table A-1 (Continued)
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121	148	Bldg. 9927 Septic System—firing site, darkroom	**Nearest Well:** KAFB #10 (inactive) 1.9 mi NW KAFB #9 2.2 mi NE **Surface Water:** Arroyo del Coyote 1.5 mi NE **Fault:** Hubbell Springs, Sandia, Tijeras Arroyo intersection 0.25 mi E **Depth to GW:** 450–500 ft	KAFB boundary 1.8 mi S KAFB Eubank Gate 5.5. mi NW	2,000 ft^2 (184 m^2) <35 ft^3 (1 m^3)	IO M(D) RAD VOC	Soil SSG
122	149	Bldg. 9930 Septic System—explosives testing, darkroom	**Nearest Well:** KAFB #10 (inactive) 2 mi NW KAFB #9 2 mi NNE **Surface Water:** Arroyo del Coyote 1 mi NNE **Fault:** Hubbell Springs, Tijeras Arroyo, Sandia intersection immediately south **Depth to GW:** 450–490 ft	KAFB boundary 2 mi S KAFB Eubank Gate 5 mi NNW	11,000 ft^2 (1,028 m^2) NFA	HE (D) IO M (D) VOC	Soil SSG
123	150	Bldg. 9939/9939A Septic System—Evaluation Explosives Facility aka Molten Core Facility	**Nearest Well:** KAFB #9 2 mi NNW **Surface Water:** Arroyo del Coyote 0.8 mi N **Fault:** Tijeras Arroyo 0.5 mi W **Depth to GW:** 50 ft	KAFB boundary 2 mi S KAFB Eubank Gate 4.5 mi NW	7,500 ft^2 (693 m^2) <35 ft^3 (<1 m^3)	DU M (D) PCB VOC	Soil SSG
124	151	Bldg. 9940 Septic System—explosives test facility, darkroom	**Nearest Well:** KAFB #10 (inactive) 1.5 mi NW KAFB #9 1.5 mi NNE **Surface Water:** Arroyo del Coyote 0.5 mi NE **Fault:** Sandia 0.2 mi W **Depth to GW:** 450–490 ft	KAFB boundary 2.5 mi S KAFB Eubank Gate 4.7 mi NNW	4,800 ft^2 (447 m^2) <35 ft^3 (<1 m^3)	DU HE (D) IO M (D) RAD VOC	Soil SSG
125	152	Bldg. 9950 Septic System—Materials Test Facility	**Nearest Well:** KAFB #10 (inactive) 1 mi NW KAFB #9 1.5 mi NNE **Surface Water:** Arroyo del Coyote 0.8 mi NE **Fault:** Sandia 0.25 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2.6 mi S KAFB Eubank Gate 4.5 mi N	4,300 ft^2 (400 m^2) NFA	HE (D) IO M (D) PCB VOC	Soil SSG
126	153	Bldg. 9956 Septic System—Hypervelocity Gun Facility	**Nearest Well:** KAFB #10 (inactive) 1 mi NW KAFB #9 1.5 mi NE **Surface Water:** Arroyo del Coyote 0.8 mi NE **Fault:** Sandia 0.25 mi E **Depth to GW:** 450–490 ft	KAFB boundary 2.4 mi W KAFB Eubank Gate 4.5 mi NNW	18,000 ft^2 (1,654 m^2) <35 ft^3 (<1 m^3)	DU HE (D) IO M (D, F) VOC	Soil SSG

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Table A-1 (Continued)
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127	154	Bldg. 9960 Septic System—Explosives Preparation Facility	**Nearest Well:** KAFB #9 1.75 mi NNW **Surface Water:** Arroyo del Coyote 0.6 mi N **Fault:** Tijeras Arroyo 0.2 mi W **Depth to GW:** 50 ft	KAFB boundary 2.2 mi S KAFB Eubank Gate 5 mi NNW	19,000 ft^2 (1,758 m^2) NFA	DU HE (D) M (D) VOC	Soil SSG
128	159	Bldg. 935 Septic System—Neutron Generator Test Facility (explosives tests and electronic development work)	**Nearest Well:** KAFB #6 0.4 mi NNW **Surface Water:** Tijeras Arroyo 0.4 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.4 mi E KAFB Eubank Gate 1 mi NE	1,500 ft^2 (141 m^2) NFA	HE (D) M (D) PCB RAD VOC	Soil
129	160	Bldg. 9832 Septic System—Vehicle Assembly Bldg.	**Nearest Well:** Schoolhouse Mesa and Graystone Manor 3 mi W KAFB #9 5 mi W **Surface Water:** Arroyo del Coyote 0.75 mi N **Fault:** Manzano 3 mi W **Depth to GW:** 50 ft	USFS Withdrawn Area boundary 2 mi NW KAFB Eubank Gate 7.25 mi NW	7,100 ft^2 (664 m^2) NFA	HE (D) VOC	Soil SSG
130	161	Bldg. 6636 Septic System—Nondestructive Test Facility	**Nearest Well:** KAFB #10 (inactive) 1.2 mi NNE KAFB #9 2.2 mi NE **Surface Water:** Arroyo del Coyote 1.75 mi NE **Fault:** Sandia 1.2 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.5 mi W KAFB Eubank Gate 5 mi NE	11,000 ft^2 (1,020 m^2) NFA	IO M (D) SVOC	Soil SSG
131	165	Bldg. 901 Septic System—Systems Analysis Facility (laundry, showers, HE synthesis)	**Nearest Well:** KAFB #6 0.3 mi NE **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.5 mi NE KAFB Eubank Gate 1 mi NE	26,000 ft^2 (2,415 m^2) NFA	HE (D) IO M (D) PHC RAD VOC	Soil
132	166	Bldg. 919 Septic System—Explosive Devices Bldg.	**Nearest Well:** KAFB #6 0.3 mi NNW **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.4 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.35 mi E KAFB Eubank Gate 1 mi NNE	5,000 ft^2 (472 m^2) NFA	BN/A HE M (D) RAD VOC	Soil

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Table A-1 (Continued)
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133	167	Bldg. 940 Septic System—Explosives Testing Laboratory	**Nearest Well:** KAFB #6 0.3 mi N **Surface Water:** Tijeras Arroyo 0.4 mi E **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.5 mi E KAFB Eubank Gate 1 mi NE	3,200 ft^2 (301 m^2) NFA	HE (D) M (D)	Soil
134	186	Bldg. 859 TCE Disposal—TCE used to clean printed circuit boards south of Bldg. 859	**Nearest Well:** KAFB #6 0.3 mi SE **Surface Water:** Tijeras Arroyo 0.9 mi SE **Fault:** Sandia 1.6 mi E **Depth to GW:** 400 ft	KAFB boundary 0.6 mi E KAFB Eubank Gate 0.7 mi ENE	11,000 ft^2 (990 m^2) 1,100 ft^3 (31 m^3)	VOC	Soil
135	187	TA-I Sanitary Sewer Lines—Septic Tank Piping for POTW	**Nearest Well:** **Surface Water:** In progress. **Fault:** **Depth to GW:** 400 ft	In progress.	AOC 270,000 ft^3 (7,646 m^3)	IO M (D)	Soil
136	188	Bldg. 6597 Aboveground Containment Spill Tank	**Nearest Well:** **Surface Water:** In progress. **Fault:** **Depth to GW:** 450–490 ft	In progress.	AOC NFA	PHC	Soil
137	190	Steam Plant Tank Farm	**Nearest Well:** KAFB #6 0.5 mi E **Surface Water:** Tijeras Arroyo 1.35 mi E **Fault:** Sandia 2.1 mi E **Depth to GW:** 400 ft	KAFB boundary 0.9 mi E KAFB Eubank Gate 1.1 mi NE	130,000 ft^2 (11,630 m^2) 130,000 ft^3 (3,681 m^3)	PHC	Soil
138	191	Equus Red—one-time simulated weapon test	**Nearest Well:** KAFB #10 2.75 mi NNW KAFB #9 3.5 mi NE **Surface Water:** Arroyo del Coyote 2.75 mi NE **Fault:** Hubbell Springs 0.25 mi E **Depth to GW:** 500 ft	KAFB boundary 0.6 mi S KAFB Eubank Gate 6.5 mi N	93,000 ft^2 (8,598 m^2) 9,300 ft^3 (263 m^3)	DU HE (D)	Soil
139	192	TA-I Waste-Oil Tank—oil collection tank for recycling)	**Nearest Well:** KAFB #6 0.6 mi SW KAFB #1.7 mi WNW **Surface Water:** Tijeras Arroyo 0.5 mi E **Fault:** Sandia 1.2 mi E **Depth to GW:** 400 ft	KAFB boundary 0.1 mi E KAFB Eubank Gate 0.15 mi NE	9,400 ft^2 (875 m^2) 9,400 ft^3 (266 m^3)	PHC	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
140	193	Sabotage Test Area—effects of sabotage on spent fuel elements	**Nearest Well:** KAFB #10 (inactive) 2.7 mi NNW KAFB #9 3.2 mi NNE **Surface Water:** Arroyo del Coyote 2.25 mi NE **Fault:** Hubbell Springs 0.25 W **Depth to GW:** 500 ft	KAFB boundary 0.8 mi S KAFB Eubank Gate 6.5 mi N	2,200 ft^2 (203 m^2) 2,200 ft^3 (62 m^3)	DU IO M (D)	Soil
141	194	General Purpose Heat Source Test Area—tests to determine the possibility of Pu dispersal from a space shuttle explosion	**Nearest Well:** KAFB #10 (inactive) 2.5 mi NNW KAFB #9 3.2 mi NE **Surface Water:** Arroyo del Coyote 2.3 mi NE **Fault:** Hubbell Springs 0.2 mi E **Depth to GW:** 500 ft	KAFB boundary 0.9 mi S KAFB Eubank Gate 6.25 mi N	18,000 ft^2 (1,709 m^2) NFA	DU HE (D)	Soil
142	196	Bldg. 6597 Cistern (TA-V)—temporary storage of waste-oil	**Nearest Well:** KAFB #10 0.3 mi W KAFB #9 1.25 mi E **Surface Water:** Tijeras Arroyo 0.8 mi E **Fault:** Sandia 0.9 mi E **Depth to GW:** 450–490 ft	In progress.	1,700 ft^2 (155 m^2) 9,800 ft^3 (278 m^3)	Freons PHC	Soil
143	211	Bldg. 840 Former UST (TA-I)—coolant water tank	**Nearest Well:** KAFB Well #1 mi NW KAFB #6 0.6 mi SE **Surface Water:** Tijeras Arroyo 1.1 mi SE **Fault:** Sandia 1.75 mi E **Depth to GW:** 400 ft	KAFB boundary 0.7 mi E KAFB Eubank Gate 0.7 mi E	AOC NFA	PHC	Soil
144	226	Old Acid Waste Line—acidic wastewater	**Nearest Well:** KAFB #6 0.35 mi SE **Surface Water:** Tijeras Arroyo 1.25 mi SE **Fault:** Sandia 1.7 mi E **Depth to GW:** 400 ft	KAFB boundary 0.7 mi E KAFB Eubank Gate 0.8 mi NE	AOC 7,000 ft^3 (765 m^3)	IO	Soil
145	227	Bunker 904 Outfall (Tijeras Arroyo)—HE lab, darkroom, sanitary waste	**Nearest Well:** **Surface Water:** **Fault:** **Depth to GW:** Determination in progress.	Determination in progress.	9,000 ft^2 (839 m^2) 9,000 ft^3 (255 m^3)	HE (D) IO M (D) RAD VOC	Soil SSG

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
146	228	Centrifuge Dump Site—debris including construction materials and various metal objects	**Nearest Well:** KAFB #6 0.3 mi W **Surface Water:** Tijeras Arroyo 0.25 mi E **Fault:** Sandia 1 mi E **Depth to GW:** 300–500 ft	On eastern KAFB boundary KAFB Eubank Gate 0.7 mi N	310,000 ft^2 (29,020 m^2) 5,000 ft^3 (142 m^3)	M (D)	Debris Soil
147	229	Storm Drain Systems Outfall	**Nearest Well:** **Surface Water:** **Fault:** **Depth to GW:** Determination in progress.	Determination in progress.	4,800 ft^2 (445 m^2) 4,800 ft^3 (136 m^3)	IO PHC	Soil
148	230	Storm Drain Systems Outfall	**Nearest Well:** KAFB #6 0.6 mi N **Surface Water:** Tijeras Arroyo 0.3 mi E **Fault:** Sandia 1.3 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.7 mi NE KAFB Eubank Gate 1.3 mi NNE	4,400 ft^2 (412 m^2) 4,400 ft^3 (125 m^3)	IO PHC	Soil
149	231	Storm Drain Systems Outfall	**Nearest Well:** KAFB #6 0.6 mi N **Surface Water:** Tijeras Arroyo 0.3 mi E **Fault:** Sandia 1.3 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.7 mi NE KAFB Eubank Gate 1.3 mi NNE	1,900 ft^2 (172 m^2) 1,900 ft^3 (54 m^3)	IO PHC	Soil
150	232	Storm Drain Systems Outfall	**Nearest Well:** KAFB #8 0.75 mi SW KAFB #6 0.75 mi N **Surface Water:** Tijeras Arroyo 0.4 mi S **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.8 mi NE KAFB Eubank Gate 1.5 mi NE	1,600 ft^2 (144 m^2) 1,600 ft^3 (45 m^3)	IO PHC	Soil
151	233	Storm Drain Systems Outfall	**Nearest Well:** KAFB #8 0.6 mi WSW **Surface Water:** Tijeras Arroyo 0.3 mi S **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.9 mi NE KAFB Eubank Gate 1.6 mi NE	900 ft^2 (84 m^2) 900 ft^3 (25 m^3)	IO PHC	Soil

Refer to footnotes at end of table.

Table A-1 (Continued)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
152	234	Storm Drain Systems Outfall	**Nearest Well:** KAFB #8 0.5 mi W **Surface Water:** Tijeras Arroyo 0.2 mi S **Fault:** Sandia 1.6 mi E **Depth to GW:** 300–500 ft	KAFB boundary 1.1 mi NE KAFB Eubank Gate 1.8 mi NE	3,300 ft^2 (311 m^2) 3,300 ft^3 (93 m^3)	IO PHC	Soil
153	235	Storm Drain Systems Outfall	**Nearest Well:** **Surface Water:** Tijeras Arroyo **Fault:** **Depth to GW:** Determination in progress	Determination in progress.	62,000 ft^2 (5,736 m^2) 62,000 ft^3 (1,756 m^3)	IO PHC	Soil
154	240	Short Sled Track—rocket motor testing	**Nearest Well:** KAFB #10 (inactive) 0.5 mi NE KAFB #9 1.9 mi NE KAFB #8 2.3 mi NW **Surface Water:** Arroyo del Coyote 1.4 mi ENE **Fault:** Sandia 1.5 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.3 mi W KAFB Eubank Gate 4 mi NNE	890,000 ft^2 (82,878 m^2) 5,000 ft^3 (142 m^3)	DU HE (D) M (D) RAD	Soil
155	241	Storage Yard—radioactive material from rocket motor testing	**Nearest Well:** KAFB #10 (inactive) 1.6 mi NNW KAFB #9 2.3 mi NE KAFB #8 3.75 mi NW **Surface Water:** Arroyo del Coyote 1.75 mi NE **Fault:** Sandia 0.8 mi E **Depth to GW:** 450–490 ft	KAFB boundary 1.9 mi W KAFB Eubank Gate 5.25 mi N	40,000 ft^2 (3,684 m^2) 4,000 ft^3 (113 m^3)	M (D)	Soil
156	275	TA-V Seepage Pits	**Nearest Well:** KAFB #10 (inactive) 2 mi N KAFB #9 2.9 mi NE **Surface Water:** Arroyo del Coyote 2.2 mi NE **Fault:** *Hubbell Springs 0.3 mi E* **Depth to GW:** 450–500 ft	KAFB boundary 0.75 mi S KAFB Eubank Gate 5.9 mi NNE	1,200 ft^3 (34 m^3) Not available	Not Available	Soil

Refer to footnotes at end of table.

Table A-1 (Concluded)
Sandia National Laboratories/New Mexico Environmental Restoration Sites

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

Number	ER Site Number	Past Use, Waste Source[a]	Geographical Features[b]	Nearest Access[c]	Assumed Area of Concern/ Volume[d]	CoC[e]	Media[f]
157	276	Building 829X Sump	**Nearest Well:** KAFB #6 0.4 mi SSW **Surface Water:** Tijeras Arroyo *0.5 mi* E **Fault:** Sandia 1.5 mi E **Depth to GW:** 300–500 ft	KAFB boundary 0.5 mi NE KAFB Eubank Gate 1 mi NE	Not Available (recently identified site).	Not Available	Soil

[a] DEER
HE
LWDS Liquid Waste Disposal System
NTS Nevada Test Site
PCB polychlorinated biphenyl
POTW Publicly Owned Treatment Works
TA Technical Area
TCA trichloroethane
TCE trichloroethene
TRUPAK transuranic package transporter
UST Underground Storage Tank

[b] GW
KAFB Kirtland Air Force Base
SNL/NM Sandia National Laboratories/New Mexico

[c] USFS United States Forest Service
NA not available

[d] Rounded to two significant figures
AOC abnormal operating conditions
TCA trichloroethane
NA not available
NFA no further action

[e] BN/A base neutral/acid extractable
DU depleted uranium
HE high explosive(s)
HE (D) high explosive(s) (dispersed)
HE (F) high explosive(s) (fragments)
IO inorganic compound
M (D) metal (dispersed)
M (F) metal (fragments)
M (S) metal (salts)
PCB polychlorinated biphenyl
PHC petroleum hydrocarbon
RAD radionuclide other than depleted uranium
SVOC semivolatile organic compound
VOC volatile organic compound

[f] BW buried waste
GW groundwater
SSG subsurface gas
SW surface water

Table A-2
Estimated Volumes and Potential Range of Treatments Assumed for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
1	1	Radioactive Waste Landfill	1 (0.3)	12,000 (1,110)	12,000 (340)	D and A
2	2	Classified Waste Landfill	1 (0.3)	110,000 (9,962)	110,000 (3,115)	D and A
3	3	Chemical Disposal Pit	1 (0.3)	12,000 (1,148)	0	NFA
4	4	LWDS Surface Impoundments	1 (0.3)	36,000 (3,304)	0	NFA
5	5	LWDS Drainfield (TA-V)	1 (0.3)	4,700 (435)	0	NFA
6	6	Gas Cylinder Disposal Pit	1 (0.3)	800 (74)	0	NFA
7	7	Gas Cylinder Disposal (Arroyo del Coyote)	1 (0.3)	310,000 (28,900)	310,000 (8,778)	D and A
8	8	Open Dump (Coyote Canyon Blast Area)	0.1 (0.03)	580,000 (53,775)	58,000 (1,641)	D and C
9	9	Burial Site/Open Dump (Schoolhouse Mesa)	NA	81,000 (7,517)	4,700 (133)[e]	D and A
10	10	Burial Mounds (Bunker Area N. Pendulum Site)	0.1 (0.03)	3,100,000 (288,603)	310,000 (8,778)	D and A
11	11	Explosive Burial Mounds	0.1 (0.03)	68,000 (6,328)	6,800 (193)	D and B
12	12	Burial Site/Open Dump (Lurance Canyon)	0.1 (0.03)	580,000 (53,848)	58,000 (1,642)	D and A
13	13	Oil Surface Impoundment (Lur. Can. Burn S.)	30 (9.1)	7,800 (729)	240,000 (6,795)	B
14	14	Burial Site (Bldg. 9920)	8 (2.4)	63,000 (5,844)	500,000 (14,158)	D and C
15	15	Trash Pits (Frustration Site)	1 (0.3)	110,000 (9,861)	0	NFA
16	16	Open Dumps (Arroyo del Coyote)	0.1 (0.03)	860,000 (80,148)	86,000 (2,435)	D and A
17	17	Scrap Yards/Open Dump (Thunder Range)	1 (0.3)	330,000 (30,520)	0	NFA
18	18	Concrete Pad (active)	0.1 (0.03)	49,000 (4,584)	5,000 (142)	D and A
19	19	TRUPAK Boneyard Storage Area	NA	170,000 (15,897)	5,000 (142)[e]	D and C
20	20	Schoolhouse Mesa Burn Site	1 (0.3)	7,900 (733)	0	NFA
21	21	Metal Scrap (Coyote Springs)	1 (0.3)	43,000 (3,961)	0	NFA
22	22	Storage/Burn (West of DEER)	1 (0.3)	1,800 (166)	0	NFA

Refer to footnotes at end of table.

Table A-2 (Continued)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
23	23	Disposal Trenches (Near Tijeras Arroyo)	1 (0.3)	700,000 (65,166)	<35 (<1)	C
24	25	Burial Site (South of TA-I)	1 (0.3)	NA	0	NFA
25	26	Burial Site (West of TA-III)	1 (0.3)	1,800,000 (168,087)	0	NFA
26	27	Bldg. 9820¾Animal Disposal Pit	1 (0.3)	5,700 (528)	0	NFA
27	28	Mine Shafts	1 (0.3)	7,000 (653)	0	NFA
28	30	PCB Spill (Reclamation Yard)	5 (1.5)	240,000 (21,861)	1,200,000 (33,980)	A
29	31	Electrical Transformer Oil Spill (TA-III)	1 (0.3)	1,400 (128)	0	NFA
30	32	Steam Plant Oil Spill (TA-I)	1 (0.3)	9,600 (894)	0	NFA
31	33	Motor Pool Oil Spill (TA-I)	1 (0.3)	81,000 (7,544)	40 (1.1)	B
32	34	Centrifuge Oil Spill (TA-III)	1 (0.3)	7,000 (649)	<35 (<1)	B
33	35	Vibration Facility Oil Spill (TA-III)	1 (0.3)	1,000 (97)	0	NFA
34	36	Oil Spill¾HERMES (TA-V)	NA	2,000 (186)	160,000 (4,530)[e]	A
35	37	PROTO Oil Spill (TA-V)	1 (0.3)	990 (92)	0	NFA
36	38	Oil Spills (Bldg 9920)	NA	600 (56)	7,200 (204)[e]	B
37	39	Oil Spill-Solar Facility	1 (0.3)	700 (65)	0	NFA
38	40	Oil Spill (6000 Igloo Area)	1 (0.3)	700 (65)	0	NFA
39	41	Building 838 Mercury Spill (TA-I)	1 (0.3)	6,100 (569)	0	NFA
40	42	Acid Spill Water Treatment Facility (TA-I)	NA	20,200 (1,877)	530 (15)[e]	C
41	43	Radioactive Material Storage Yard (TA-II)	NA	4,900 (453)	1,700 (48)[e]	D and C
42	44	Decontamination Site/Uranium Calibration Pit (TA-II)	NA	29,000 (2,669)	1,400 (40)[e]	C
43	45	Liquid Discharge (Behind TA-IV)	0.1 (0.03)	78,000 (7,257)	7,800 (221)	D and A

Table A-2 (Continued)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
44	46	Old Acid Waste Line Outfall (Tijeras Arroyo)	1 (0.3)	48,000 (4,482)	48,000 (1,359)	A
45	47	Unmanned Seismic Observatory	1 (0.3)	2,100 (196)	0	NFA
46	48	Bldg. 904 Septic System (TA-II)	1 (0.3)	20,000 (1,892)	0	NFA
47	49	Bldg. 9820 Drains	1 (0.3)	8,700 (801)	0	NFA
48	50	Old Centrifuge Site (Tijeras Arroyo)	1 (0.3)	17,000 (1,570)	0	NFA
49	51	Bldg. 6924 Pad, Tank, Pit	NA	6,700 (624)	9,100 (258) [e]	A
50	52	LWDS Holding Tanks (TA-V)	1 (0.3)	25,000 (2,344)	0	NFA
51	53	Bldg. 9923 Storage Igloo	1 (0.3)	1,500 (137)	0	NFA
52	54	Pickax Site (Thunder Range)	0.1 (0.03)	18,000,000 (1,715,139)	1,800,000 (50,471)	C
53	55	Red Towers Site (Thunder Range)	0.1 (0.03)	73,000 (6,768)	7,300 (207)	D and C
54	56	Old Thunderwells (Thunder Range)	1 (0.3)	1,800 (165)	0	NFA
55	57	Workman Site	0.1 (0.03)	430,000 (40,105)	43,000 (1,218)	D
56	58	Coyote Canyon Blast Area	0.1 (0.03)	1,700,000 (153,629)	170,000 (4,814)	D and A
57	59	Pendulum Site	1 (0.3)	8,800 (817)	0	NFA
58	60	Bunker Area (N. of Pendulum Site)	0.1 (0.03)	10,000 (924)	990 (28)	D and C
59	61	Schoolhouse Mesa Test Site	1 (0.3)	4,200,000 (393,438)	0	NFA
60	62	Graystone Manor (Coyote Springs)	1 (0.3)	50,000 (4,607)	0	NFA
61	63	Balloon Test Area	0.1 (0.03)	540,000 (49,779)	54,000 (1,529)	D and C
62	64	Gun Site (Madera Canyon)	1 (0.3)	110,000 (10,645)	0	NFA
63	65	Lurance Canyon Explosive Test Site	0.1 (0.03)	2,900,000 (273,879)	290,000 (8,212)	D and C
64	66	Boxcar Site	1 (0.3)	280,000 (26,001)	0	NFA
65	67	Frustration Site	NA	700 (65)	<35 (<1) [e]	D and C
66	68	Old Burn Site	NA	280,000 (26,228)	1,700 (48) [e]	D and A
67	69	Old Borrow Pit	1 (0.3)	42,000 (3,924)	0	NFA
68	70	Explosives Test Pit (Water Towers)	1 (0.3)	17,000 (1,547)	0	NFA

Table A-2 (Continued)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
69	71	Moonlight Shot Area	1 (0.3)	3,600,000 (336,328)	0	NFA
70	72	Operation Beaver Site	1 (0.3)	31,000 (2,904)	0	NFA
71	73	Hazardous Waste Repackaging/Storage (Bldg. 895)	1 (0.3)	16,000 (1,449)	0	NFA
72	74[f]	Chemical Waste Landfill	20 (6.1)	83,000 (7,686)	934,000[e] (26,459)	D and A, E
73	76	Mixed Waste Landfill (TA-III)	15 (4.6)	110,000 (9,948)	1,650,000 (46,717)	E
74	77	Oil Surface Impoundment (Tijeras Arroyo)	1 (0.3)	7,600 (704)	0	NFA
75	78	Gas Cylinder Disposal Pit (TA-III)	3 (0.9)	20,000 (1,862)	60,000 (1,699)	D and C
76	81	New Aerial Cable Site/Burial Site/Dump/Test Area	0.1 (0.03)	1,100,000 (104,505)	110,000 (3,115)	D and C
77	82	Old Aerial Cable Site Scrap	0.1 (0.03)	1,300,000 (118,696)	130,000 (3,681)	D and C
78	83	Long Sled Track (TA-III)	NA	10,200,000 (944,318)	5,000 (142)[e]	D and A
79	84	Gun Facilities (TA-III)	0.1 (0.03)	62,000 (5,715)	6,200 (176)	D and C
80	85	Firing Site (Bldg. 9920)	0.1 (0.03)	580,000 (54,084)	58,000 (1,642)	D and A
81	86	Firing Site (Bldg. 9927)	NA	8,000 (743)	<35[e] (<1)	D and C
82	87	Building 9990 (Firing Site)	35 (10.7)	7,100 (656)	250,000 (7,059)	D and C
83	88	Firing Site (SW of Coyote Springs)	1 (0.3)	680,000 (62,849)	0	NFA
84	89	Shock Tube Site (Thunder Range)	1 (0.3)	124,000 (11,534)	0	NFA
85	90	Beryllium Firing Site (Thunder Range)	1 (0.3)	6,900 (638)	6,900 (195)	D and C
86	91	Lead Firing Site (Thunder Range)	0.1 (0.03)	43,000 (3,958)	4,300 (122)	D and C
87	92	Pressure Vessel Test Site (Coyote Canyon Blast Area)	1 (0.3)	50,000 (4,690)	0	NFA
88	93	Madera Canyon Rocket Launcher Pads	1 (0.3)	66,000 (6,135)	0	NFA
89	94	Lurance Canyon Burn Site	0.1 (0.03)	750,000 (69,221)	75,000 (2,124)	D and A

Table A-2 (Continued)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
90	96	Storm Drain System	1 (0.3)	27,000 (2,508)	27,000 (765)	A
91	98	Bldg. 863 TCA, Photochem. Releases:	0.1 (0.03)	16,000 (1,486)	1,600 (45)	A
92	100	Building 6620 HE Sump/Drain (TA-III)	1 (0.3)	1,600 (148)	0	NFA
93	101	Explosive Contaminated Sumps, Drains (Bldg. 9926)	1 (0.3)	1,700 (158)	0	NFA
94	102	Radioactive Disposal (East of TA-III)	1 (0.3)	6,900,000 (636,693)	0	NFA
95	103	Scrap Yard (Bldg. 9939)	10 (3.0)	1,300 (122)	13,200 (373)	D and A
96	104	PCB spill, Computer Facility	1 (0.3)	NA	0	NFA
97	105	Mercury (Bldg. 6536) (TA-III)	1 (0.3)	NA	0	NFA
98	107	Explosive Test Area (SE of TA-III)	1 (0.3)	1,100,000 (105,578)	0	NFA
99	108	Firing Site (Bldg. 994)	0.1 (0.03)	76,000 (7,045)	7,600 (215)	D and C
100	109	Firing Site (Bldg. 9956)	10 (3.0)	2,300 (218)	23,000 (651)	D and C
101	111	Bldg. 6715 Sump/Drains (Area III)	1 (0.3)	450 (42)	0	NFA
102	112	Explosive Contaminated Sump (Bldg. 9956)	1 (0.3)	9,100 (846)	0	NFA
103	113	Area II Firing Sites	1 (0.3)	17,000 (1,574)	0	NFA
104	114	Explosive Burn Pit (Area II)	1 (0.3)	12,000 (1,114)	0	NFA
105	115	Firing Site (Bldg. 9930)	1 (0.3)	7,400 (687)	7,400 (210)	D and C
106	116	Bldg. 9990 Septic System	NA	2,700 (249)	<35 (<1)[e]	A
107	117	Trenches (Bldg. 9939)	NA	22,000 (2,068)	12,000 (340)[e]	D and C
108	135	Bldg. 906 Septic System	1 (0.3)	1,300 (124)	0	NFA
109	136	Bldg. 907 Septic System	1 (0.3)	32,000 (2,991)	0	NFA
110	137	Bldg. 6540/6542 Septic System	1 (0.3)	53,000 (4,969)	0	NFA
111	138	Bldg. 6630 Septic System	1 (0.3)	11,000 (1,025)	0	NFA
112	139	Bldg. 9964 Septic System	1 (0.3)	3,400 (314)	0	NFA

Table A-2 (Continued)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
113	140	Bldg. 9965 Septic System	NA	3,300 (308)	<35 (<1)[e]	C
114	141	Bldg. 9967 Septic System	NA	4,000 (369)	<35 (<1)[e]	B
115	142	Bldg. 9970 Septic System	1 (0.3)	2,800 (258)	0	NFA
116	143	Bldg. 9972 Septic System	1 (0.3)	21,000 (1,906)	0	NFA
117	144	Bldg. 9980 Septic System	1 (0.3)	18,000 (1,660)	0	NFA
118	145	Bldg. 9981/9982 Septic System	1 (0.3)	28,000 (2,605)	0	NFA
119	146	Bldg. 9920 Drain System	1 (0.3)	2,000 (184)	0	NFA
120	147	Bldg. 9925 Septic System	NA	35,000 (3,221)	<35 (<1)[e]	A
121	148	Bldg. 9927 Septic System	NA	2,000 (184)	<35 (<1)[e]	A
122	149	Bldg. 9930 Septic System	1 (0.3)	11,000 (1,028)	0	NFA
123	150	Bldg. 9939/9939A Septic System	NA	7,500 (693)	<35 (<1)[e]	A
124	151	Bldg. 9940 Septic System	NA	4,800 (447)	<35 (<1)[e]	A
125	152	Bldg. 9950 Septic System	1 (0.3)	4,300 (400)	0	NFA
126	153	Bldg. 9956 Septic System	NA	18,000 (1,654)	<35 (<1)[e]	A
127	154	Bldg. 9920 Septic System	1 (0.3)	19,000 (1,758)	0	NFA
128	159	Bldg. 935 Septic System	1 (0.3)	1,500 (141)	0	NFA
129	160	Bldg. 9832 Septic System	1 (0.3)	7,100 (664)	0	NFA
130	161	Bldg. 6636 Septic System	1 (0.3)	11,000 (1,020)	0	NFA
131	165	Bldg. 901 Septic System	1 (0.3)	26,000 (2,415)	0	NFA
132	166	Bldg. 919 Septic System	1 (0.3)	5,000 (472)	0	NFA
133	167	Bldg. 940 Septic System	1 (0.3)	3,200 (301)	0	NFA

Table A-2 (Continued)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
134	186	Bldg. 859 TCE Disposal	0.1 (0.03)	11,000 (990)	1,100 (31)	B
135	187	TA-I Sanitary Sewer Lines	1 (0.3)	NA	270,000 (7,646)	C
136	188	Bldg. 6597 Aboveground Containment Spill Tank	1 (0.3)	NA	0	NFA
137	190	Steam Plant Tank Farm	1 (0.3)	130,000 (11,630)	130,000 (3,681)	B
138	191	Equus Red	0.1 (0.03)	93,000 (8,598)	9,300 (263)	D and C
139	192	TA-I Waste Oil Tank	1 (0.3)	9,400 (875)	9,400 (266)	B
140	193	Sabotage Test Area	1 (0.3)	2,200 (203)	2,200 (62)	D and C
141	194	General Purpose Heat Source Test Area	1 (0.3)	18,000 (1,709)	0	NFA
142	196	Bldg. 6597 Cistern (TA-V)	NA	1,700 (155)	9,800 (278)[e]	B
143	211	Bldg. 840 Former UST (TA-I)	1 (0.3)	NA	0	NFA
144	226	Old Acid Waste Line (TA-I)	1 (0.3)	NA	27,000 (765)	C
145	227	Bunker 904 Outfall (Tijeras Arroyo)	1 (0.3)	9,000 (839)	9,000 (255)	D and A
146	228	Centrifuge Dump Site	NA	310,000 (29,020)	5,000 (142)[e]	C
147	229	Storm Drain System Outfall	1 (0.3)	4,800 (445)	4,800 (136)	A
148	230	Storm Drain System Outfall	1 (0.3)	4,400 (412)	4,400 (125)	A
149	231	Storm Drain System Outfall	1 (0.3)	1,900 (172)	1,900 (54)	A
150	232	Storm Drain System Outfall	1 (0.3)	1,600 (144)	1,600 (45)	A
151	233	Storm Drain System Outfall	1 (0.3)	900 (84)	900 (25)	A
152	234	Storm Drain System Outfall	1 (0.3)	3,300 (311)	3,300 (93)	A
153	235	Storm Drain Systems Outfall	1 (0.3)	62,000 (5,736)	62,000 (1,756)	A
154	240	Short Sled Track	NA	890,000 (82,878)	5,000 (142)[e]	D and C or E
155	241	Storage Yard	0.1 (0.03)	40,000 (3,684)	4,000 (113)	C
156	275	TA-V Seepage Pits	1 (0.3)	1,200 (34)	NA	Unknown

Table A-2 (Concluded)
Estimated Volumes Potential Range of Treatments for Environmental Restoration Sites at Sandia National Laboratories/New Mexico

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	ER Site No.	Description	Depth Assumed feet (meters)[a]	Areal Extent ft^2 (m^2)[b]	Treatable Volume ft^3 (m^3)[c]	Assumed Corrective Measure[d]
157	276	Building 829X Sump	1 (0.3)	Not available	Not available	Unknown

[a]Site descriptions were used to estimate contaminant depth if possible. Sites without sufficient information were assumed to have contaminants evenly distributed in the soil to a depth of 1 foot (ft). If specific information on contaminant distribution allowed a different estimate depth to be made, that depth is noted here.
[b]Areal extent estimates in square feet (ft^2) extracted from unpublished interim reports in the SNL/NM ER Project files, 1994 are rounded to two significant figures. Rounding may introduce apparent inconsistencies in unit conversions.
[c]Treatable volume estimates in cubic feet (ft^3) based on assumed average 1-ft depth unless otherwise indicated in column 3.
[d]All sites considered are potential candidates for no further action (NFA) designation depending on site characterization results. Other letters represent treatment options assumed to be used for this EA analysis. Actual selected site corrective measures may differ. Treatment options are:

A = Excavation and thermal desorption
B = Bioremediation at ER Site
C = Soil washing and stabilization
D = Removal and Decontamination
E = Closure in place (Capping/Institutional Controls)

[e]Treatable volume was conservatively estimated for this site by SNL/NM Environmental Restoration task leader responsible for site at the time this EA was prepared. Actual treatable volumes may differ as new information is obtained on the sites.
[f]The Chemical Waste Landfill is expected to be only partially excavated. The treatable volume is estimated to be about 934,000 ft^3 rather than the 10,800,000 full volume of the site shown in Table A-1 (Fish, 1995).

DEER =
HE = high explosives
LWDS = Liquid Waste Disposal System
NA = not available
NFA = no further action
PCB = polychlorinated biphenyl
TA = Technical Area
TCA = trichloroethane
TCE = trichloroethene
TRUPAK = transuranic package transporter
UST = Underground Storage Tank

Table A-3
Assumed Waste Soil Volumes to be Excavated and Trip Distances to TU and/or CAMU for Sandia National Laboratories/New Mexico Environmental Restoration Sites[a]

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	Site No.	Volume Excavated		Number of Trips to CAMU	Volume Returned		Number of Return Trips	One-Way Distance		Total Transport	
		Cubic Meters	Cubic Feet		Cubic Meters	Cubic Feet		km	mi	km	mi
1	1	340	12,000	14	NA	NA	0	7.6	4.7	210	130
2	2	3,115	110,000	128	NA	NA	0	7.4	4.6	1,900	1,200
3	7	8,778	310,000	359	NA	NA	0	2.9	1.8	2,000	1,300
4	8	1,641	58,000	67	NA	NA	0	9.0	5.6	1,200	750
5	9	133	4,700	6	NA	NA	0	7.6	4.7	80	50
6	10	8,778	310,000	359	NA	NA	0	11.4	7.1	8,200	5,000
7	11	193	6,800	8	NA	NA	0	7.6	4.7	120	74
8	12	1,642	58,000	67	NA	NA	0	13.8	8.6	1,900	1,200
9	14	14,158	500,000	578	NA	NA	0	5.1	3.2	5,900	3,700
10	16	2,435	86,000	100	NA	NA	0	2.4	1.5	480	300
11	18	142	5,000	6	NA	NA	0	0.0	0.0	0.0	0.0
12	19	142	5,000	6	NA	NA	0	10.2	6.3	120	74
13	23	<1	<35	1	<1	27	1	3.5	2.2	<1	<1
14	30	33,980	1,200,000	1,387	26,000	900,000	1,041	7.4	4.6	36,000	22,000
15	36	4,530	160,000	178	3,400	120,000	139	5.1	3.2	3,300	2,100
16	42	15	530	1	11	400	1	7.6	4.7	30	19
17	43	48	1,700	2	NA	NA	0	7.1	4.4	28	17
18	44	40	1,400	2	30	1,100	2	6.9	4.3	39	25
19	45	221	7,800	9	NA	NA	0	6.9	4.3	130	77
20	46	1,359	48,000	56	1,000	36,000	42	6.5	4.0	1,300.0	780
21	51	258	9,100	11	200	6,800	8	1.7	1.1	63	39
22	54	50,471	1,800,000	2,061	NA	NA	0	2.4	1.5	9,900	6,100
23	55	207	7,300	9	NA	NA	0	4.0	2.5	68	42
24	57	1,218	43,000	50	NA	NA	0	10.5	6.5	1,000	650

Refer to footnotes at end of table.

Table A-3 (Continued)
Assumed Waste Soil Volumes to be Excavated and Trip Distances to TU and/or CAMU for Sandia National Laboratories/New Mexico Environmental Restoration Sites[a]

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	Site No.	Volume Excavated		Number of Trips to CAMU	Volume Returned		Number of Return Trips	One-Way Distance		Total Transport	
		Cubic Meters	Cubic Feet		Cubic Meters	Cubic Feet		km	mi	km	mi
25	58	4,814	170,000	197	NA	NA	0	9.0	5.6	3,500	2,200
26	60	28	990	2	NA	NA	0	11.4	7.1	26	16
27	63	1,529	54,000	63	1,200	41,000	.47	12.4	7.7	2,700	1,700
28	65	8,212	290,000	335	NA	NA	0	13.1	8.1	8,800	5,400
29	67	<1	<35	1	<1	27	1	13.1	8.1	52	32
30	68	48	1,700	2	NA	NA	0	9.5	5.9	37	23
31	74[b]	26,459	934,000	1,080	19,800	700,000	810	2.1	1.3	7,900	4,900
32	78[c]	0	0	0	NA	NA	0	0.0	0.0	0.0	0.0
33	81	3,115	110,000	128	NA	NA	0	15.5	9.6	3,900	2,400
34	82	3,681	130,000	151	NA	NA	0	11.3	7.0	3,400	2,100
35	83	142	5,000	6	NA	NA	0	1.2	0.7	14	8
36	84	176	6,200	8	NA	NA	0	1.0	0.6	14	9
37	85	1,642	58,000	67	NA	NA	0	5.1	3.2	680	420
38	86	<1	<35	1	NA	NA	0	6.0	3.7	12	7
39	87	7,059	250,000	289	NA	NA	0	9.3	5.8	5,400	3,200
40	90	195	6,900	8	NA	NA	0	4.0	2.5	64	40
41	91	122	4,300	5	NA	NA	0	3.8	2.4	38	24
42	94	2,124	75,000	87	NA	NA	0	14.0	8.7	2,400	1,500
43	96	765	27,000	32	574	20,000	24	8.0	5.0	870	540
44	98	45	1,600	2	34	1,200	2	8.1	5.0	52	32
45	103	373	13,200	16	NA	NA	0	5.6	3.5	170	110
46	108	215	7,600	9	NA	NA	0	4.0	2.5	70	44
47	109	651	23,000	27	488	17,000	20	3.3	2.1	300	190

Refer to footnotes at end of table.

Table A-3 (Continued)
Assumed Waste Soil Volumes to be Excavated and Trip Distances to TU and/or CAMU for Sandia National Laboratories/New Mexico Environmental Restoration Sites[a]

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

No.	Site No.	Volume Excavated		Number of Trips to CAMU	Volume Returned		Number of Return Trips	One-Way Distance		Total Transport	
		Cubic Meters	Cubic Feet		Cubic Meters	Cubic Feet		km	mi	km	mi
48	115	210	7,400	9	NA	NA	0	6.3	3.9	108	67
49	116	<1	<35	1	<1	27	1	9.3	5.8	23	14
50	117	340	12,000	14	NA	NA	0	5.6	3.5	160	100
51	140	<1	<35	1	<1	27	1	3.8	2.4	15	10
52	147	<1	<35	1	<1	27	1	6.7	4.2	27	17
53	148	<1	<35	1	<1	27	1	6.0	3.7	24.0	15
54	150	<1	<35	1	<1	27	1	6.0	3.7	24.0	15
55	151	<1	<35	1	<1	27	1	3.3	2.1	13	8
56	153	<1	<35	1	<1	27	1	4.0	2.5	16.0	10.0
57	187	7,646	270,000	313	5,700	200,000	235	7.6	4.7	8,300	5,200
58	191	263	9,300	11	NA	NA	0	4.3	2.7	92	57
59	193	62	2,200	3	NA	NA	0	4.0	2.5	20	13
60	226	765	27,000	32	574	20,000	24	6.9	4.3	750	470
61	227	255	9,000	11	191	6,800	8	6.4	4.0	230	150
62	228	142	5,000	6	107	3,800	5	6.4	4.0	130	81
63	229	136	4,800	6	102	3,600	5	6.4	4.0	120	80
64	230	125	4,400	6	94	3,300	4	7.1	4.4	130	80
65	231	54	1,900	3	41	1,400	2	7.1	4.4	55	34
66	232	45	1,600	2	34	1,200	2	7.1	4.4	46	28
67	233	25	900	1	19	660	1	7.1	4.4	25	16
68	234	93	3,300	4	70	2,500	3	4.8	3.0	64	40
69	235	1,756	62,000	72	1,300	47,000	54	7.1	4.4	1,800	1,100

Refer to footnotes at end of table.

Table A-3 (Concluded)
Assumed Waste Soil Volumes to be Excavated and Trip Distances to TU and/or CAMU for Sandia National Laboratories/New Mexico Environmental Restoration Sites[a]

These data are preliminary and were used only to determine bounding conditions. Uncertainties associated with these numbers make other uses inappropriate.

		Volume Excavated		Number	Volume Returned		Number	One-Way Distance		Total Transport	
No.	Site No.	Cubic Meters	Cubic Feet	of Trips to CAMU	Cubic Meters	Cubic Feet	of Return Trips	km	mi	km	mi
70	240	142	5,000	6	NA	NA	0	0.0	0.0	0.0	0.0
71	241	113	4,000	5	85	3,000	4	1.9	1.2	31	19
	Totals	210,000	7,300,000	8,500	61,000	2,100,000	2,500	460	290	130,000	79,000

[a]*Assumptions:*
1. The TU CAMU site will be near the Chemical Waste Landfill (ER Site 74) for all excavated materials.
2. Distances were calculated from outer site boundaries on the most direct Kirtland Air Force Base or United States Forest Service route using a curvimeter on a 1"-2000 site map.
3. Sites designated for no further action and sites marked for Treatment B (in situ treatment) are not included.
4. The load size is assumed to be 32 cubic yards. A 25% reduction in volume is assumed from Treatments A and C.
5. Soils from treatment D sites will be excavated but not returned to the site.
6. Volume used in estimating air emissions from truck transport and the number of trips needed is smaller than that reflected in this table because some sites have been withdrawn from *corrective action requirements under the current RCRA Part B HSWA permit application.*
7. Rounded to two significant figures. Rounding may introduce apparent inconsistencies in unit conversions.

[b]Chemical Waste Landfill is expected to be only partially excavated (about 934,000 cubic feet), rather than fully excavating the 10,800,000 cubic foot total volume shown in Table A-1.
[c]Debris removed, no treatment.

CAMU = corrective action management unit
NA = not applicable
km = kilometer(s)
mi = mile(s)

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APPENDIX B

Major Assumptions

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Major Assumptions

Numerous assumptions have been made in preparing this document. This appendix identifies the major assumptions on which the impact analysis has been based. Assumptions have also been made where relevant data are currently unavailable or for the purpose of generating models. More detailed assumptions relating to treatment facility design, modeling, and risk assessment are found in appendices and supplemental volumes relating to those sections.

1. For this assessment, as shown in Appendix A, Table A-1, an original estimate of 73 Environmental Restoration (ER) Project sites were assumed to qualify for no further action (NFA) status. As of December 1995, 64 of the currently estimated 157 Sandia National Laboratories/New Mexico (SNL/NM) ER Project sites are expected to be designated as NFA sites and, therefore, would not require further corrective measures. NFA sites were not assumed to contribute to human health risks because they would have to meet U.S. Environmental Protection Agency (EPA) criteria to protect public health in order to be designated NFA sites.

2. More definitive information on the extent of contaminants of concern (CoCs) at the ER Project sites would become available over the next four years as the Resource Conservation and Recovery Act facility investigations are completed.

3. Treatment technologies with potential impacts equal to or less than those technologies analyzed in this Environmental Assessment (EA) would be covered by the risk analysis although they may not be specifically discussed in the EA.

4. At least 80 percent of the soil volumes subject to treatment consist of contaminated soils.

5. Any potential contaminants of concern (CoCs) identified in historical documents could be present at a given site.

6. Thermal desorption and off-gas treatment would accomplish complete thermal destruction of hazardous organics. High efficiency particulate air (HEPA) filtration on treatment units would remove 99.99% of the particulate contaminants from exhaust air.

7. Soil washing would result in a waste volume reduction of 25 percent.

8. For risk evaluation, data collected from example sites are used to represent comparable sites for which data are not available.

9. The entire ER Project would be completed in 10 years. On the average, ER Project activities at any given site will take one year.

10. In order to qualify for NFA designation, ER Project sites would carry a long-term lifetime excess cancer risk to members of the public acceptable to EPA. This assessment assumes that EPA would accept risks less than 1×10^{-5}.

11. Risks to workers at voluntary corrective measures (VCMs) and corrective action sites would be controlled by Occupational Safety and Health Administration, Department of Energy, and SNL/NM safety criteria.

12. Land use would continue as it is currently for the next 100 years. SNL/NM sites would continue to be designated for industrial use and their present recreational use.

13. Receptors would be those members of the public and workers who are currently exposed.

14. Current operations on lands occupied by SNL/NM and Kirtland Air Force Base would not change significantly over the next 100 years.

APPENDIX C

Correspondence with Federal and State Agencies

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Correspondence with Federal and State Agencies

The U.S. Department of Energy has corresponded with the following agencies regarding corrective action activities at Sandia National Laboratories/New Mexico Environmental Restoration Project sites:

- Kirtland Air Force Base, 377th ABW/EM.
- Kirtland Air Force Base, AAMESH.
- New Mexico Department of Game and Fish.
- New Mexico Energy, Minerals and Natural Resources Department, Forestry and Resource Conservation Division.
- U.S. Fish and Wildlife Service, Ecological Services.
- State of New Mexico Office of Cultural Affairs, Historic Preservation Division.

Correspondence on cultural resources and sensitive/endangered species is provided in this appendix in chronological order.

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United States Government | Department of Energy

memorandum

Albuquerque Operations Office
Kirtland Area Office

AUG 18 1994

REPLY TO ATTN OF: KAO:ESH:SDL

SUBJECT: Cultural Resource Surveys and Sensitive Species Surveys for Two Geophysical Study Sites at Sandia National Laboratories, New Mexico

TO:

T. A. Wolff, SNL 7258, MS 1037

This memorandum is to inform you that the Department of Energy has consulted with the U. S. Forest Service on the subject surveys. We have been informed by Mr. John Hayden that the subject activities do not constitute an undertaking as defined in Section 106 of the National Historic Preservation Act. If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542.

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

cc:
J. M. Harris, SNL 7258, MS 1037

SNA - 92 - 34 - 05

Sandia National Laboratories

P.O. Box 5800
Albuquerque, New Mexico 87185-1037

August 29, 1994

George Laskar
Assistant Area Manager, Environment, Safety and Health
US Department of Energy, Kirtland Area Office
PO Box 5400, MS 0184
Albuquerque, NM 87185-0184

Dear Mr. Laskar:

Subject: Transmittal of "Cultural Resource Surveys of 6.84 Acres for Sandia National Laboratories, Environmental Restoration, Sitewide Drill Locations Number 1 and 2, Kirtland Air Force Base, New Mexico"

The attached cultural resources survey report, "Cultural Resource Surveys of 6.84 Acres for Sandia National Laboratories, Environmental Restoration, Sitewide Drill Locations Number 1 and 2, Kirtland Air Force Base, New Mexico," was prepared by Steven R. Hoagland. The report discusses site surveys for two out of six drilling locations as described in the accompanying National Environmental Policy Act (NEPA) environmental checklist/action description memorandum (ECL/ADM) SNA-92-034-006 "Site-Wide Hydrogeologic Characterization 1994 Drilling Project." As noted in the memo dated Aug. 22, 1994, John Weckerle of the SNL NEPA team reviewed the ECL/ADM and considered the proposed action to be within the scope of the existing categorical exclusion determination based upon ECL/ADM SNA-92-034 for site characterization.

The enclosed cultural resources survey report encompasses *only* sites one and two. Sites three through six will be surveyed separately prior to any drilling activities. Based upon the survey results, the archaeologist indicates that there are no significant intact cultural resources located in the area of potential effect (sites one and two). As noted in the ECL/ADM, the proposed drilling sites are on US Air Force owned property.

The Department of Energy (DOE) may wish to consult with the Air Force and/or the State Historic Preservation Officer (SHPO) regarding compliance with the National Historic Preservation Act.

Please inform me of the results of any consultations between the DOE and other federal agencies or the State Historic Preservation Officer (SHPO) under the National Historic Preservation Act regarding the proposed drilling at sites one and two.

Sincerely,

Joan M. Harris
NEPA Specialist
Risk Management and NEPA

JMH:7258:jmh

enc.:
(1) (Five copies) LA Project/Activity Record
(2) (Five copies) "Cultural Resource Surveys of 6.84 Acres for Sandia National Laboratories, Environmental Restoration, Sitewide Drill Locations Number 1 and 2, Kirtland Air Force Base, New Mexico," by Steven R. Hoagland, dated June 1994
(3) (Two copies) Memo dated August 22, 1994 from John E. Weckerle to Sue Collins and Clifford Jarman regarding ECL/ADM SNA-92-034-006
(4) (Two copies) ECL/ADM SNA-92-034-006

Copy to (w/o enc.):
Susan Lacy, Chemical Engineer
Environment, Safety and Health
US Department of Energy, Kirtland Area Office
PO Box 5400, Mail Stop 0184
Albuquerque, NM 87185-0184

Deborah A. Garcia
US Department of Energy, Kirtland Area Office
PO Box 5400, Mail Stop 0184
Albuquerque, NM 87185-0184

cc with one copy of enc. (1) and (2) only:
MS 1037 Ted A. Wolff, 7258
NEPA Records (SNA-92-034-006)

cc (w/o enc.):
MS 0876 Nettie L. Jones, 7312
MS 0876 Linda A. Campbell, 7312
MS 1348 Clifford Jarman, 7585
MS 1348 Dick Fate, 7585
MS 1350 Caroline Byrd, 7584
MS 1350 Sue Collins, 7584
MS 1350 John McCord, 7584
MS 1350 Michael Mitchell, 7584
MS 1037 Joan M. Harris, 7258
Cultural Resources Records
Day File, Harris

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

NOV 04 1994

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Ms. Tuttle:

Enclosed for your review and transmittal to the State Historic Preservation Officer are the following Cultural Resource Surveys:

Cultural Resource Surveys of 7.34 Acres for Sandia National Laboratories, Environmental Restoration, Sitewide Drill Locations Number 3 and 4.

Five copies of the document are enclosed. If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/o enclosure:
T. A. Wolff, SNL 7258, MS 1037
J. M. Harris, 7258, MS 1037

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

NOV 10 1994

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Ms. Tuttle:

Enclosed for your review and transmittal to the State Historic Preservation Officer, the U. S. Forest Service, and other agencies as appropriate, are the following Cultural Resources and Sensitive Species Survey:

Report on the Sensitive Species Survey at ER Site 87 (Building 9990).

Cultural Resource Survey of 148 Acres for Sandia National Laboratories, Environmental Restoration Site 87 North, Kirtland Air Force Base, New Mexico.

Five copies of the document are enclosed, each of which includes an addendum containing a biological survey. If you have any questions regarding this information, please contact Susan Lacy, NEPA Compliance Officer, at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/o enclosure:
T. A. Wolff, SNL 7258, MS 1037
J. M. Harris, SNL 7258, MS 1037
D. Nargelovic, SNL 7258, MS 1037

Sandia National Laboratories

Albuquerque, New Mexico 87185-1037

date: Feb. 2, 1995

to: Ted Wolff, 7258, MS 1037

from: Joan M. Harris, 7258, MS 1037

subject: Cultural Resources Consultation Received for ER ADS 1309, Site 23

As required by Section 106 of the National Historic Preservation Act, the US Air Force has consulted with the New Mexico State Historic Preservation Officer (SHPO) concerning the "Voluntary Corrective Measure: Environmental Restoration Project - Tijeras Arroyo ADS 1309, Site 23." The SHPO has concurred that the proposed undertaking will have no effect upon historic properties. A copy of the SHPO's letter is attached.

Please note that the SHPO has requested that all future requests for consultation should include completed New Mexico Cultural Resource Information System (NMCRIS) project/activity forms and site recording forms.

Copy to:
MS 1347 Fran Nimick, 7582
MS 1347 Jim Brinkman, 7582
MS 1348 R. E. Fate, 7582
MS 1348 D. R. Bleakly, 7583
MS 1037 Joan M. Harris, 7258
MS 1037 Tim Sanchez-Brown, 7258
MS 1037 Ted Wolff, 7258
NEPA Records (SNA-94-089, and CRA-94-003)
Day File, Harris

STATE OF NEW MEXICO
OFFICE OF CULTURAL AFFAIRS
HISTORIC PRESERVATION DIVISION

VILLA RIVERA BUILDING
228 EAST PALACE AVENUE
SANTA FE, NEW MEXICO 87503
(505) 827-6320

January 27, 1995

Major Scott E. Streifert, USAF
Director
Environmental Management Division
Headquarters 377th Air Base Wing (AFMC)
377 ABW/EM
2000 Wyoming Boulevard, SE
Kirtland Air Force Base, New Mexico 87117-5659

Re: Environmental Restoration Project - Tijeras Arroyo ADS 1309, Site 23

Attn: Ms. Christine Tuttle

Dear Major Streifert:

At your request, the Historic Preservation Division has reviewed the results of a cultural resources survey of the area to be affected by the Department of Energy's Voluntary Corrective Measure: Environmental Restoration Project - Tijeras Arroyo ADS 1309, Site 23 on Kirtland Air Force Base. The results of this survey are described in a March 23, 1994 preliminary report prepared by Mr. Steven R. Hoagland, Butler Service Group, Inc.

The preliminary report describes a single isolated hearth feature of unknown cultural or temporal affiliation located within the survey area. We concur with you determination that this feature does not meet any of the criteria of eligibility for inclusion in the National Register of Historic Places (36 CFR 60.4). It is our opinion that any information potential of this feature will be (or has been) exhausted by formal recording. Since no other properties entered in or determined eligible for inclusion in the National Register are located in the vicinity, it is our opinion that this undertaking will have no effect on any historic properties.

Changes in the scope or location of the proposed environmental restoration project will require further review by this office. It is also possible that buried archaeological

manifestations will be uncovered by construction activities. If any such discoveries are made, artifacts and features should be protected in place and this office notified immediately of the find. Cultural resources discovered during construction will be evaluated and treated in accordance with the provisions of 36 CFR Part 800.11.

To ensure proper recording of site and survey data from Kirtland Air Force Base, future requests for State Historic Preservation Officer consultations should include completed New Mexico Cultural Resource Information System (NMCRIS) project/activity forms and site recording forms. This information should be submitted for this project as soon as possible. Copies of these forms and the NMCRIS Users Guide may be obtained from the Historic Preservation Division's Archaeological Records Management Section.

Thank you for the opportunity to consult with you on the described undertaking. Provided that you have no further questions regarding our comments, this determination of no effect should conclude our consultation on this matter.

Sincerely,

for Michael Romero Taylor
State Historic Preservation Officer

MRT:DER:slv/Log 45969

cc: Susan Lacy

CRA-95-001

Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

April 25, 1995

Mr. Michael Romero Taylor
State Historic Preservation Officer
Office of Cultural Affairs
La Villa Rivera, Room 101
224 E. Palace Ave.
Santa Fe, NM 87501

Dear Mr. Taylor:

A cultural resource investigation has been conducted for the Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration (ER) Program. This project involved a cultural resources survey and records review for approximately 2,445.4 acres of property situated throughout Kirtland Air Force Base (KAFB), New Mexico, and included the survey or resurvey of 1635.8 acres of property and the reporting of previous surveys for 809.6 acres of property. Lands surveyed for this project are owned by the Department of Energy (DOE); Department of Defense (DOD); and the United States Forest Service (USFS), Cibola National Forest withdrawn properties. The survey areas, methods, site descriptions, results, and recommendations are contained in the enclosed report "Cultural Resource Investigation for Sandia National Laboratories/New Mexico Environmental Restoration Program, Kirtland Air Force Base, New Mexico."

The survey and records review resulted in the documentation of 31 new sites, 39 previously documented sites including, one potential historic district, and 128 isolated occurrences from the SNL ER locales. One prehistoric site, eight historic, three prehistoric/historic and all of the isolated occurrences are no longer thought to be significant as their research potential has been mitigated through recordation. Twenty-nine of the prehistoric sites, including the three sites which have been included into LA 107488, fifteen of the historic sites, thirteen of the historic/prehistoric sites, and one site of unknown temporal affiliation are thought to be eligible or potentially eligible to the National Register of Historic Places (NRHP).

Although the likelihood for significant remains is thought to be fairly limited for LA 47900, and LA 107497, it is unclear whether the research potential has been exhausted; thus, they are still considered potentially eligible to the NRHP. The vast majority of the cultural resources sites are considered eligible under criterion (d), "likely to yield information important in prehistory or history." Four sites, however, are potentially eligible under criterion (a), "association with an event that has made a significant contribution to the broad patterns of our history" (LA 105324 and Tech Area II), and/or criterion (c), "distinctive characteristics of types, periods, and methods of construction" (LA 64556, LA 105324, LA 107498, and Tech Area II). LA 64556 is also thought to be eligible under criterion (d).

Tech Area II is also potentially eligible as a historic district under criterion (g), "properties that have achieved significance within the last fifty years."

The Environmental Restoration Program is considering "undertakings" under Section 106 of the National Historic Preservation Act to be activities carried out by the ER Program that concern particular ER Sites. For instance, soil sampling and other characterization activities within the boundaries of a particular ER Site would be considered an undertaking in the discussion below.

Please note that all ER Sites discussed in this letter are sites located at the SNL/NM site. The ER Site numbers discussed in this letter and the enclosed report are not continuous. Three ER Sites at SNL/NM were not surveyed as part of this project. These are ER Sites 20, 61b, 225, and 275.

1. Environmental Restoration Sites Located in Areas Believed to Contain No Historic Properties:

No historic properties were located within the boundaries of the following environmental restoration (ER) sites:

Sites: 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 25, 26, 27, 28-5, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 59, 64, 66, 68, 69, 70, 71, 72, 73, 74, 76, 77, 78, 81, 82, 83, 84, 85, 86, 89, 90, 91, 94, 96, 98, 100, 101, 103, 104, 105, 107, 108, 109, 111, 112, 114, 115, 116, 117, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 160, 161, 186, 187, 188, 190, 191, 192, 193, 194, 196, 211, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 240, 241, and 242.

Note that ER Sites 21, 28-2, 28-6, 28-7, and 92, contain cultural resource sites, but these cultural resources sites are no longer thought to be eligible to the NRHP.

The Department of Energy (DOE) has determined that environmental restoration activities of the ER Sites listed above would have no effect upon historic properties because there are no properties present in these areas that are considered eligible to the NRHP.

The DOE is requesting concurrence with this determination.

2. Environmental Restoration Sites Located in the Vicinity of Historic Properties:

Some ER Sites were found to contain properties that are considered eligible or potentially eligible to the NRHP. (A table summarizing the historic properties in the vicinity of these ER Sites is attached to this letter.) Although the enclosed report indicates that ER Site 102 does not contain any historic properties, on April 11, 1995, the Sandia Environmental

Restoration Program was informed that Steven Hoagland had discovered an historic drainage ditch in the vicinity of ER Site 102. Because of this discovery, an addendum to the enclosed report is in preparation.

2.1 Environmental Restoration Sites in the Vicinity of Historic Properties Proposed for "No Further Action:"

The following ER Sites are proposed for "no further action:"

Sites: 21, 23, 28-2, 28-3, 28-4, 28-6, 28-7, 28-8, 28-9, 28-10, 43, 44, 48, 62, 63-A, 63-B, 67, 88B, 92, 93c, 113, 135, 136, 159, 165, 166, and 167.

Note that ER Sites 21, 28-2, 28-6, 28-7, and 92, were also discussed under Item 1, above, as containing cultural resource sites, but these cultural resources sites are no longer thought to be eligible to the NRHP.

"No further action" means that these sites are not proposed for clean-up activities. However, it will be necessary to take a small number of soil samples from each of these ER Sites. Soil sampling will consist of a series of shallow, hand-dug, excavations ranging from 3 to 12 inches in diameter and from 1 to 12 inches in depth. None of the soil sampling will be conducted within any of the associated cultural resource sites. The avoidance of historic properties will be ensured by either (1) having an archeologist present at the ER Site during the identification and marking of locations for soil sampling activities or (2) by consulting with an archaeologist on the basis of existing maps showing ER Sites and Historic Properties when identifying locations proposed for soil sampling.

The DOE has determined that although these ER Sites are located in the vicinity of historic properties, the undertakings associated with soil sampling are expected to have no effect upon historic properties because the properties will be avoided.

The DOE is requesting concurrence with this determination.

2.2 Environmental Restoration Sites in the Vicinity of Historic Properties Proposed for Further Investigation and Possible Remediation:

Several ER Sites and potential ER Sites are located in the vicinity of historic properties and also require further investigation and possible remediation. Proposals for remedial activities do not exist now, but would be developed based on further geophysical and radiological studies of these ER Sites. Specific impacts to the historic properties in the vicinity of these ER Sites resulting from cleanup activities would have to be assessed on a site-by-site basis.

ER Sites requiring further investigation and possible remediation are:

Sites: 1, 2, 8, 57, 58, 60, 61, 65, 87, and 88A.

Potential ER Sites requiring further review and investigation are:

Sites: 238 and 239.

The Department of Energy has determined that site characterization work, such as geophysical and radiological studies, and soil sampling, would not affect historic properties located in the vicinity of these ER Sites and potential ER Sites because the historic properties would be avoided during sampling and characterization work. The avoidance of historic properties will be ensured by either (1) having an archeologist present at the ER Site during the identification and marking of locations for soil sampling or characterization activities or (2) by consulting with an archaeologist on the basis of existing maps showing ER Sites and Historic Properties when identifying locations proposed for soil sampling or characterization activities.

If proposals for remedial activities are developed for any of the ER Sites listed in 2.1 or 2.2, above, the DOE would evaluate the potential for effects to historic properties from the proposed activities. No environmental restoration work, other than sampling and site characterization, would be conducted in the vicinity of these historic properties until the DOE has completed further consultations with your office.

The DOE is requesting your concurrence with the determination that soil sampling and characterization activities would have no effect upon historic properties.

2.3 Environmental Restoration Sites within the Boundary of Technical Area II:

The following ER Sites are located within the boundaries of Technical Area II:
Sites: 1, 2, 43, 44, 48, 113, 135, 136, 159, 165, 166, and 167.

Of these, ER Sites 43, 44, 48, 113, 135, 136, 159, 165, 166, and 167 are proposed for no further action (as discussed in 2.1, above). ER sites 1 and 2 require further investigation and possible remediation (as discussed in 2.2, above).

If only Buildings 904 and 907 within Area II are considered to be eligible to the NRHP the discussion above under 2.1 and 2.2 applies. If, however, Area II is considered to be eligible to the NRHP as a district, then activities in these ER Sites can not be considered to have no effect upon historic properties.

Assuming that SNL/NM Technical Area II is considered to eligible to the NRHP as a district, the DOE has determined that the proposed ER activities, namely sampling and characterization, carried out within the boundaries of Area II have no adverse effect upon historic properties. The ER activities of sampling and characterization are not expected to have an adverse effect upon the characteristics or attributes that may contribute to the historic value of Area II.

If proposals for remedial activities are developed for any of the ER Sites within Area II, the DOE would evaluate the potential for effects to historic properties from the proposed activities. No environmental restoration work, other than sampling and site characterization,

would be conducted in Area II until the DOE has completed further consultations with your office.

The DOE is requesting your concurrence with the determination that ER program activities associated with ER Sites located within SNL/NM Technical Area II would have no adverse effect upon historic properties.

3. Summary

In summary:

ER Sites listed in Section 1.0, above, are not considered to contain properties eligible to the NRHP, therefore the DOE has determined that environmental restoration activities at these sites should have no effect upon historic properties.

ER Sites listed in 2.1 are proposed for "no further action" under the ER program. The DOE has determined that the site sampling activities proposed for the ER Sites listed under 2.1 should have no effect upon historic properties because such properties would be avoided.

ER Sites listed under 2.2 require further sampling and characterization. The DOE has determined that site sampling and characterization activities would have no effect on historic properties because such properties would be avoided.

ER Sites listed under 2.3 are within the boundaries of SNL/NM Technical Area II. If only Buildings 904 and 907 are considered to be eligible to the NRHP, the discussion under 2.1 and 2.2 pertains to these ER Sites. If, however, Area II is considered to be eligible as a district, the DOE has determined that ER sampling and characterization activities at these ER Sites would have no adverse effect on historic properties. The DOE believes that there would be no adverse effect on historic properties because these activities are not expected to affect the attributes or characteristics which may contribute to the historic character of Area II.

The DOE is requesting your concurrence with these determinations.

ER Sites listed in 2.2 require further environmental restoration characterization and sampling before it can be determined what remedial actions, if any, may be required. It is not possible to make a determination of effect at this time for future remediation or "clean up" activities that may be proposed for the ER Sites listed under 2.2. The DOE will consider future undertakings at these ER Sites when such actions are proposed. The DOE will contact your office for further consultation if activities other than sampling and/or characterization are proposed for any SNL/NM ER Sites listed in section 2.2 of this letter.

Thank you for your assistance. If you have any questions regarding this information/request, please contact Susan Lacy of my staff at 845-5542.

Sincerely,

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/enclosure:
C. Tuttle, 377 ABW/EM
U.S. Air Force, KAFB
F. Thompson, Cibola National Forest
U. S. Forest Service

Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

JUN 2 2 1999

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Dear Ms. Tuttle:

Enclosed for consultation with the State Historic Preservation Officer is a package containing a description of a proposed undertaking at Environmental Restoration Site 88B on Kirtland Air Force Base, New Mexico. We are requesting a Determination of Effect and Consultation under Section 106 of the National Historic Preservation Act. If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/o enclosure:
T. A. Wolff, 7258, MS 1037
J. M. Harris, 7258, MS 1037

377 ABW/EMC
2000 Wyoming Blvd SE
Kirtland AFB NM 87117-5659

3 Jul 95

Mr. Michael Romero Taylor
State Historic Preservation Officer
Villa Rivera
228 East Palace Avenue
Santa Fe NM 87503

Dear Mr. Romero Taylor

Attached is a cultural resource survey of the Department of Energy (DOE) Environmental Restoration Site 88B, which is located on Kirtland Air Force Base. The attached report from Mr. Steven R. Hoagland recommends a determination of "no adverse effect" upon historic properties. Although the potential exists to affect cultural resources, the area of disturbance is expected to be small, and he recommended that an archeologist monitor and observe the sampling.

My point of contact for questions on this proposed action is Ms. Christine Tuttle, 846-2808/5007. Ms. Susan Lacy, 845-5542, is the DOE point of contact.

Thank you for your prompt review of this project.

Respectfully

TERRY W. COOPER
Acting Chief, Compliance
Environmental Management Division

Attachment:
6 Jun 95 Ltr Sandia National Laboratories

Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

JUL 05 1995

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Dear Ms. Tuttle:

Enclosed for consultation with the State Historic Preservation Officer (SHPO) is the report "Cultural Resource Survey of nine Drill Locations for Sandia National Laboratories/New Mexico, Sitewide Environmental Restoration Program, Kirtland Air Force Base, New Mexico." We believe the proposed undertaking would have "no effect" upon historic properties. Six copies are enclosed, please forward copies to the U.S. Forest Service, and to the SHPO.

If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/o enclosure:
T. A. Wolff, 7258, MS 1037
J. M. Harris, 7258, MS 1037

Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

JUL 11 1995

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Dear Ms. Tuttle:

Enclosed for consultation with the State Historic Preservation Officer (SHPO) is the report "Cultural Resource Survey of Twelve Borehole Drill Sites for Sandia National Laboratories/New Mexico, Sitewide Environmental Restoration Program, Kirtland Air Force Base, New Mexico." We believe the proposed undertaking would have "no effect" upon historic properties. Four copies are enclosed, please forward copies to SHPO.

If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/o enclosure:
T. A. Wolff, 7258, MS 1037
J. M. Harris, 7258, MS 1037

Department of Energy
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

JUL 3 1 1995

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Dear Ms. Tuttle:

Enclosed for consultation with the State Historic Preservation Officer (SHPO) is the report "Cultural Resource Survey of Four Well and Five Borehole Drill Sites for Sandia National Laboratories/New Mexico, Sitewide Environmental Restoration Program, Kirtland Air Force Base, New Mexico." We believe the proposed undertaking would have "no effect" upon historic properties. Six copies are enclosed, please forward copies to the SHPO.

If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety and Health

Enclosure

cc w/o enclosure:
T. A. Wolff, 7258, MS 1037
J. M. Harris, 7258, MS 1037

Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

SEP 2 6 1995

Ms. Chris Tuttle
377 ABW/EM
Kirtland Air Force Base, NM 87117

Dear Ms. Tuttle:

Enclosed for consultation with the State of New Mexico, State Historic Preservation Officer (SHPO), are six copies of the Cultural Resource Survey for the proposed Sampling at Environmental Restoration Sites 63A and 63B. Please transmit two copies to the SHPO, and two to the Forest Service. If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542. Thank you for your assistance.

Sincerely,

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety, and Health

Enclosure

cc w/o enclosure:
R. Erdman, KAO, PPMB

United States Government

Department of Energy

memorandum

Albuquerque Operations Office
Kirtland Area Office

JAN 29 1996

REPLY TO ATTN OF: KAO:ESHCB:SDL

SUBJECT: State Historic Preservation Officer Consultation on the Proposed Environmental Restoration Project at Sandia National Laboratories, New Mexico

TO: T. A. Wolff, 7315, MS 1037

Attached is the consultation letter from the State of New Mexico Historic Preservation Officer on the Environmental Restoration Project for Sandia National Laboratories, New Mexico. Please note that the Section 106 consultation process under the National Historic Preservation Act for this undertaking is not complete. Please continue to provide the required information to this office as directed in the attached letter to ensure eventual closure of this consultation.

If you have any questions regarding this information, please contact Susan Lacy of my staff at 845-5542.

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety, and Health

Attachment

cc w/attachment:
J. Harris, 7315, MS 1037

cc w/o attachment:
J. Andrews, KAO, MS 1037
M. Jackson, KAO, MS 0184

STATE OF NEW MEXICO
OFFICE OF CULTURAL AFFAIRS
HISTORIC PRESERVATION DIVISION

GARY E. JOHNSON
GOVERNOR

VILLA RIVERA BUILDING
228 EAST PALACE AVENUE
SANTA FE, NEW MEXICO 87503
(505) 827-6320

MICHAEL ROMERO TAYLOR
DIRECTOR

January 18, 1996

Mr. George Laskar
Assistant Area Manager
Environment, Safety and Health
Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P.O. Box 5400
Albuquerque, NM 87185-5400

Dear Mr. Laskar:

We are writing in response to your request for consultation on the proposed Sandia National Laboratories/New Mexico Environmental Restoration (ER) project. We received your request last April; however, It appears that because of the oversized nature of the archaeological survey report we misplaced it in our office. We only discovered this error on our part in November. Since then, David Cushman of our staff has spoken to Mr. John Andrews of the DOE about this project. It is our understanding that we can still provide comments of the proposed undertaking. Therefore, we are submitting our response with our apologies for being so late.

Approximately 2445.4 acres of land located throughout Kirtland Air Forces Base was surveyed for cultural resources by Butler Service Group, Inc. In the process, 31 new archaeological sites and 39 previously documented sites were recorded along with 128 isolated occurrences. Our determinations of site eligibility and our comments on effect are presented below.

Determinations of Eligibility

Sties LA 2334, 47889-47892-47893-47894, 64557, 87431, 103178, 107472, 107473, 107474, 107477, 107482, 107486, 107488, 107489, 107490, 107491, 107492, 107493, 107494, 107499, are eligible to the National Register of Historic Places under 36 CFR 60.4 (d).

Sites LA 47900, 107476, 107485, 107497, 107498, are potentially eligible to the National Register of Historic Places under 36 CFR 60.4 (d), although additional testing/information would be needed to make an actual determination. We agree that site LA 105324 is potentially eligible under 36 CFR 60.4 (a) and (d). It is our opinion that sites LA 64558, 107471, 107479, 107483, 107484, 107487, and 107496, are also potentially eligible rather than being eligible as recommended by Butler Service Group.

Sites LA 107475, 107478, 107480, 107481, 107495, 107500 are not eligible to the National Register. None of the 128 Isolated Occurrences is National Register; in-field recordation has exhausted their information potential.

The remaining previously recorded sites have already been evaluated; we accept the contractor's reporting of site eligibility for these sites as presented in table 11-1 of the report.

Tech Area II is noted in the report as being a potential Historic District because of its association with the first atomic weapons. We agree that buildings 904 and 907 are National Register eligible; however, a formal nomination would have to be prepared to create a Historic District for the Tech II area. This is not necessary for this undertaking, but we would be interested in working with the Department of Energy on this at some time in the future.

Comments on Effect

It is our understanding from the survey report and your cover letter that of the 166 ER sites examined during the survey, 128 ER sites do not contain eligible or potentially eligible sites. Since there are no historic properties in these areas, there are no additional preservation requirements.

No further action is being proposed for ER sites 21, 23, 28-2, 28-3, 28-4, 28-6, 28-7, 28-8, 28-9, 28-10, 43, 44, 48, 62, 63-A, 63-B, 67, 88B, 92, 93c, 113, 135, 136, 159, 165, 166, and 167, which do contain eligible or potentially eligible sites. Some soil sampling may be necessary within these areas; however, the DOE proposes to avoid all historic properties. This is appropriate and is sufficient to prevent effect in our view. We recommend that a standardized buffer zone of 100 feet be established around the limits of each site to ensure avoidance.

Further sampling and possible remediation may be needed for ER sites, 1, 2, 8, 57, 58, 60, 61, 65, 87, 87A and possibly ER sites 238 and 239. However, the DOE has made no decision yet on which ER sites will be effected or how. The DOE will take steps to avoid any eligible or potentially eligible properties within these areas in the same manner as above. Our recommendation on buffer zones to ensure avoidance apply here as well.

Lastly, you state that only ER sites 1 and 2 within Tech Area II may require further investigation and possible remediation. The DOE plans to avoid buildings 904 and 907 within Tech Area II and therefore there will be no effect.

It is apparent that decisions about what actions may occur within ER sites 1, 2, 8, 57, 58, 60, 61, 65, 87, 87A, 238 and 239 have not yet been made, and so, the potential effect of the undertaking as a whole on National Register eligible sites cannot be evaluated at this time. We recommended that the DOE conduct the testing and sampling needed to determine which ER sties will require clean up, provided that all eligible or potentially eligible sites are avoided by at least 100 feet. Then, as soon as the ER sites that will be remediated are identified, the DOE consult with our office on effect and any treatment of effect that may be necessary.

Depending on the results of the ER sites selection process and the projected effects of remediation on historic properties, A simple MOA between all affected agencies (DOE, DOD, USFS) may suffice to guide treatment of effect. A data recovery plan would be required to direct site specific mitigation and this plan would have to be developed as part of the consultation on effect. Once we have the all the information that we need on which historic properties will be affected and how, then we can take the next step in assisting you in concluding the Section 106 consultation process for this undertaking.

One last issue: the contractors reference ER site 102 as having been surveyed and that archaeological sites were found within the area. Please send us a copy of their survey documentation on ER 102 as an addendum to the main survey report, and we will comment on eligibility and effect.

Thank you for your patience. Please consult with us on effect once the ER sites have been selected for remediation.

If you have any questions, please contact David Cushman of our staff.

Sincerely,

David Cushman

for Michael Romero Taylor
State Historic Preservation Officer

MRT/DWC: 47045

United States Government **Department of Energy**

memorandum

Albuquerque Operations Office
Kirtland Area Office

DATE: NOV 28 1995

REPLY TO ATTN OF: KAO:AAMESH

SUBJECT: Concurrence from the State of New Mexico Department of Game & Fish on the Threatened or Endangered Species Survey for the Sandia National Laboratories, New Mexico (SNL/NM) Environmental Restoration Project

TO: A. O. Bendure, SNL 7315, MS 1037

Enclosed is the letter of concurrence from the State of New Mexico Department of Game & Fish indicating that the SNL/NM Environmental Restoration Project will have no adverse effect on state listed threatened or endangered species. Since our records indicate that this memo has not been transmitted to your office, it is being transmitted now for your files.

If you have any questions regarding this information, contact Susan Lacy of my staff at 845-5542.

for George K. Laskar
Assistant Area Manager
Environment, Safety and Health

cc w/ enclosure:
J. Andrews, DOE/KAO
T. A. Wolff, SNL 7315, MS 1037
J. V. Guerrero, SNL 7315, MS 1037
D. Nargelovic, SNL 7315, MS 1037
J. Weckerle, PAI
DOE/KAO NEPA File

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

JAN 18 1995

Director
New Mexico Department of Game and Fish
Villagra Buildling
Santa Fe, New Mexico 87503

State Endangered Wildlife Species Survey Information for the Sandia National Laboratories/New Mexico Environmental Restoration Project at Kirtland Air Force Base

Dear Sir:

This letter seeks comment and concurrence from the New Mexico Department of Game and Fish with respect to Group 1 and Group 2 endangered wildlife species that may be affected by the planned implementation of the Environmental Restoration (ER) Project by Sandia National Laboratories/New Mexico (SNL/NM) under contract with the U.S. Department of Energy/Albuquerque Operations Office. The purpose of the ER Project is to identify, investigate, and remediate hazardous waste sites that have resulted from the history of SNL/NM activities on Kirtland Air Force Base (KAFB), Bernalillo County, New Mexico.

At this time, 241 potentially contaminated sites have been identified and investigated, of which 89 are now proposed for corrective action. Eleven of these sites are proposed for *in situ* bioremediation. The remaining 78 sites are proposed for soil excavation, treatment, and backfilling, followed by reclamation to restore vegetative cover at sites where vegetation is removed. One site consists of eleven abandoned mine shafts and adits, several of which are collapsed. If found to be contaminated, the remaining mines may be sealed rather than excavated. The 78 sites comprise a total of about 1,300 acres, ranging in size from less than 1 acre to about 420 acres and are distributed throughout an area approximately contained by the following townships: T.9N, R.4E; T.9N, R.4½E; and T.9N, R.5E.

Biological surveys for sensitive species have been conducted at all SNL/NM ER Project sites. The habitats at the sites proposed for corrective action include grassland, piñon-juniper woodland, and small areas of riparian scrubland and woodland. None of these sites contain wetland habitat. No state listed endangered wildlife species was found during these surveys. In September, 1993, two canyons in the Manzanita Mountains that contain SNL/NM ER Project sites (Sol se Mete and Lurance Canyons) were visited by Roger W. Skaggs to assess the habitat for the potential occurrence of the Mexican spotted owl (*Strix occidentalis lucida*). Favorable habitat conditions for this species were not found in either canyon. Based on discussions with Dr. Scott Altenbach of the University of New Mexico,

the spotted bat (*Euderma maculatum*) is a potential user of mine shafts and adits in this area; however, due to the unsafe nature of these mines, surveys for this species were not made.

Please advise us of any concerns that your agency may have regarding impacts to state listed endangered wildlife species that may result from the proposed action or of your concurrence that this action does not pose additional threats to these species. A copy of the sensitive species survey report for the SNL/NM ER Project is available upon request. A draft Environmental Assessment for this project is currently being completed and will be available in early 1995.

If your require additional information on this matter, please contact Susan Lacy of my staff at (505) 845-5542. Thank you for your assistance in this matter.

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety, and Health

cc:
T. A. Wolff, SNL 7258, MS 1037

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

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JAN 18 1995

Field Supervisor
Ecological Services
U.S. Fish and Wildlife Service
3530 Pan American Highway N.E., Suite D
Albuquerque, New Mexico 87107

Threatened and Endangered Species Survey Information for the Sandia National Laboratories/New Mexico Environmental Restoration Project at Kirtland Air Force Base

Dear Sir:

This letter seeks comment and concurrence from the U.S. Fish and Wildlife Service with respect to federally listed and proposed threatened and endangered species that may be affected by the planned implementation of the Environmental Restoration (ER) Project by Sandia National Laboratories/New Mexico (SNL/NM) under contract with the U.S. Department of Energy/Albuquerque Operations Office. The purpose of the ER Project is to identify, investigate, and remediate hazardous waste sites that have resulted from the history of SNL/NM activities on Kirtland Air Force Base (KAFB), Bernalillo County, New Mexico.

At this time, 241 potentially contaminated sites have been identified and investigated, of which 89 are now proposed for corrective action. Eleven of these sites are proposed for *in situ* bioremediation. The remaining 78 sites are proposed for soil excavation, treatment, and backfilling, followed by reclamation to restore vegetative cover at sites where vegetation is removed. One site consists of eleven abandoned mine shafts and adits, several of which are collapsed. If found to be contaminated, the remaining mines may be sealed rather than excavated. The 78 sites comprise a total of about 1,300 acres, ranging in size from less than 1 acre to about 420 acres and are distributed throughout an area approximately contained by the following townships: T.9N, R.4E; T.9N, R.4½E; and T.9N, R.5E.

Biological surveys for sensitive species have been conducted at all SNL/NM ER Project sites. The habitats at the sites proposed for corrective action include grassland, piñon-juniper woodland, and small areas of riparian scrubland and woodland. None of these sites contain wetland habitat. No federally listed or proposed threatened or endangered species were found during these surveys. In September, 1993, two canyons in the Manzanita Mountains that contain SNL/NM ER Project sites (Sol se Mete and Lurance Canyons) were visited by Roger W. Skaggs to assess the habitat for the potential occurrence of the Mexican spotted owl (*Strix occidentalis lucida*). Favorable habitat conditions for this species were

not found in either canyon. Based on discussions with Dr. Scott Altenbach of the University of New Mexico, the spotted bat (*Euderma maculatum*) and the occult little brown bat (*Myotis lucifugus occultus*), both C2 candidate species, are potential users of mine shafts and adits in this area; however, due to the unsafe nature of these mines, surveys for these species were not made. Individuals and populations of the grama grass cactus (*Pediocactus papyracanthus*), another C2 candidate species, have been found at nine of the ER Project sites. Efforts will be made in the ER Project to protect vigorous populations of this species where they are known to occur and to mitigate the loss of scattered individuals by transplanting.

Please advise us of any concerns that your agency may have regarding impacts to federally listed and proposed threatened and endangered species that may result from the proposed action or your concurrence that this action does not pose additional threats to these species. A copy of the sensitive species survey report for the SNL/NM ER Project is available upon request. A draft Environmental Assessment for this project is currently being completed and will be available in early 1995.

If your require additional information on this matter, please contact Susan Lacy of my staff at (505) 845-5542. Thank you for your assistance in this matter.

George K. Laskar

George K. Laskar
Assistant Area Manager
Environment, Safety, and Health

cc:
T. A. Wolff, SNL 7258, MS 1037

NO EFFECT FINDING

The described action will have no effect on listed species, wetlands, or other important wildlife resources.

Date 1/27/95

Consultation # 2-22-95-I-115

Approved by R. Mark Wilson

U.S. FISH and WILDLIFE SERVICE
NEW MEXICO ECOLOGICAL SERVICES FIELD OFFICE
ALBUQUERQUE, NEW MEXICO

Gary E. Johnson

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH
Villagra Building
PO Box 25112
Santa Fe, N.M. 87504

DIRECTOR AND SECRETARY
TO THE COMMISSION
Gerald A. Maracchini

February 1, 1995

Re: State threatened or endangered species for the Sandia National Laboratories/New Mexico Environmental Restoration Project at Kirtland Air Force Base

Mr. George K. Laskar, Asst. Area Manager
Environment, Safety and Health
Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, NM 87115

Dear Mr. Laskar:

The Department of Game and Fish (Department) has reviewed your letter concerning environmental restoration at Kirtland Air Force Base by Sandia National Laboratories/New Mexico and the Department of Energy. It is the Department's understanding that the environmental restoration would entail identification, investigation and remediation of 241 potentially contaminated sites located on the Base, of which 89 are now proposed for corrective action. Eleven of these sites are proposed for *in situ* remediation, while the remaining sites will be excavated, treated and reclaimed. These activities would occur in grassland, pinon-juniper, and small areas of riparian scrubland and woodland. Furthermore, it is our understanding that none of these activities will occur in wetlands and that your survey found no state listed endangered species.

Based on this information, the Department foresees no adverse effects to state listed threatened or endangered species. Your letter mentioned possible concern for the Spotted Bat, Euderma maculatum. While the Spotted Bat does use caves for hibernacula,

it does not appear that this species winters in Bernalillo County. Furthermore, it appears the Spotted Bat prefers crevices in cliffs near water during active months. We suggest contacting Homer Milford of the Abandoned Mine Land Bureau for information on gating mine shafts or adits in order to preserve potential bat habitat. His address is:

Mr. Homer Milford
Environmental Coordinator
Abandoned Mine Land Bureau
Energy, Minerals and Natural Resources Dept.
2040 South Pacheco St.
Santa Fe, NM 87505
(505)827-5970

We also suggest contacting Robert Sivinski or Karen Lightfoot of the Forestry and Resources Conservation Division concerning information on state listed threatened or endangered plants. The address is:

Forestry and Resources Conservation Division
Energy, Minerals and Natural Resources Dept.
P.O. Box 1948
Santa Fe, NM 87504-1948
(505)827-7865

Finally, we recommend the use of native species during revegetation in order to enhance wildlife habitat. We have enclosed a listing of state listed threatened or endangered species for your information.

Thank you for the opportunity to comment on this environmental restoration project. Please send a copy of the sensitive species survey report to John McKay at the Conservation Services Division. If you have any further questions, please contact John McKay at 827-1210.

Sincerely,

Jerry Maracchini

Jerry A. Maracchini
Director

JAM/cjm

Enclosure

xc: Andrew Sandoval (Conservation Services Division Chief, NMGF)
Jim Bailey (Conservation Services Asst. Div. Chief, NMGF)
Dan Pursley (Northwest Area Operations, NMGF)

...MON NAME	SCIENTIFIC NAME	FEDERAL END.	FED.... THREAT.	FED.. PROP.	FED... CAND.	STATE END.	STATE.. THREAT.
Grande Silvery Minnow	Hybognathus amarus	X	-	-	-	-	X
...s Horned Lizard	Phrynosoma cornutum	-	-	-	X	-	-
...e-faced Ibis	Plegadis chihi	-	-	-	X	-	-
...d Eagle	Haliaeetus leucocephalus alascanus	X	-	-	-	-	X
...thern Goshawk	Accipiter gentilis (2 ssp.)	-	-	-	X	-	-
...ruginous Hawk	Buteo regalis	-	-	-	X	-	-
...rican Peregrine Falcon	Falco peregrinus anatum	X	-	-	-	X	-
...oping Crane	Grus americana	X	-	-	-	X	-
...tern Snowy Plover	Charadrius alexandrinus nivosus	-	-	-	X	-	-
...ntain Plover	Charadrius montanus	-	-	-	X	-	-
...ican Spotted Owl	Strix occidentalis lucida	-	X	-	-	-	-
...thern Beardless-tyrannulet	Camptostoma imberbe ridgwayi	-	-	-	-	X	-
...thwestern Willow Flycatcher	Empidonax traillii extimus	-	-	X	-	-	X
...gerhead Shrike	Lanius ludovicianus (3 ssp.)	-	-	-	X	-	-
...ult Little Brown Bat; Myotis	Myotis lucifugus occultus	-	-	-	X	-	-
...tted Bat	Euderma maculatum	-	-	-	X	-	X
...dow Jumping Mouse	Zapus hudsonius luteus	-	-	-	X	-	X
...ert Bighorn Sheep	Ovis canadensis mexicana	-	-	-	-	X	-
Common Name (millipede)	Toltecus chihuanus	-	-	-	X	-	-

NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

DEC 15 1995
DOE/KAO rec'd

December 12, 1995

Department of Energy
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Attention: Mr. Laskar

Thank you for the opportunity to comment on the New Mexico Environment Restoration Project at Kirtland Air Force Base. Upon review of the materials you sent, we see no need for further comment from our office at this time.

If you have any questions, please do not hesitate to call Karen Lightfoot, Endangered Species Botanist for the State of New Mexico.

Sincerely,

Karen S. Lightfoot

Karen S. Lightfoot

KSL/ajc

OFFICE OF THE SECRETARY - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5950
ADMINISTRATIVE SERVICES DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5925
ENERGY CONSERVATION AND MANAGEMENT DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5900
FORESTRY AND RESOURCES CONSERVATION DIVISION - P. O. BOX 1948 - SANTA FE, NM 87504-1948 - (505) 827-5830
MINING AND MINERALS DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5970
OIL CONSERVATION DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-7131
PARK AND RECREATION DIVISION - P. O. BOX 1147 - SANTA FE, NM 87504-1147 - (505) 827-7465

APPENDIX D

Risk Assessment

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APPENDIX D1 RISK ASSESSMENT OVERVIEW

APPENDIX D2 RISK ASSESSMENT DETAILS

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Risk Assessment

This appendix presents the risk assessment methodology that has been used for assessing potential human health and environmental risks resulting from releases of hazardous chemicals and radionuclides associated with the Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration (ER) Project. Appendix D1 presents an overview of the underlying assumptions regarding the approach taken to estimate risks as early as possible in the decision-making process, as required by Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] 1502.2). Appendix D2 focuses on specific risk assessment methods, models, and results. Uncertainty has not been quantified at this time, because site characterizations are still being performed. However, best technical judgment was used to provide an adequate margin of conservatism in the assumptions, so that the risk assessments provide an upper limit of impacts.

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APPENDIX D1

Risk Assessment Overview

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Risk Assessment Overview

The following sections discuss assumptions made regarding the specific elements of the proposed action and no action alternative human health risk assessment.

D1.1 RISK ASSESSMENT OVERVIEW FOR PROPOSED ACTION

For the purpose of this environmental assessment (EA), risks were assessed using the general methodologies described in U.S. Environmental Protection Agency (EPA) guidance (EPA, 1989a) for assessing risk from releases of toxic wastes. This guidance provides approaches and conservative risk estimates for assessing risks in situations for which only limited data are available. Although these methods were designed for use in baseline risk assessments required for Resource Conservation and Recovery Act facility investigation and corrective measures study activities, they are also relevant and applicable to National Environmental Policy Act-type risk assessments. EPA guidance does not address risks of accidental injuries or fatalities. These risks were assessed using U.S. Department of Labor (DoL) statistics on similar industrial operations.

A number of specific assumptions were made in performing the risk assessment. They are discussed in the following sections.

D1.1.1 Contaminant Concentrations

Those sites with the most extensive data on contaminant concentrations at the time of the EA analyses were examined. These sites are identified as "example" sites. They include two landfills, a burn site, a former explosive test area, a disposal facility, and a septic system. The example sites are:

- Chemical Waste Landfill (ER Site 74).
- Radioactive Waste Landfill (ER Site 1).
- Explosive Burn Pits (ER Site 114).
- Former Explosive Test Area (ER Site 107).
- Liquid Waste Disposal Facility (ER Site 4).
- Building 901 Septic System (Technical Area II) (ER Site 165).

Since the time of the analyses, more recent data available on indicator contaminants at the example sites has been evaluated. New information indicates that the risks estimated in this EA are in fact conservative. Measured contaminant concentrations at these example sites are provided in Appendix D2, Tables D2-1 through D2-5. Reported concentrations have been rounded to two significant figures in these tables. The Chemical Waste Landfill (ER Site 74) has the most diverse collection of contaminants.

Where available, data on volatile organic compound (VOC) concentrations at example sites, except the Chemical Waste Landfill, do not indicate that VOCs were present, based on historical information and process knowledge. VOCs are known or suspected to be present at many sites. It is considered likely that VOCs that may have been present were not detected because they had already volatilized. In order to estimate the upper end of potential impacts for the purpose of the EA, VOCs were conservatively assumed (overestimated) to be present at a concentration of 1 part per million (ppm). For sites not considered comparable to example sites, each indicator contaminant (see Section D1.1.2) was assigned an average unit risk concentration of 1 ppm, consistent with EPA guidance for performing unit risk assessments for sites at which data are incomplete (EPA, 1989a).

D1.1.2 Indicator Contaminants

Based on the sampling data available for these sites, a set of chemical and radionuclide contaminants was selected to represent all contaminants present at the ER Project sites. The "indicator" contaminants were selected based on two factors: 1) historical knowledge of their origin and abundance, 2) they pose a potential hazard to human health or the environment at least as high as other contaminants in the contaminant category, based on their toxicity or mobility. For example, carbon tetrachloride was used to represent a toxic contaminant, trichloroethylene an abundant contaminant, and polychlorinated biphenyls, a persistent contaminant. Indicator contaminants and their basis for selection are specified in Appendix D2, Section D2.2.2. They include:

- Radionuclides—tritium, uranium-235, and cesium-137.
- Petroleum hydrocarbons—benzene, toluene, and xylenes.
- Chlorinated hydrocarbons—carbon tetrachloride, trichloroethene, and polychlorinated biphenyls.
- Inorganic anions—nitrate and nitrite.
- Hazardous metals—beryllium, cadmium, chromium, lead, mercury, and arsenic.
- Explosive compounds and residues—homo-cyclonite (HMX), cyclonite (RDX), and trinitrotoluene (TNT).

D1.1.3 Comparable Sites

Wherever possible, ER Project sites with known historical use and types of contaminants similar to one of the six example sites were grouped with an example site. These site groups are referred to as "comparable" sites. Risks were assessed for each group of comparable sites by using contaminant concentrations at the example sites multiplied by the total waste volume of the site group.

Other sites requiring remediation may have different concentrations of contaminants or even different contaminants. However, because data are incomplete for these other sites, there is no basis for using any other assumptions about concentrations or appropriate indicator contaminants in assessing total health risks projected for the ER Project.

For routine activity releases (i.e., excavation and treatment), characterization data for one of the example sites were used to represent all other comparable sites. For accidental releases, the highest concentration of a contaminant at any of the six sites was used to represent all sites.

Comparable site classifications are detailed in Appendix D2, Tables D2-6 through D2-10. Examples of comparable sites groups are:

- Landfill sites: the Radioactive Waste Landfill (ER Site 1) and the Chemical Waste Landfill (ER Site 74).
- Waste disposal sites: an open dump (ER Site 8), a burial site (ER Site 9), and burial mounds (ER Site 10).
- Explosive test sites: the Building 6924 pad, tank and pit high-explosives residue (ER Site 51), and Pickax Site explosive residues (ER Site 54).
- Burn sites: the acid spill at the Water Treatment Facility (ER Site 42) and the Explosive Burn Pit (ER Site 114).
- Septic systems and drainfields: the storm drain system (ER Site 96) and the Building 9965 septic system (ER Site 140).

Sites that could not be represented by example sites were ER Sites 7, 30, 38, 81, 98, and 240. Consistent with EPA guidance for performing unit risk assessments for sites from which data are incomplete (EPA, 1989a), contaminant concentrations at these sites were assumed to be 1 ppm of each indicator contaminant.

D1.1.4 Soil Volume

The contaminant concentration and soil volumes were multiplied to obtain an exposure source term. For the purpose of this analysis, treatment options were assumed consistent with containment types likely to be present (Treatment options and assumed soil volumes are shown in Appendix A, Table A-2). The following assumptions were made:

- All sites designated for treatment options A, C, or D (see Appendix A, Table A-2) would be excavated, except the Chemical Waste Landfill (ER Site 74), which would be only partially excavated.

- Sites designated for in situ bioremediation (treatment option B), for capping (treatment option E), or for no further action (NFA) would not be excavated (see Appendix A, Table A-2).

- Health risks from excavation were evaluated for each site group by multiplying representative contaminant concentrations times the total volume of soil to be excavated from comparable sites.

- Despite mitigation measures employed to reduce fugitive dust emissions, excavation would mobilize contaminants at measured concentrations (see Section D2.2.1) in an equal distribution on soil particles at a rate of 1.2 tons of soil per acre per month (1.0 10^{-4} grams per square meter per second) for 10 years (EPA, 1988).

- For the purpose of evaluating air emissions from excavation activities, based on experience, gaseous VOC and semivolatile organic compounds (SVOCs) contaminants in soils were assumed to be attached to soil particles. By contrast, in situ vapor extraction would have no gaseous releases because it would occur in a closed system where gases would be captured and treated. The only gaseous contaminant release from excavation might be tritium gas, which has been detected near the Radioactive Waste Landfill (ER Site 1). No other gaseous radioactive contaminants or decay products were considered to be a potential source of exposure.

- The waste volume excavated for treatment was assumed to total about 7,300,000 cubic feet (about 120,000 cubic meters). The treatment facility was assumed to have a nominal daily throughput capacity of 2,200 pounds (or 1,000 kg) of waste per day. Particulate emissions from the treatment facility would be reduced by 99.99 percent by emissions controls. VOC emissions would be completely mitigated through engineering design of an off-gas recovery system. No tritium emissions would be associated with treatment because tritium-contaminated waste from the Radioactive Waste Landfill (ER Site 1) would be stored on site rather than treated prior to disposal.

- The industrial accident rate associated with waste-handling activities remains constant in relation to volume.

D1.1.5 Exposure Period

Human-health and ecological effects associated with contaminant releases from excavation and treatment were modeled assuming that, on the average, each site would require one year to remediate. Some sites would require much longer than one year to remediate, while other sites may require less than one year. It was assumed that the entire ER Project would be completed within 10 years. All human health and environmental exposures were assumed to occur at a constant rate during the 10-year life of the project. Thus, the total human health risk assessment does not depend on the number of sites being remediated simultaneously in any one year.

D1.1.6 Reporting Exposure Consequences

Risks of exposures to carcinogenic chemicals and radionuclides are reported in this EA in terms of the potential additional risk of cancer incidence (fatal and non-fatal) during the lifetime of an exposed individual. These risks are calculated as an increased probability of contracting a cancer over and above the existing risks facing any individual during his or her lifetime. This is defined as the excess cancer risk.

The currently reported individual lifetime risk for contracting a cancer in the United States is reported as about 1 in 5 (DOC, 1989).

Risks associated with exposures to hazardous chemicals that are not cancer-causing agents are reported in terms of a hazard index. A threshold exposure to a chemical that results in adverse physical symptoms or long-term effects was established by EPA as having a hazard index of 1. Thus, hazard indices that are less than 1 indicate that there would be no known adverse effects resulting from exposure.

D1.1.7 Exposed Populations

The analysis predicts potential human health effects for potentially exposed individuals in the following three population groups:

- Workers involved in constructing and implementing corrective measures at ER Project sites (assumed to be wearing appropriate personnel protective clothing and respiratory protection during ER Project activities).
- Workers present on site but not involved with corrective measure operations (no respiratory protection).
- Members of the general public residing or present outside the Kirtland Air Force Base (KAFB) boundary (no respiratory protection).

D1.1.8 Exposure Pathways

Health and environmental effects were projected for both routine operations and accidental exposure scenarios. The following routes of exposure were considered for both hazardous chemicals and radionuclides:

- Inhalation.
- Ingestion.

- Dermal contact.
- Direct radiation exposure.

D1.1.9 Dispersion Modeling for Routine Releases

Excavation and waste-treatment activities could result in some exposures due to dispersal of contaminants into the air. Contributions from both direct inhalation and ingestion of deposited contaminants were included in the risk assessment. The risk for excavation of each type of representative site was calculated. The risk from each comparable site was considered to be the same as the risk estimated for the example site. Risks were assessed using the following assumptions or protocols:

- Average annual meteorological data from the Albuquerque International Airport, which is adjacent to KAFB site, were used to represent dispersion characteristics of the site.

- Despite fugitive dust mitigation measures, an estimated 1.2 tons of soil per acre per month (1.0×10^{-4} grams per square meter per second) would be dispersed by excavation activities (EPA, 1988).

- The EPA Industrial Source Code 2 (ISC2) was used to estimate dispersed contaminant concentrations.

- Dispersion from diffuse sources (excavation activities at ER Project sites) was assumed to occur at a height of 20 feet (6 meters). The size of the diffuse area source varied with the example site used.

- Dispersion from the treatment facility was modeled as a point source release from a stack height of 30 feet (9 meters).

D1.1.10 Accident Scenarios

Credible scenarios were postulated for the analysis of potential accidents (see Appendix D2, Section D2.5.2). Potential accidents during construction, operations, and transportation were evaluated. Scenarios of accidents caused by natural catastrophic events (e.g., tornados and seismic events) and human error were also included, as was an aircraft crash scenario. This captures impacts of catastrophic events having low probabilities of occurrence.

Occupational risks in many comparable industries were obtained from statistics of DoL and other sources (DoL, 1990). These risks result from physical accidents, not from releases of hazardous wastes. Cumulative nonrelease accident risks were estimated by applying accident/injury statistics to the total work force involved in remediating the total soil volume assumed to be excavated and treated.

The following types of accidents were considered:

- Occupational (not related to hazardous nature of waste or to contaminant releases).
  - Traffic accidents from waste transport within SNL/NM.
  - Waste handling and heavy equipment operation.
  - Treatment plant operation (construction, maintenance, decontamination, decommissioning, closure).
- Accidental exposures (resulting from unintentional contaminant releases).
  - Waste handling accident (container drop and release of treated or untreated waste).
  - Transportation accident with breach of containers for treated or untreated waste.
- Abnormal event.
  - Aircraft crash. Risks were assessed for an aircraft crashing directly into a central waste treatment facility or crashing and sliding into the facility, causing the release of contamination and impact and burn injuries to workers in the plant. For this scenario, it was assumed that the facility would contain an amount of waste equal to a one-day treatment capacity (2,200 pounds [1,000 kg]). However, the probability of this event would be very low—1 in 10 million (10^{-7}) to 1 in 100 million (10^{-8}).
  - Seismic or high-wind events. Releases resulting from seismic or high-wind events would be very similar to those caused by an aircraft crash. The total inventory equal to a one-day treatment capacity would also be released by these events. The probability of occurrence would be likely to be smaller because of the low seismic event and tornado frequencies at the SNL/NM facility location.

D1.1.11 Dispersion Modeling for Accidental Releases

Short-duration releases were modeled as a passing plume of contaminants with a Gaussian concentration distribution. Both stable air conditions (low winds, which would tend to concentrate contaminants near the source of the accidental release) and average wind conditions (which would tend to spread the contaminants over a larger area without strong dilution) were used to estimate exposure to nearby workers and to members of the public, respectively.

D1.1.12 Populations Impacted by Accidents

The following populations were considered in assessing accident risks:

- Occupational workers. The maximum number of people identified in staffing estimates for proposed actions (see Section D2.5.2.2) was 60. All were assumed to be subject to occupational accident statistics and as receptors for accidental releases associated with identified accidents.
- Nearby workers (SNL/NM staff not directly involved in ER Project activities) were considered to be the workers at a central waste treatment facility for the purposes of this analysis. This staff was estimated to be 60 workers.
- The number of members of the public who would be exposed to accidental releases would depend on the accident location and prevailing wind speed and direction at the time of the event. For this analysis, 1,000 people were assumed to be downwind of the accidental release.

D1.1.13 Disposal Risks

Human-health and environmental risks for disposal activities were based on the assumption that mixed and hazardous wastes were treated for disposal. It was assumed that the level of risk for disposal would be consistent with EPA goals and would not exceed the 1 in 100,000 (10^{-5}) excess cancer risk for carcinogens or would not be above a hazard threshold associated with adverse health effects for other contaminants.

DI.2 RISK ASSESSMENT OVERVIEW FOR THE NO ACTION ALTERNATIVE

The human health risk from the proposed action may be compared to a baseline of 0.00047 (4.7×10^{-4}) incremental cancer risk to both SNL/NM workers and the public from general levels of contaminants existing on site and in the Albuquerque metropolitan area. These estimates were based on levels of soil contaminants on and near KAFB and locations in the greater Albuquerque metropolitan area (Culp et al., 1994).

Risk estimates based on on-site sample data reflect potential exposures of workers at the technical areas. Estimates based on perimeter or off-site measurements were used to represent potential health risks from contaminant exposure to residents in the surrounding community or the general public. There have been no known incidents of accidental releases from undisturbed ER Project sites. The analysis in this EA was based on the assumption that current practices would continue and that such accidental releases were neither reasonable nor foreseeable.

Because of a lack of necessary site-specific characterization information and an inability to project specific air and groundwater migration pathways to long-term future receptors, long-term risks associated with the no action alternative were not evaluated.

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APPENDIX D2

Risk Assessment Details

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Risk Assessment Details

This appendix describes specific risk assessment methods, assumptions, models, and results. The analysis does not discuss uncertainty in the risk evaluations. Because site characterization is still being performed, contaminant concentrations and waste volumes used in risk calculations were based on data available at the time of this analysis. Intentional overestimates of the contaminated waste volume and the number of sites requiring excavation and treatment were used to compensate for uncertainties in estimating impacts.

D2.1 DEFINITIONS

The following terms are used frequently in this risk assessment discussion:

- **Accident Scenario** is any scenario, other than an exposure or routine scenario, that leads to a release of contaminants from a source, ranging from a dropped container of waste to an aircraft crash at a waste site.
- **Carcinogenic risk** is the probability that a potential exposure of an individual to a chemical will result in cancer.
- **Indicator contaminants** are contaminants known or suspected to be present at an ER Project site. Because a relatively large variety of chemicals, as well as common explosives and limited radionuclide contaminants, are expected to be encountered at ER Project sites, 19 chemicals and radionuclides have been selected as indicator contaminants.
- **Exposure pathway** is the course (e.g., air, water, or soil) a chemical or physical contaminant takes from its source to an exposed person or organism.
- **Exposure scenario** is a sequence of events that leads to a release of contaminants from a source, wind dispersion of the contaminant, and intake by an exposed person or organism.
- **Hazard** is a measure of potential health impact resulting from exposure to a noncarcinogenic chemical that may have a damaging effect on the body (e.g., kidney failure, central nervous system effects, nausea, headache, liver damage, etc.).
- **Intake** is a measure of exposure expressed as the mass of a substance in contact with the person per unit body weight per unit time (e.g., milligrams of chemical per kilogram of body weight per day).

- **Risk** is the probability that an adverse health effect will occur as a result of a routine or accidental exposure scenario, including both the probability that a scenario will result in an exposure of a person or organism and the probability that the exposure will cause adverse health or environmental (ecological) effects.

- **Routine scenario** is a release that is incidental to normal operations and that takes place according to an approved health and safety plan. Because of safeguards integral to the proposed action, routine releases are expected to be below regulatory limits.

- **Source term** describes the characteristics of a contaminated site, including the nature of the contaminants and their concentrations in environmental media.

D2.2 SOURCE TERM CHARACTERIZATION

This section describes how known or suspected contaminants at ER Project sites have been used to estimate human health and environmental exposure risks resulting from potential releases during ER Project activities. This section also summarizes the risks associated with exposure to these contaminants.

D2.2.1 ER Project Sites With Characterization Data (Example Sites)

As previously noted, analytical measurements of contaminant concentrations in soil are available for the following ER Project sites:

- The Radioactive Waste Landfill (ER Site 1).
- The Chemical Waste Landfill (ER Site 74).
- The Liquid Waste Disposal System (ER Site 4).
- The Former Explosive Test Area (ER Site 107).
- The Explosive Burn Pits (ER Site 114).
- The Building 901 Septic System (Technical Area II) (ER Site 165).

The only radioactive waste landfill (ER Site 1) contaminant of concern (CoC) is tritium. Historical information on wastes disposed of at this site does not suggest that uncontained tritium would be found in the landfill (Aas, 1995). However, it was conservatively assumed to be present at the same concentrations measured in the vicinity of the landfill. The highest tritium concentrations, measured near the Radioactive Waste Landfill, is 0.358 picocuries per gram. Tables D2-1 through D2-5 present the indicator contaminant (see Section D2.2.2) data available from other example ER Project sites. Data available from the example ER Project sites were evaluated statistically to determine reasonable maximum soil concentrations for the indicator contaminants identified in Section D2.2.2. These evaluations considered the following factors:

Table D2-1
Concentrations of Indicator Contaminants at the ER Site 74—Chemical Waste Landfill[a]

Contaminant (units)	Mean[b]	Maximum	Minimum
Arsenic (ppm)	4.1	93	0.43
Benzene (ppm)	0.03	0.05	0.01
Beryllium (ppm)	0.44	2.0	0.21
Cadmium (ppm)	2.0	87	0.10
Carbon tetrachloride (ppm)	118.9	352	16.9
Chromium VI (ppm)	60	930	0.037
Cesium-137 (pCi/g)	Not Reported		
Homo-cyclonite (HMX) (ppm)	Not Reported		
Lead (ppm)	310	45,000	1.0
Mercury (ppm)	1	20	0.05
Nitrate/nitrite (ppm)	1.94/0.75	6.10/2.90	0.90/0.08
Polychlorinated biphenyl (ppm)	2,100	8,200	0.043
Cyclonite (RDX) (ppm)	Not Reported		
Toluene (ppm)	60	700	0.009
Trichloroethene (ppm)	700	10,000	0.007
Trinitrotoluene (TNT) (ppm)	Not Reported		
Tritium	Not Reported		
Xylenes (ppm)	100	800	0.007
Uranium-235 (pCi/g)	0.00004	0.00007	0.00002

[a] Data extracted from analytical data stored in the SNL/NM Environmental Restoration Data Base Management System (ERDBMS). *Current December 1995 data was used to update analysis to include possible landfill excavation.*

[b] Mean of detected concentrations; many samples showed no detections, but due to historical time frame for data collection, minimum detectable levels vary, and 95 percent confidence level cannot be calculated.

ppm = part(s) per million
pCi/g = picocurie(s) per gram

Table D2-2
Concentrations of Indicator Chemicals at ER Site 4—Liquid Waste Disposal System[a]

Contaminant (units)	Number of Samples	Number of Detections	Mean	Maximum	Minimum	Standard Deviation	Upper 95% Confidence Limit
Arsenic (ppm)	48	48	2.7	6.3	1.0	1.1	3.0
Benzene	Not Reported						
Beryllium (ppm)	48	48	0.78	5.5	0.24	1.1	0.83
Cadmium (ppm)	48	18	b	29	0.55	b	29[b]
Carbon Tetrachloride	Not Reported						
Chromium VI (ppm)	48	48	11	97.7	3.70	15.1	12.2
Cesium-137 (pCi/g)	48	48	0.46	9.2	0.02	1.4	0.44
Homo-cyclonite (HMX) (ppm)	Data Not Available						
Lead (ppm)	48	48	10.9	71.6	4.30	11.9	11.7
Mercury (ppm)	48	6	b	0.35	0.10	b	0.35[b]
Nitrate/Nitrite (ppm)	Not Reported						
Polychlorinated biphenyl (ppm)	Not Reported						
Cyclonite (RDX) (ppm)	Not Reported						
Toluene	Not Reported						
Trichloroethene	Not Reported						
Trinitrotoluene (TNT) (ppm)	Not Reported						
Tritium	Not Reported						
Uranium-235 (pCi/g)	48	48	0.17	0.78	0.11	0.10	0.19
Xylenes	Not Reported						

[a]Extracted from unpublished interim reports in the Environmental Restoration Program Files, 1994.
[b]Majority of samples had no detected concentration; maximum value used.

ppm = part(s) per million
pCi/g = picocurie(s) per gram

Table D2-3
Concentrations of Indicator Chemicals at ER Site 107—Former Explosive Test Area[a]

Contaminant (units)	Number of Samples	Number of Detections	Mean	Maximum	Minimum	Standard Deviation	Upper 95% Confidence Limit
Arsenic (ppm)	14	14	1.9	2.7	0.90	0.49	2.2
Benzene	Not Reported						
Beryllium (ppm)	Not Reported						
Cadmium (ppm)	Not Reported						
Carbon Tetrachloride	Not Reported						
Chromium VI (ppm)	14	14	8.0	13	5.3	1.9	8.8
Cesium-137 (pCi/g)	14	14	0.11	0.24	0.019	0.065	0.18
Homo-cyclonite (HMX) (ppm)	Not Reported						
Lead (ppm)	14	14	9.60	15.4	7.65	2.10	10.6
Mercury (ppm)	Not Reported						
Nitrate/Nitrite (ppm)	14	14	1.9	6.0	0.79	1.3	2.5
Polychlorinated biphenyl (ppm)	Not Reported						
Cyclonite (RDX) (ppm)	Not Reported						
Toluene	Not Reported						
Trichloroethene	Not Reported						
Trinitrotoluene (TNT) (ppm)	Not Reported						
Tritium	Not Reported						
Uranium-235 (pCi/g)	Not Reported						
Xylenes	Not Reported						

[a]Extracted from unpublished interim reports in the Environmental Restoration Program Files, 1994.
ppm = part(s) per million
pCi/g = picocurie(s) per gram

Table D2-4
Concentrations of Indicator Chemicals at ER Site 114—Former Explosive Test Area[a]

Contaminant (units)	Number of Samples	Number of Detections	Mean	Maximum	Minimum	Standard Deviation	Upper 95% Confidence Limit
Arsenic (ppm)	369	369	2.0	6.4	0.52	0.84	2.1
Benzene	Not Reported						
Beryllium (ppm)	Not Reported						
Cadmium (ppm)	Not Reported						
Carbon Tetrachloride	Not Reported						
Chromium VI (ppm)	369	369	5.1	13	1.0	1.8	5.3
Cesium-137 (pCi/g)	Not Reported						
Homo-cyclonite (HMX) (ppm)	Not Reported						
Lead (ppm)	369	127	b	110	3.7	b	10[b]
Mercury (ppm)	Not Reported						
Nitrate/Nitrite (ppm)	Not Reported						
Polychlorinated biphenyl (ppm)	Not Reported						
Cyclonite (RDX) (ppm)	Not Reported						
Toluene	Not Reported						
Trichloroethene	Not Reported						
Trinitrotoluene (TNT) (ppm)	Not Reported						
Tritium	Not Reported						
Uranium-235 (pCi/g)	Not Reported						
Xylenes	Not Reported						

[a] Extracted from unpublished interim reports in the Environmental Restoration Program Files, 1994.
[b] Majority of samples had no detected concentration; maximum value used.

ppm = part(s) per million
pCi/g = picocurie(s) per gram

Table D2-5
Concentrations of Indicator Chemicals at
ER Site 165—Septic System for Tech Area II[a]

Contaminant (units)	Maximum Reported Mean Value Obtained at Depth Less Than 20 Feet
Arsenic (ppm)	2.9
Benzene	Not Reported
Beryllium (ppm)	Not Reported
Cadmium (ppm)	Not Reported
Carbon Tetrachloride	Not Reported
Chromium VI (ppm)	27.6
Cesium-137 (pCi/g)	Not Reported
Homo-cyclonite (HMX) (ppm)	Not Reported
Lead (ppm)	Not Reported
Mercury (ppm)	0.32
Nitrate/Nitrite (ppm)	Not Reported
Polychlorinated biphenyl (ppm)	Not Reported
Cyclonite (RDX) (ppm)	Not Reported
Toluene	Not Reported
Trichloroethene	Not Reported
Trinitrotoluene (TNT) (ppm)	Not Reported
Tritium	Not Reported
Uranium-235 (pCi/g)	Not Reported
Xylenes	Not Reported

[a]Extracted from unpublished interim reports in the Environmental Restoration Program Files, 1994.
ppm = part(s) per million
pCi/g = picocurie(s) per gram

- The number of soil samples in the data set for each site.
- The number of samples with detected indicator contaminant concentrations.
- The maximum and minimum concentration of each detected indicator contaminant.
- The arithmetic mean concentration of each detected indicator contaminant.
- The standard deviation of the concentration of each detected indicator contaminant.
- The upper 95-percent confidence limit calculated using the student's *t* distribution (meaning there is a 95-percent level of confidence that these contaminant concentrations are below that number).

The above factors were not considered when data for the Chemical Waste Landfill (ER Site 74) were evaluated. Because the analytical data have been collected for many years, data do not readily lend themselves to evaluation of 95-percent confidence level, which requires availability of constant minimum detectable levels (MDL) and MDLs vary over time (i.e., as analytical techniques are improved). Therefore, chemical waste landfill contaminant concentrations were assumed to be the maximum detected level. This is a very conservative assumption because the total number of nondetects is not factored in, resulting in a higher apparent level of contaminant concentrations.

VOCs were not reported at sites other than the Chemical Waste Landfill (ER Site 74) but VOCs were considered to be potentially present. Consistent with EPA guidance for performing unit risk assessments at sites with incomplete data (EPA, 1989a), concentrations of VOC indicator contaminants (see Section D2.2.2) were assumed to be 1 ppm by volume.

D2.2.2 Indicator Contaminants

Indicator contaminants have been designated for the purpose of this EA risk assessment because the historical information on chemicals used at the sites is more complete than the analytical data. Although many organic and inorganic chemicals and some radionuclides are suspected to be present at the ER Project sites subject to proposed corrective measures, a limited number of indicator contaminants has been selected for risk evaluation. The contaminants were selected based on historical knowledge of their origin and abundance or because they represented a greater potential hazard to human health or the environment because of their toxicity or mobility. These are defined as indicator contaminants because they are used to indicate a level of risk at least as high as any other contaminants present.

Selected contaminants and the reasons for their selection as indicators of potential risks are as follows:

- Radionuclides—uranium-235 and cesium-137. These two radionuclides have been measured at one or more of the sites selected for this risk assessment and, based on knowledge of SNL/NM operations, are expected to occur at other sites as well. Uranium-235 is a radioactive component of depleted uranium, which is known to be present at some ER Project sites. To provide a conservative overestimation of risks, all uranium was assumed to be uranium-235. This isotope emits alpha radiation, which cannot penetrate the skin but is of concern if ingested or inhaled. Cesium-137 is used to represent exposure to radioactive fission products because it emits penetrating gamma radiation primarily. This is of concern regardless of whether the cesium-137 is externally located or incorporated into the body. Additionally, cesium-137 is easier to mobilize in the environment than other radionuclides that could be present.

- Tritium. This is the only gaseous radionuclide whose presence is indicated by historical information. It can be absorbed through the skin and, because it is an isotope of hydrogen, can become incorporated in the body as tritiated water. It has a relatively short (12-year) half-life and is a beta emitter.

- Petroleum hydrocarbons—benzene, toluene, and xylenes. Petroleum hydrocarbons are commonly associated with fuel spills. They have also been measured at some of the ER Project sites selected for risk assessment. All three compounds are volatile and readily mobilized in soil. Because they can adsorb onto dust particles, they can present inhalation risks. Risks from ingestion and dermal contact are also possible.

- Chlorinated hydrocarbons—carbon tetrachloride, trichloroethene, and polychlorinated biphenyls. Carbon tetrachloride and trichloroethene are commonly associated with waste solvents. Carbon tetrachloride is relatively more toxic than other solvents expected to be present at the ER Project sites. Trichloroethene is a less toxic, commonly used solvent that is considered likely to be present in ER Project site wastes. Both compounds are volatile and readily mobilized in soil. Polychlorinated biphenyl compounds are not as volatile as the other chlorinated compounds. Based on experience at the Chemical Waste Landfill, organic vapors are not likely to be present during excavation activities. Instead, these organic compounds are likely to adsorb onto dust particles. Inhalation exposure risks are evaluated based on inhalation of soil particles contaminated with these chlorinated hydrocarbons. Soil particles are assumed to contain concentrations of VOCs measured in soil samples. Risks from ingestion and dermal contact are also possible. All three compounds have been measured at some of the sites selected for this risk assessment and are expected to also occur at some other ER Project sites.

- Inorganic anions—nitrate and nitrite. Nitrates and nitrites are by-products of burning and detonation activities and are the inorganic components representative of SNL/NM operations at burn sites and firing sites. Inhalation of windblown dust containing nitrates and nitrites is the exposure route of primary concern, although ingestion exposures are also considered in this risk assessment.

- Metals—arsenic, beryllium, cadmium, chromium, lead, and mercury. These metals have been measured at one or more of the sites selected for this risk assessment and are expected to occur at other sites as well. All of the selected metals are common laboratory chemicals. In addition, mercury and arsenic were used in previous decades in fungicides and herbicides. All of the metals can be present in powder form or can adsorb onto dust particles and can represent inhalation risks. Other exposure routes, such as ingestion and direct contact with the skin, were also evaluated.

- Explosive compounds and residues—homo-cyclonite, cyclonite, trinitrotoluene, and nitrates/nitrites. Explosive compounds and residues are known to be present at SNL/NM firing sites. Although explosive compounds and residue concentrations greater than 12 percent in soil represent a risk of detonation, these risks are not addressed in this risk assessment. It is expected that firing sites where explosive compounds and residues or unexploded ordnance are present will not be considered for NFA designation.

Because ER Project sites contain a variety of contaminants, exposures to a mixture of chemicals are expected. The responses to such mixed exposures could be additive, synergistic, or antagonistic or could depend on the order of exposure (potentiated response). Such changes in the incidence of response to mixed exposures have been demonstrated in laboratory animals exposed to high doses. However, there are not sufficient multiple-risk data on human responses to assess multiple risk and hazards at this time. The methodology used in this risk assessment is consistent with EPA guidance and assumes that the risks are additive (EPA, 1989a). For example, the risk from inhalation of chromium dust mixed with arsenic dust is assumed to equal the chromium risk plus the arsenic risk.

D2.2.3 Comparable Sites

The ER Project example sites for which quantitative characterization data were available for this analysis are assumed to represent other, comparable ER Project sites to be remediated. Although other sites to be remediated may have different concentrations of contaminants or even different contaminants, currently, there are no site-specific data available and, consequently, no basis for using any other assumptions about concentrations or appropriate indicator contaminants in assessing risks projected for the ER Project. Therefore, to the extent possible, ER Project sites were categorized as comparable to example sites for which contaminant data were available based on their previous uses and/or CoCs.

Using information from the SNL/NM ER Site Information Sheets (SNL/NM, 1993), ER Project sites were identified and grouped into five comparable site categories: landfills, burn sites, explosive test sites, waste disposal sites, and septic systems and drainfields. To estimate health and environmental impacts, the concentrations of indicator contaminants measured in the example sites were assumed for all comparable sites. The total volume of soil to be remediated at all site types was used to assess risks for both carcinogens and noncarcinogens. Example sites and their comparable sites are shown in Tables D2-6 through D2-10. The volumes used in risk calculations are shown in these tables.

Landfill sites were treated a little differently from other comparable site groups because each is unique. It was assumed that the Radioactive Waste Landfill (ER Site 1) would be excavated and waste from there would be containerized. It was also assumed that the Classified Waste Landfill (ER Site 2) would be excavated. Slightly elevated tritium levels have been detected in soils near the Radioactive Waste Landfill. To conservatively estimate risks from a tritium release, the tritium inventory in the landfill was assumed to be uniformly distributed in the soil and released as a gaseous emission during excavation. No emissions of other contaminants present in solid components were deemed credible. However, based on historical information on the nature of the waste and careful ("archeological-like") hand excavation methods that have been proposed, no releases of contaminants are expected. Consistent with current ER Project plans, it was assumed that the Mixed Waste Landfill (ER Site 76) would be closed in place. It was assumed that the Chemical Waste Landfill (ER Site 74) would be partially excavated to the extent required for contaminant source removal (Fish, 1995). Data from chemical waste landfill characterization were used to calculate indicator contaminant concentrations. Thus, the only contaminant releases from landfills would be chemicals from the Chemical Waste Landfill (ER Site 74) and tritium from the Radioactive Waste Landfill (ER Site 1).

D2.2.4 ER Project Sites Without Characterization Data

A few sites could not be grouped as comparable. For these sites, a unit concentration of 1 ppm (1 milligram per kg) by weight of all indicator contaminants was conservatively assumed to be present in soils. Table D2-11 lists ER Project sites without characterization data. This approach is consistent with EPA guidance for assessing risks at sites with incomplete data (EPA, 1989a). The unit concentrations of indicator contaminants were used to evaluate potential relative or unit risks that can be readily multiplied by actual concentrations of contaminants. When characterization is more complete, contaminant concentration data can be used to determine whether risks fall within the "envelope" of impacts evaluated in this assessment.

D2.3 HUMAN EXPOSURE PATHWAYS ASSOCIATED WITH THE PROPOSED ACTION

This section addresses factors that were considered in assessing potential human exposures to the contaminants described in Section D2.2.

Table D2-6
Sandia National Laboratories/New Mexico Environmental Restoration Landfill Sites

ER Site Number	Past Site Use/Waste Type	Volume of Waste Assumed Excavated and Treated (cubic feet)	(cubic meters)
1	Landfill/radioactive waste	12,000	340
2	Landfill/classified waste [a]	No release or treatment	
74	Landfill/chemical waste [b]	934,000	26,459
75	Landfill/mixed waste	No excavation proposed	

[a]This volume is expected to be excavated without release because waste remains enclosed in containers (Aas, 1995). Wastes will not require treatment prior to disposal.
[b]This is the volume of waste at ER Site 74, the Chemical Waste Landfill, expected to be excavated (Fish, 1995).

Table D2-7
Sandia National Laboratories/New Mexico Environmental Restoration Project Sites Comparable to ER Site 4—Liquid Waste Disposal System [a]

ER Site Number	Past Site Use/Waste Type	Volume of Waste Assumed Excavated and Treated (cubic feet)	(cubic meters)
8	Open dump/mixed waste	57,944	1,641
9	Burial site/open dump/radioactive waste	4,696	133
10	Burial mounds/mixed waste	309,951	8,778
11	Radioactive, explosive/burial mounds, mixed waste	6,815	193
12	Burial site, open dump/mixed waste	57,979	1,642
14	Burial site/mixed waste	499,919	14,158
16	Open dumps/mixed waste	85,980	2,435
18	Concrete pad/radioactive waste	5,014	142
19	TRUPAK boneyard storage/mixed waste	5,014	142
23	Disposal trenches/mixed waste	<35	<1
43	Radioactive material storage yard, mixed waste	1,695	48
44	Decontamination site and uranium calibration pits, mixed waste	1,412	40
45	Liquid discharge, not specified	7,804	221
55	Red Towers Site, mixed waste	7,309	207
58	Coyote Canyon Blast Area, mixed waste	169,982	4,814
60	Bunker area (north of Pendulum Site), mixed waste	989	28
63	Balloon Test Area, mixed waste	53,989	1,529
65	Lurance Canyon Explosive Test Site, mixed waste	289,966	8,212
68	Old Burn Site, mixed waste	1,695	48
82	Old Aerial Cable Site, mixed waste	129,976	3,681
83	Long Sled Track, mixed waste	5,014	142
84	Gun Facilities, radioactive waste	6,215	176
85	Bldg. 9920 firing site, mixed waste	57,979	1,642
86	Bldg. 9927 firing site, mixed waste	<35	<1
87	Bldg. 9990 firing site, mixed waste	249,253	7,059
90	Beryllium firing site, mixed waste	6,885	195
94	Lurance Canyon burn site, mixed waste	74,998	2,124
103	Bldg. 9939 scrap yard, mixed waste	13,171	373
108	Bldg. 9940 firing site, mixed waste	7,592	215
109	Bldg. 9956 firing site, mixed waste	22,987	651

Table D2-7 (Concluded)
Sandia National Laboratories/New Mexico Environmental Restoration Project Sites Comparable to ER Site 4—Liquid Waste Disposal System

ER Site Number	Past Site Use/Waste Type	Volume of Waste Assumed Excavated and Treated	
		(cubic feet)	(cubic meters)
115	Bldg. 9930 firing site, mixed waste	7,415	210
116	Bldg. 9990 septic system, radioactive waste	<35	<1
117	Bldg. 9939 trenches, mixed waste	12,005	340
147	Bldg. 9925 septic system, radioactive waste	<35	<1
148	Bldg. 9927 septic system, radioactive waste	<35	<1
150	Bldg. 9939/9939A septic system, radioactive waste	<35	<1
151	Bldg. 9940 septic system, radioactive waste	<35	<1
153	Bldg. 9956 septic system, radioactive waste	<35	<1
191	Equus Red, mixed waste	9,287	263
193	Sabotage Test Area, mixed waste	2,189	62
225[b]	AEC Storage Facility Kirtland Air Force Base, radioactive waste	5,014	142
226	Acid Waste Line, metals	27,012	765
241	Storage yard, not specified	3,990	113

[a]ER Site 4 was used in the analysis based on information provided by SNL/NM Environmental Restoration task leaders at the time this EA was prepared. The site has subsequently been designated as an NFA candidate.

[b]Excavation of this site was assumed at the time analysis was performed. The site has since been eliminated from the ER Project because it was found not to be a candidate for cleanup. Inclusion of this site in the risk estimate is conservative.

Table D2-8
Sandia National Laboratories/New Mexico Environmental Restoration Project Sites Comparable to ER Site 107—Former Explosive Test Area

ER Site Number	Past Use, Waste Type	Volume of Waste Assumed Excavated and Treated	
		(cubic feet)	(cubic meters)
51	Building 6924 pad, tank, and pit, high-explosive residues	9,110	258
54	Pickax Site, explosive residues	1,782,131	50,471
57	Workman Site, unexploded ordnance	43,008	1,218
67	Frustration Site, unexploded ordnance/explosive residues	<35	<1
91	Lead Firing Site, metals/explosive residues	4,308	122
107[a]	Explosives Test Area, radioactive waste	319,803	9,057

[a]Treatable volume was conservatively estimated by SNL/NM Environmental Restoration task leaders at the time this EA was prepared. Some sites were subsequently designated as NFA candidates and the volume will not actually be excavated. The assumption made on this EA that wastes will be excavated and risks will be incurred from contaminant releases is conservative.

Table D2-9
Sandia National Laboratories/New Mexico Environmental Restoration Project Sites Comparable to ER Site 114—Explosives Burn Pit

ER Site Number	Past Use, Waste Type	Volume of Waste Assumed Excavated and Treated	
		(cubic feet)	(cubic meters)
42	Acid Spill Water Treatment Facility, acids	530	15
46	Old Acid Waste Line Outfall, acids, plating solutions	47,986	1,359
114	Burn Pit, explosives/metals	3,708	105
227	Bunker 904 outfall, explosives, metals, chemicals	9,004	255
228	Centrifuge Dump Site, not specified	5,014	142
242[a]	Sabotage Test Box, explosives, metals	<35	<1

[a]Excavation of this site was assumed at the time analysis was performed. The site has since been eliminated from the ER Project because it was found not to be a candidate for cleanup. Inclusion of this site in the risk estimate is conservative.

Table D2-10
Sandia National Laboratories/New Mexico Environmental Restoration
Project Sites Comparable to ER Site 165—Septic System for Technical Area II

ER Site Number	Past Use, Waste Type	Volume of Waste Assumed Excavated and Treated (cubic feet)	(cubic meters)
96	Storm Drain System, Not Specified	27012	765
140	Bldg. 9965 Septic System, Photographic Chemicals	<35	<1
165[a]	Bldg. 901 Septic System, Explosives, Chemicals, Metals	37,287	1,056
187	Septic Tank Piping for publicly owned treatment works, Chemicals	269,980	7,646
196	Bldg. 6597 Cistern, Nonhazardous Waste	9,816	278
229	Storm Drain Systems Outfall, Metals, Oils	4,802	136
230	Storm Drain Systems Outfall, Metals, Oils	4,414	125
231	Storm Drain Systems Outfall, Metals, Oils	1,907	54
232	Storm Drain Systems Outfall, Metals, Oils	1,589	45
233	Storm Drain Systems Outfall, Metals, Oils	883	25
234	Storm Drain Systems Outfall, Metals, Oils	3,284	93
235	Storm Drain Systems Outfall, Metals, Oils	62,004	1,756

[a]Treatable volume was conservatively estimated by SNL/NM Environmental Restoration task leaders at the time this EA was prepared. Some sites were subsequently designated as NFA candidates and the volume will not actually be excavated. The assumption made on this EA that wastes will be excavated and risks will be incurred from contaminant releases is conservative.

Table D2-11
Sandia National Laboratories/New Mexico
Environmental Restoration Project Sites That Were Assessed by the Unit Risk Approach

ER Site Number	Past Use, Waste Type	Volume of Waste Treated (cubic feet)	Volume of Waste Treated (cubic meters)
7	Disposal Pit, Gas Cylinders, Explosives, unexploded ordnance, Chemicals	309,951	8,778
30	Polychlorinated Biphenyl Spill, polychlorinated biphenyls	1,199,834	33,980
38	Building 9920 Oil Spills Fuels/Oils	7,203	204
81	New Aerial Cable Site/Burial Site/Dump/Test Area, Mixed Waste	109,991	3,115
98	Bldg. 863 Canyons Test Area—Photo. Lab, Trichloromethane/Photographic Chemicals	1,589	45
239[a]	Impact Area 155-millimeter and Rockets, Not Specified	209,989	5,947
240	Short Sled Track, Not Specified	5,014	142

[a]Excavation of this site was assumed at the time analysis was performed. The site has since been eliminated from the ER Project because it was found not to be a candidate for cleanup. Inclusion of this site in the risk estimate is conservative.

D2.3.1 Exposure Pathway Elements

For exposure and potential risks to occur, exposure pathways must be complete, which requires all of the following elements (EPA, 1989a):

- A mechanism for release of contamination from its source (e.g., suspension of soil by excavation).
- A transport medium (e.g., windblown dust).
- A contaminant concentration at the point of human contact (the exposure point concentration).
- A route of intake by the person (e.g., inhalation).
- The presence of the person at the exposure location.

Thus, the exposure pathway describes the course a contaminant takes from its source through its intake by an exposed individual. If any one of these elements is missing, the pathway is not considered complete and no exposure occurs (EPA, 1989a).

Release mechanisms are assumed to result from physical or physicochemical processes, fugitive dust generation, leaching by water, and direct contact with the skin. External radiation emitted from the contaminant is also considered a release mechanism.

In the exposure assessment for this EA, source contaminants are assumed to be in or adsorbed onto soil particles and transported on windblown dusts. Exposure pathways from groundwater and surface water were not considered credible. Exposure points are locations of human contact with contaminated media. Human contact could occur at an ER Project site as part of normal operations or remediation activities. Human contact at locations far removed from the site would be at lower concentrations due to dispersion or other physical removal or reduction processes.

An exposure route is a way in which a contaminant comes into contact with or enters the body. For this assessment, the exposure routes are considered to be the following:

- Inhalation: Inhalation is one of the most common routes of exposure to contaminants. The lungs have a large surface area through which chemicals can be absorbed and are permeable to many compounds. Toxic inhalations frequently result in acute and chronic exposure. If a contaminant of potential concern is not able to become airborne as a mist, fume, vapor, or dust, exposure through the pulmonary system is unlikely.
- Ingestion: Ingestion can be a route of absorption of a toxic agent into the body and can occur through eating, drinking, or incidental soil ingestion. Children are more

likely to ingest soil than are adults. Inhalation exposures to dust also involve incidental ingestion of particles deposited in the upper respiratory tract.

- Dermal Contact: Dermal contact with chemicals in contaminated soil is usually of lesser concern than inhalation exposures. The interior surface area of the lung is much greater than the external skin surface area. Unbroken, healthy skin provides an effective barrier against many toxic agents. Although lipophilic substances (such as chlorinated organic solvents) absorb through the skin, these chemicals are also readily absorbed through lung tissue. Industrial chemicals can cause dermatitis when encountered at relatively high concentrations. Dermal exposure to strong acids and bases or prolonged or repeated exposures at high concentrations to other chemicals can cause acute effects at the skin surface as well as systemic effects.

- External Irradiation: External radiation exposure can result from close proximity to a radioactive source. Direct contact with the radionuclide is not required. Alpha radiation does not pose an external radiation risk because it cannot penetrate the skin. The major source of external radiation exposure is penetrating gamma radiation. Beta radiation is also somewhat penetrating but less so than gamma radiation.

D2.3.2 Identification of Potential Exposure Groups and Pathways

The analysis predicts potential human health effects for exposed individuals in three population groups: (1) workers involved in constructing and implementing corrective measures at ER Project sites, (2) other SNL/NM workers present on site but not involved with corrective measure operations, and (3) members of the general public residing or present outside the KAFB boundary. The potential risks associated with exposures to carcinogens and hazards from noncarcinogens were estimated. These health and environmental effects were projected for both routine operations and accidental exposure scenarios.

For the purpose of this analysis, it was assumed that an individual in one of the three evaluated population groups (ER Project site workers, other SNL/NM workers, and members of the public) did not also belong to another group. This assumption was based on the fact that due to dispersion, exposure decreases dramatically with distance. For example, a person working at an ER Project site who also resides outside the KAFB boundary would incur the greater risk at the ER Project site. As a result, this person was considered to be an ER Project site worker rather than a member of the general public. This is conservative because ER Project site workers were assumed to be exposed for 8 hours a day.

Human health and ecological impacts resulting from soil disturbances and airborne releases of contaminants were modeled assuming that, on the average, each site would require one year to remediate. However, some sites will require much longer than one year to remediate, while other sites may require less than one year. It was assumed that the entire ER Project will be completed within ten years and that all human health and environmental exposures are chronic for routine operations and are not time dependent. Thus, the total human-health risk assessment does not depend on the number of sites being remediated simultaneously in any one year. Under this assumption, the risks evaluated represent the annual remediation risk. In other words, the risk can be interpreted as "risk per year." It can be increased or decreased according to the actual time required for remediation at different ER Project sites. The following pathways were considered for each population group:

- Ingestion of soil contaminated by dust from an ER Project site.
- Inhalation of contaminated dust from an ER Project site.
- Dermal contact with soil contaminated by nonradioactive ER Project site dust.
- External irradiation from soil contaminated by radioactive ER Project site dust.

The pathways selected for evaluation constitute all major complete exposure pathways, based on knowledge of ER Project site conditions and assumed remediation activities. Potentially exposed populations were selected according to the appropriate activity. For example, potential ingestion of contaminated soil by children residing in the surrounding community was included as a likely pathway. However, because children would not be involved in remediation work, potential ingestion of contaminated soil by children at a remediation site was not considered as a credible pathway. Ingestion, dermal contact, and inhalation exposures to ER Project site workers were not considered credible for routine activities because they would be subject to appropriate requirements for personal protective equipment by a site-specific health and safety plan. Similarly, based on general facility safety training, SNL/NM workers not involved in ER Project site remediation activities would be only routinely exposed through the inhalation pathway. Both ER Project site workers and other SNL/NM facility workers were assumed to be potentially exposed to accidental releases through all four of the above pathways. Public exposure was evaluated assuming exposure through all the above pathways for routine and accidental releases.

D2.4 ESTIMATION OF HUMAN EXPOSURE

A quantitative estimation of potential human exposures to contaminants involves:

- A determination of duration of emissions (see Section D2.4.1).

- A combination of exposure concentrations and factors used to estimate intake (see Section D2.4.2).

- A description of applicable human exposure parameters such as breathing rate (see Section D2.4.2).

- A determination of the contaminant concentrations at the point of exposure (see Section D2.4.3).

- A determination of how the contaminants (source terms) are released (see Section D2.5).

D2.4.1 Emission Source Terms

For the purpose of determining emissions, the treatment options described in Chapter 2.0 of the EA were assumed to be operational in processing remediation wastes for ten years. Emissions from routine operations were calculated for the entire volume of soil to be excavated and treated (see Appendix A, Tables A-2 and A-3). Soil volumes for sites for which in situ bioremediation is proposed are not included because they would remain in place and would not be evacuated. For routine operations, contaminant concentrations for example sites were assumed available for release at all comparable sites.

Human health risks for routine emissions from treatment operations were evaluated using the assumption that an engineered system was capable of removing 99.99 percent of all contaminants present in soils, except tritium. The particulate thermal desorption treatment option and its off-gas treatment system were assumed to result in full destruction of hazardous VOC and SVOC compounds.

Contaminant releases from accidents were evaluated separately and are described in Section D2.5.2.

Because ER Project activities would involve excavation and other dust-generating activities, it was necessary to estimate the potential impact of windblown contamination on human health. Meteorological data were used in calculating the concentration of a contaminant in the air and deposition on the ground at various user-specified locations. Estimated contaminant concentrations at the location of a receptor were obtained from the EPA ISC2 air-quality model and the above-mentioned meteorological data. The EPA ISC2 models were used for this analysis because they are specifically designed to support EPA's regulatory modeling programs (EPA, 1992).

D2.4.2 Intake and Exposure Parameters

Estimates of contaminant concentration in the air were used to estimate exposure by the inhalation pathway. Similarly, estimates of contaminant deposition on the ground were used to estimate exposure by the ingestion, dermal contact, and external radiation pathways. Exposure consequences were projected using EPA's Risk Assessment Guidance for Superfund (EPA, 1989a) values for typical human receptors and the Exposure Factors Handbook (EPA, 1989b).

D2.4.3 Dispersion Modeling

Executing the EPA ISC2 models requires information that describes the physical characteristics of the emission site, the contaminants and their emission rates, meteorological data, and locations of potential exposure points. Based on EPA emission factors for unmitigated fugitive dust releases during construction activities, it was estimated that 1.2 tons of soil per acre per month (1.0×10^{-4} gram per square meter per second) would be excavated during excavation activities (EPA, 1988) despite fugitive dust mitigation measures planned for ER Project site excavation activities. This value was used as the areal emission rate for all sites and was multiplied by their estimated areas. The measured indicator contaminant concentrations for each of the sites were used to represent the contaminant concentrations in the dust releases. The total period of release for each site was conservatively estimated to be one year, the assumed average remediation time for ER Project sites. Meteorological data for calculating the air dispersion of contaminants were obtained from the Technology Transfer Network (EPA, 1992) and averaged for the year 1991.

The size of the diffuse area source varied with the example site used. Area source sizes were conservatively assigned to their respective example sites based on information available when the analysis was performed. These areas have proven to be equal to or larger than later revised area source estimates shown in Appendix A, Table A-2.

- Radioactive Waste Landfill (ER Site 1): 11,944 square feet (1,110 square meters). Tritium releases at this site were not related to the area but were considered proportional to the total volume available for release.

- Liquid Waste Disposal System (ER Site 4) and comparable sites: 35,565 square feet (3,304 square meters) for each of 43 sites.

- Chemical Waste Landfill (ER Site 74): 82,737 square feet (7,686 square meters).

- Former Explosive Test Area (ER Site 107) comparable sites: 4,769,856 square feet (443,119 square meters).

- Explosives Burn Pit (ER Site 114) comparable sites: 1,852,321 square feet (172,081 square meters).

- Septic System for Tech Area II (ER Site 165) comparable sites: 4,769,856 square feet (443,119 square meters).

The EPA ISC2 model was used to estimate contaminant dispersion over a 13.7- by 13.7-mile (22.0- by 22.0-kilometer) area. Estimated contaminant concentration contours for each of the example sites were generated by the model to identify the outer contours of significant contamination. This area was found to include all of the potentially exposed population groups.

Results of dispersion modeling were expressed graphically as contours of constant contaminant concentration around the center of an ER Project site. These lines represent contours of constant exposure point concentrations where individuals might be exposed and were converted to lines of constant risk for the three exposure groups.

D2.5 CONTAMINANT RELEASES

This section addresses emissions incidental to normal operations. Routine operations would be conducted according to an approved health and safety plan designed to minimize the possibility of releases, accidents, and injuries.

D2.5.1 Contaminant Releases Resulting from Routine Operations

The only routine releases associated with remediation activities were found to result from excavation. Releases from waste treatment operations were not considered to be credible on a routine basis due to engineered controls for waste treatment processes. Although there are no controls for tritium releases at the proposed thermal treatment facility, tritium releases are not of concern because treatment of tritium-contaminated soil or debris from the Radioactive Waste Landfill (ER Site 1) is not proposed.

D2.5.1.1 Release During Corrective Measures

Routine releases of contamination from corrective measures operations are expected to be dominated by airborne releases during excavation. Releases of indicator contaminants from excavations at ER Project sites were assessed according to the site groupings described in Section D2.2.3. These are:

- The Radioactive Waste Landfill (ER Site 1).
- The Chemical Waste Landfill (ER Site 74).
- The waste disposal facilities comparable to the Liquid Waste Disposal System (ER Site 4).
- The firing sites comparable to the Former Explosives Test Site (ER Site 107).
- The burn pit sites comparable to the Explosives Burn Pit (ER Site 114).
- The septic system sites comparable to the Septic System for Tech Area II (ER Site 165).

<u>Airborne Dust Emissions from Excavation</u>

Contaminants are assumed to be released in the concentrations in which they were measured in the soil at the example ER Project sites for which data exist. The release rate for all sites, as discussed in Section D2.4.3, was assumed to be 1.2 tons of soil per acre per month (1.0×10^{-4} grams of soil per square meter per second) despite fugitive dust emission controls, such as applying water at excavation sites. For sites not considered comparable, a unit concentration is assumed to be released. This concentration is conservatively assumed to be 1 ppm by weight for each indicator contaminant. This was based on EPA emission factors for fugitive dust emissions during construction projects (EPA, 1988).

Airborne Emissions from Waste Treatment Facility

Releases from the proposed corrective action management unit (CAMU) waste treatment facility option, assumed to be located near the Chemical Waste Landfill (ER Site 74), would depend on specific design and operating parameters. Because ER Project sites have not yet been characterized, there is currently insufficient information on which to base a specific treatment facility design. Therefore, routine airborne releases are assumed to result from a treatment facility with a nominal daily throughput of 2,200 pounds (1,000 kg) (consistent with typical thermal desorber design [Feizollahi and Shropshire, 1994]) and work-off rate of ten years for treating assumed ER Project site waste volumes) of waste per day from a point source (stack) with a height of 30 feet (9.1 meters). The waste treatment facility is assumed to have a minimum contaminant removal efficiency that would allow particulate contaminant concentrations to be reduced in the air exhaust waste stream by 99.99 percent and would be capable of complete destruction of VOCs, consistent with the proposed off-gas treatment and emission controls system.

D2.5.2 Contaminant Releases and Concentrations Resulting from Accidents and Abnormal Events

The accident analyses considers accidents that could typically be expected during proposed ER Project activities related to implementing corrective measures. Accidental releases for the no action alternative are not addressed because no accidental release scenarios were identified.

D2.5.2.1 Accidents Resulting from Implementation of Corrective Measures

Contaminant Concentrations

To conservatively estimate accidental releases associated with waste transportation, handling, and treatment, it was assumed that wastes encountered would reflect waste generated at any of the ER Project sites. Therefore, a general waste composition was assumed throughout the assessment of accidental releases. The waste composition was developed from concentration data for the chemical components among the indicator contaminants and the maximum values for radionuclides among the example sites. Table D2-12 shows the contaminant concentrations used to model accidental releases along with the adverse health effects typically associated with the contaminant. The contaminant concentrations available at the time this analysis was performed are not identical to those used for routine releases from example sites. However, the assumptions made in the analyses are conservative and newer information on contaminant concentrations does not change the conclusions for this analysis.

Table D2-12
Concentrations of Indicator Chemicals Evaluated for Accidental Releases[a]

Contaminant	Estimated Concentration	Health Effect	Data Source (ER Site Number)
Arsenic (ppm)	32	Cancer Systemic toxicity[b]	Chemical Waste Landfill (ER Site 74)
Beryllium (ppm)	24	Cancer Systemic toxicity[b]	Chemical Waste Landfill (ER Site 74)
Cadmium (ppm)	0.98	Cancer Systemic toxicity[b]	Chemical Waste Landfill (ER Site 74)
Chromium VI (ppm)	290	Cancer Systemic toxicity[b]	Chemical Waste Landfill (ER Site 74)
Cesium-137 (pCi/g)	9.2	Cancer	Liquid waste Disposal System (ER Site 4)
Homo-cyclonite (HMX) (ppm)	Data not available		
Lead (ppm)	310	Systemic toxicity	Chemical Waste Landfill (ER Site 74)
Mercury (ppm)	5.8	Systemic toxicity[b]	Chemical Waste Landfill (ER site 74)
Nitrate/nitrite (ppm)	1.9	Systemic toxicity[b]	Chemical Waste Landfill (ER Site 74)
Polychlorinated biphenyl (ppm)	8,200	Cancer	Chemical Waste Landfill (ER site 74)
Cyclonite (RDX) (ppm)	Data not available		
Tritium (pCi/g)	0.36	Cancer	Radioactive Waste Landfill (ER Site 1)
Trinitrotoluene (TNT) (ppm)	Data not available		
Uranium-235 (pCi/g)	0.78	Cancer	Liquid Waste Disposal System (ER Site 4)

[a]Extracted from unpublished interim reports in the Environmental Restoration Program Files, 1994.
[b]Systemic toxicity consists of non-cancer-related health effects, including but not limited to, nausea, headache, liver damage, kidney failure, and central nervous system disorders. (EPA, 1989b)
ppm = part(s) per million
pCi/g = picocurie(s) per gram

Volume Available for Release

Waste excavation, handling, storage, transportation, and treatment accidents were assessed for the ER Project sites identified in Appendix A, Table A-3. This table shows the sites where contaminated soil is assumed to be excavated for treatment, as well as the associated soil volumes assumed to be contaminated. These estimates are very conservatively derived and are intended to overestimate the total contaminated soil volumes.

The information provided in Appendix A, Table A-3, was summarized to provide the waste volume and ER Project site location information necessary to assess risks. Total mileages theoretically required for waste transportation from each ER Project site to storage and treatment facilities were based on an assumed CAMU location near the Chemical Waste Landfill (ER Site 74). Transportation accident frequency per mile for a route through an area 90 percent rural, 5 percent suburban, and 5 percent urban (Madsen et al., 1986) were then applied to the mileage traveled. Accident frequency information was obtained from data compiled by (DoL, 1990) and the National Safety Council (NSC, 1993).

In addition, ER Project site workers would be expected to incur risks of occupational injuries or fatalities from waste handling, vehicular traffic, treatment facility construction, and demolition and waste treatment accidents. Potential risks from abnormal events ranging from container punctures to an aircraft crash at a storage facility were also assessed. The total daily capacity of a central treatment facility was assumed available for release (2,200 pounds [1,000 kg]).

Populations Exposed

The number of people estimated for each of the three population groups identified in Section D2.3.2 was based on several assumptions. The number of workers assumed to be involved in ER Project site corrective measures activities was based on the assumed treatment facility throughput capacity of 2,200 pounds (1,000 kg) of waste per day assumed for the treatment plant design. Based on this assumption, it was anticipated that the operations would require 60 full-time workers. The number of full-time SNL/NM workers associated with the treatment, handling, and disposal facility, but not involved in corrective measures operations, was estimated to be 60. Because the number of people in the general public who would be affected by an accident is difficult to estimate for the entire SNL/NM facility, risks were estimated based on the potential exposure of 1,000 people. These risks to the general public from accidental releases can be interpreted as representing "risk per 1,000 people per year."

Accident Types

Specific types of accidents that were assumed to result in releases or injuries and fatalities not associated with a release are summarized below:

- Waste-Handling Accidents. Risks were assessed for waste-handling accidents involving dropping a container of untreated contaminated soil and inhaling suspended aerosols. Health effects were estimated for potential exposures of nearby ER Project workers, workers not involved in the accident, and the general public. The equations used to assess risks from handling treated waste are identical to those for untreated waste, except for the smaller aerosol suspension factor used for treated waste. Therefore, risks from handling treated waste are proportionately lower as well. However, these risks were not calculated whenever risks calculated for untreated waste were tolerable or negligible.

- Transportation Accidents. Risks were assessed for transportation accidents involving a one- or two-vehicle accident in which waste containment was breached, followed by inhalation of aerosols by people nearby. As above, risks from transportation accidents involving treated waste were not calculated whenever calculated risks for untreated waste were tolerable or negligible.

- Treatment Accidents. Risks were assessed for a small-scale explosion or fire during the desorption of flammable compounds in the thermal desorption unit. Other accidents associated with waste treatment are assumed to include the same waste-handling accidents described above.

Risks from accidents during in situ bioremediation are assumed to be negligible because soil moving activities are anticipated to be minimal. Also, bioremediation generates explosive gases so slowly that explosive accidents were not considered credible. Accidents from treatment of unexploded ordnance are assumed to be minimized by procedures defined in a health and safety plan. Accidents from carbon dioxide sandblasting, soil washing, and waste solidification are assumed to be included in occupational injury and fatality risks calculated below.

D2.5.2.2 Releases Resulting from Abnormal Events

The following types of scenarios were considered in determining risks from releases occurring as a result of abnormal events:

- Aircraft Crash. Risks were assessed for an aircraft crashing directly into the treatment plant or crashing and sliding into the plant, causing the release of contamination as well as impact and burn injuries to workers in the plant. It is assumed that the plant would contain an amount of waste equal to a one-day treatment capacity. This accident scenario is also assumed to apply to an aircraft crash into a storage facility. However, the probability of this event is very low—1 in 10 million (10^{-7}) to 1 in 100 million (10^{-8}).

- Seismic or High-Wind Events. Releases resulting from seismic or high-wind events would be very similar to those occurring during an aircraft crash. The total inventory equal to a one-day treatment capacity would also be released by these events. The probability of occurrence would probably be smaller than the aircraft-crash scenario because of the low seismic event and tornado frequencies at the SNL/NM facility location (see Section 3.1).

D2.6 NO ACTION ALTERNATIVE

The human health risk from the proposed action may be compared to a baseline risk incurred by both SNL/NM workers and the public from general levels of contaminants measured on site and within the Albuquerque metropolitan area as part of the ongoing environmental monitoring program at SNL/NM (Culp et al., 1994). Levels of soil contaminants on and near KAFB and locations in the greater metropolitan Albuquerque area were used to establish baseline risk for the no action alternative. Contamination from ongoing operations and existing ER Project sites contributes to this risk, but their relative contributions are unknown. Therefore, the baseline provides an upper limit estimate of the risk associated with no action.

Table D2-13 summarizes these soil data used to estimate the baseline no action risk. No air-monitoring data were reported in 1993. Therefore, the risk assessment for the no action alternative was based on soil-monitoring data. Soil concentrations for the indicator contaminants were divided into four groups:

- Group 1, samples collected from Tech Areas I, II, and IV.
- Group 2, samples collected from Tech Areas III and V.
- Perimeter samples collected at seven locations on the SNL/NM boundary.
- Off-site samples collected at 12 locations within a 50-mile (80-kilometer) radius of SNL/NM.

Risk estimates based on Groups 1 and 2 sample data reflect potential exposures of workers at the technical area in question. Estimates based on perimeter or off-site measurements reflect potential risks to residents in the surrounding community or to the general public.

No action means that no action would be taken at the ER Project sites and that the risks would be the same as those currently incurred. To assess the risks associated with the no action alternative, it was assumed that current waste management practices would continue without modification and that existing environmental monitoring measurements would reflect future contaminant concentrations. This is a conservative assumption because ongoing SNL/NM operations are a primary contributor to measured contaminant concentrations.

There are no known incidents of accidental releases from undisturbed ER Project sites. The analysis in this EA assumes that current practices would continue and that such accidental releases would not be reasonable or foreseeable.

Table D2-13
Concentrations of Indicator Chemicals in Soil Reported in the Environmental Monitoring Report, 1993
Sandia National Laboratories/New Mexico

Contaminant	Tech Areas I, II, IV (ppm)	Tech Areas III, V (ppm)	Perimeter[a] (ppm)	Off Site[b] (ppm)
Arsenic	Not Detected			
Benzene	Not Detected			
Beryllium	0.5	0.5	1.0	0.6
Cadmium	0.75	0.72	1.0	0.522
Carbon tetrachloride	Not Detected			
Chromium VI	18.0	19.4	19.9	27.2
Cesium-137 and daughters	0.3	0.3	0.47	0.47
Homo-cyclonite (HMX)	Not Detected			
Lead	1930	8.75	11.2	25.8
Mercury	Not Detected			
Nitrate	Not Detected			
Nitrite	Not Detected			
Polychlorinated biphenyl	Not Detected			
Cyclonite (RDX)	Not Detected			
Trinitrotoluene (TNT)	Not Detected			
Toluene	Not Detected			
Trichloroethene	Not Detected			
Uranium-235 and daughters	Not Detected			
Xylene	Not Detected			

[a] Samples collected at the SNL/NM perimeter.
[b] Samples collected at 12 locations within a 50-mi (80 km) radius of SNL/NM.
ppm = parts per million

Reference:

Culp, T., C. Cheng, W. Cox, N. Durand, M. Irwin, A. Jones, F. Lauffer, M. Lincoln, Y. McClellan, K. Molley, and T. Wolff, 1994. "1993 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND94-1293-UC-630, Sandia National Laboratories, Albuquerque, New Mexico.

D2.7 HUMAN HEALTH CONSEQUENCES

D2.7.1 Human Health Consequences of Radionuclide and Hazardous Chemical Releases During Routine Corrective Measures

This section briefly describes the estimated potential human health risks associated with routine operations at ER Project sites. Such estimations are based on regulatory guidance that provides a bias contained in EPA risk assessment methodology to protect human health by overestimating risks (EPA, 1989a).

D2.7.1.1 Human Health Risk Characterization

A brief discussion of cancer risks and health hazards is included in this section to aid the reader in understanding the estimated risks and interpreting risk assessment results.

Human health risk assessment characterizes two general kinds of effects separately: 1) potential cancer risks as described by the incremental cancer risk, and 2) potential effects of exposure to hazardous noncarcinogens as described by the hazard index. These two kinds of health effects are evaluated in fundamentally different ways (EPA, 1989a). For example, the health hazards associated with exposure to noncarcinogens such as toluene are considered to have a threshold dose below which there is no adverse effect. Increased doses above the threshold dose lead to increased severity of the effect. Carcinogens such as radiation are considered to have no threshold dose. Thus, any increase in dose leads to increased probability of cancer induction but not to increased cancer severity. Furthermore, cancer risks are considered to be additive. Effects of exposure to hazardous chemicals are also considered to be additive for the same type of human health effect such as kidney damage. However, because cancer risks and systemic toxicity hazards together are not considered to be additive, they are evaluated separately (EPA, 1989b).

Some carcinogens such as carbon tetrachloride also pose a noncarcinogenic hazard, usually at higher doses than are required for cancer induction. These potential hazards are characterized in the same manner as other noncarcinogens. To evaluate the significance of carcinogenic risk, EPA relates calculated incremental cancer risk values to a risk of one excess cancer in a potentially exposed population of one million people. This risk standard is often described as the "one-in-one-million risk," the "ten-to-the-minus-6 risk," or the "10^{-6} risk." Because quantitative risk assessment is one of many factors considered in making remediation decisions, a risk of 10^{-6} does not define the highest risk that can be considered acceptable. EPA specifies that a risk range of "one in one million" up to "one in ten thousand" (10^{-6} to 10^{-4}) can be considered for selection of remediation alternatives (55 Federal Register [FR] 30796).

In evaluating worker exposures to radioactive contaminants, it is appropriate to compare exposures with existing occupational health and safety exposure protection limits. Worker exposures to radiation under normal operations would be controlled under established DOE Orders and SNL/NM standard operating procedures to limit exposures to 5 rems per year and, further, to be at levels that are as low as reasonably achievable (ALARA). Workers whose exposures do not exceed these limits would not be expected to incur any harmful health effects from radiation exposures received during normal operations.

D2.7.1.2 Routine Risk Estimates From ER Project Sites With Characterization Data

Risk estimates for exposure to routine excavation releases were made for the example sites having contaminant concentration data and were projected as similar for comparable sites. Total risks to human health from exposure to contaminants potentially released during excavation of comparable sites were estimated using the risks calculated for the example sites. The estimated incremental cancer risks and hazard indices for each of the example sites were multiplied by the ratio of the total comparable sites' waste volume to that of the example site.

Risks from any individual site were very small ($<2 \times 10^{-7}$) for ER Project workers. Because ER Project site workers would have worn appropriate personal protective equipment, the risk was entirely from direct irradiation. Risks to non-ER Project site workers at other SNL/NM facilities were many thousands of times higher than were risks to members of the population.

The highest estimated risk (to a non-ER Project worker) for each example site plus comparable sites was used to represent the human health risk from routine releases for this EA analysis. Table D2-14 summarizes the total estimated risks to human health from routine releases.

Table D2-14
Total Estimated Risks to Human Health from Routine Releases of Contaminants from Example Sites and Comparable Sites[a]

ER Site Group	Incremental Cancer Risk	Hazard Index[b]
Radioactive Waste Landfill	6.5×10^{-16}	NA
Chemical Waste Landfill	3.3×10^{-8}	0.000012
Waste Disposal Sites Analogous to ER Site 4 (the Liquid Waste Disposal System)	2.7×10^{-7}	0.002
Firing Sites Analogous to ER Site 107 (the Former Explosives Test Area)	1.7×10^{-5}	0.12
Burn Pits Analogous to ER Site 114 (the Explosives Burn Pit)	2.4×10^{-5}	0.17
Septic Systems Analogous to ER Site 165 (the Septic System for Technical Area 2)	2.8×10^{-7}	0.002
TOTAL	4.2×10^{-5}	0.30

[a]Risk estimates were made based on data available at the time of the analysis (IT Corporation, 1994). Use of more recent information does not change conclusions in this analysis.
[b]All of these hazard indices are less than 1.0, meaning there would be no adverse impact.

D2.7.1.3 Risk Estimates from ER Project Sites Without Example Sites

Because no analytical data are available for human health risk evaluation at certain sites that were not considered comparable to one of the example sites, a unit risk estimate was performed to obtain an estimate of potential maximum health impacts from any such site. The sites not considered comparable, termed "orphan sites" for the purpose of this discussion, were ER Sites 7, 30, 38, 81, 98, and 240. Air concentrations of indicator contaminants were assumed to be 1 microgram per cubic meter. Concentrations of contaminated soils were assumed to be 1 milligram (mg)/kg for each of the indicator contaminants.

For an orphan site, the inhalation exposure pathway is the dominant contributor to risk.. The total incremental cancer risk and hazard index values for non-ER Project site workers without respiratory protection were estimated to be 2×10^{-4} and 2.28, respectively. These risks are hypothetical and presented only to demonstrate the magnitude of potential risk. At the time of excavation of any ER site, actual measurements of airborne contaminants would be taken and appropriate measures taken to assure the health and safety of all workers potentially exposed. It is intended that the unit risk approach results in an overestimation of potential risks. Risks to members of the public at off-site locations would be expected to be much lower due to wind dispersion of contaminants. Risks from an "orphan" site are not added to total risks to human health from routine releases because risks are hypothetical.

D2.7.1.4 Incident Free Transportation

On-site transport of untreated waste from excavated sites to a TU and/or CAMU or other treatment facilities and transport of clean waste back to ER Project sites for backfill would result in some environmental and human health impacts. These impacts have been factored into the estimates of air quality and human health impacts discussed in Sections 4.1.4 and 4.1.10, respectively. The total on-site transport distance estimated in Table A-3, Appendix A, to be traveled by waste-hauling trucks directly engaged in ER Project activities is about 79,000 miles (130,000 km).

Additionally, some waste generated by the ER Project may require shipment to permitted disposal areas off site. The exact amounts of waste to be shipped and the disposal sites have not been determined, but for the purpose of evaluating potential environmental impacts, sufficient information is available to put a realistic upper bound on this aspect of the analysis. Parameters important to the analysis of transportation impacts, such as source term information (type and form of hazardous material, concentration, total amount), mix of roadway types, population exposed and total mileage are compared between the SNL/NM ER Project and other similar actions analyzed recently by DOE. Since analyses of transportation impacts typically show very small risks, this comparative approach can readily be used to illustrate the relative magnitude of impacts for this aspect of the program.

For purposes of this comparison, all sites in SNL's ER Project, except the mixed waste landfill, were assumed to be excavated and all of the waste thereby generated was assumed to be shipped off site. Given these conservative assumptions, the ER Project was projected to generate a maximum of 2.2 million cubic feet of LLW and LLMW (this is a subset of the total volume of ER waste shown in Appendix A, Table A-3). The maximum estimate of the shipping distance for this waste was 4.4 million miles.

The Waste Isolation Pilot Plant Supplemental Environmental Impact Statement (WIPP/SEIS) (DOE, 1990) described a shipping campaign to be conducted over 20 years and encompassing about 5.5 million cubic feet of waste, which is at least twice the maximum volumes of low level and mixed waste expected from the ER Project. In the WIPP/SEIS, the shipping campaign with the longest transportation distance was from the Savannah River Site (SRS) to New Mexico, with a prospective 3000 shipments (approximately 4.5 million miles) over twenty years. This campaign resulted in an expected occurrence of 0.01 latent cancer fatalities (LCFs) over the entire campaign. In another example, the Draft Nevada Test Site Environmental Impact Statement (NTS/EIS) (DOE, 1996a) predicted a similar LCF occurrence for the shipping campaign from SRS to the Nevada Test Site (NTS) (approximately 16.5 million miles), of 0.02 LCFs over 10 years.

The Draft Waste Management Programmatic Environmental Impact Statement (WM/PEIS) (DOE, 1996b) also analyzed transportation of LLW and LLMW projected for the entire DOE complex for the next 20 years (a waste volume at least 10 times higher than expected from the ER Project) over 500 million miles. A maximum 9.3 LCF occurrence for the public was predicted. The WM/PEIS (DOE, 1996b) analysis found that the risk from transportation is largely linear, based on a per mile basis (i.e., transportation risk is a function of travel distance).

The programmatic documents discussed above considered low level waste from all sources, including process wastes, which generally contain higher concentrations of radioactive material than ER wastes. For example, the average drum shipped to WIPP was expected to contain $0.5 \times 10^{+2}$ Ci/per drum of radioactive material compared to 8.6×10^{-5} Ci/per drum projected for ER wastes (Brown, 1996).

An additional comparison was made of the LLW generated by the environmental restoration projects at the Fernald Operating Units (OU) 3 and 5. These shipments originated at Fernald, Ohio, and were transported by highway to Envirocare in Clive, Utah. The analyses used for comparison were the Fernald Feasibility Studies (DOE, 1995b and DOE, 1995c) and are considered more directly analogous, except larger in scope, to the SNL/NM ER Project than the DOE programmatic documents. The incident-free impacts and accident risks were estimated using the RADTRAN 4 code. The maximum projected impact from the transportation of OU 3 and 5 wastes was 4.5×10^{-5} LCFs per year.

The risk from transporting LLMW include risk from exposure to the chemical component of the wastes. The health hazards of concern in assessing risk from transportation of chemicals do not include cancer because the only plausible mechanism for exposure of the public is a one-time exposure due to accidents. whereby acute health effects would predominate. Noncarcinogenic health effects are considered to have a threshold dose below which there is no adverse effect. This threshold for evidence of systemic toxicity is assigned a hazard index (HI) of one. An analysis yielding an HI of less than one indicates no significant health effects. In the analyses for LLMW performed in the WIPP/SEIS (DOE, 1990), the assumed concentrations of volatile chemicals were at least as high or higher than the 1 ppm concentrations assumed for the ER LLMW. A high concentration of lead (2.2 gm per drum) was assumed for the WIPP analysis. The analyses of all considered shipping campaigns in the WIPP/SEIS (DOE, 1990) yielded an HI from chemical exposure at least one hundred times less than one.

The impacts from a proposed SNL/NM ER Project shipping campaign would be well below the impacts determined by analyses in the WIPP/SEIS (DOE, 1990), the NTS/EIS (DOE, 1996a), and the WM/PEIS (DOE, 1996b) documents because the volumes proposed to be shipped are smaller, the source term is smaller, and the distances to be shipped are shorter. Therefore, transportation of relatively small volumes of waste expected from SNL/NM ER Project are projected to have negligible LCF and other health impacts based on the comparison with analyses of transport of the LLW and LLMW generated by the entire DOE complex over several decades.

D2.7.2 Human Health Consequences of Radionuclide and Hazardous Chemical Releases from Accidents and Abnormal Events

This section briefly describes the estimated potential health risks associated with accidents and abnormal events at ER Project sites. As with risk assessments of routine operations, the estimations follow regulatory guidance that employs a health-protective bias leading to an overestimation of the risks (EPA, 1989a).

Accident analysis addresses events that might not occur but are "reasonably foreseeable." Under the Council on Environmental Quality regulations in 40 CFR 1502.22, "reasonably foreseeable" includes "impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis . . . is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason."

A spectrum of potential accident and abnormal event scenarios could occur during construction, operation, or transportation activities anticipated for the proposed corrective actions. The accident scenarios chosen are limited to those that can reasonably be analyzed by scientifically credible methods. An accident with a potentially major impact on one group (e.g., ER Project workers) but with relatively minor or inconsequential effects on another group (e.g., the general public) was considered using the sliding-scale approach. An injury to a forklift operator is an example of such an accident.

D2.7.2.1 Waste Handling and Treatment Operations Spills

Table D2-15 summarizes the cancer risks estimated for contaminants released from waste-handling accidents involving dropping a container of untreated waste or spills during storage/treatment operations. Non-ER Project workers encounter the maximum cancer risk from waste-handling operations. This is true even though the estimated risk to the individual ER Project worker involved in waste handling is larger than the risk to the individual non-ER Project worker. However, the number of ER Project workers (6) assumed to be directly involved in the accident is smaller than the number of non-ER Project workers (60) potentially exposed. Therefore, the total risks estimated for the two groups are similar. Likewise, the risk to 1,000 members of the general public is similar to the risks to the other potentially exposed groups, although the risk to an individual member of the public is much lower than that for other groups. These estimated cancer risks are dominated by potential exposure to hexavalent chromium and were overestimated under the assumption that all chromium present is in the carcinogenic hexavalent state. Nevertheless, the overall cancer risk to the three population groups including contribution from direct radiation exposure and contaminant inhalation from waste-handling accidents is less than 1×10^{-5}.

As shown in Table D2-16, exposure to non-carcinogens during waste-handling and treatment/storage operations spills are all very much less than unity, indicating no systemic toxicity risks.

D2.7.2.2 Transportation

Tables D2-15 and D2-16 summarize the estimated cancer risks from contaminants released during transportation accidents involving a one- or two-vehicle accident in which untreated waste is released. The risk of cancer from accidental exposure involving untreated waste transportation accidents is somewhat similar for all three potential exposure groups. The number of ER Project workers potentially affected in waste transportation accidents was assumed to be two, and the number of other workers at SNL/NM potentially involved was assumed to be 20. The risk to the general public was calculated per 1,000 people. As above, these risks were overestimated according to the assumption that all chromium present is in the carcinogenic hexavalent state. The overall cancer risk to the three population groups from transportation accidents including contribution from direct radiation exposure and contaminant inhalation is less than 2×10^{-5}, and there is no systemic toxicity risk.

D2.7.2.3 Treatment Explosion/Fire

Cancer risks were estimated for exposure to contaminants released from a small-scale explosion or fire in the treatment plant. Tables D2-15 and D2-16 summarize these risks. As shown in Table D2-15, the estimated risks to all of the potentially exposed groups are dominated by risks from transportation accidents. As can be seen from the tables, cancer risk to the three population groups including contribution from direct radiation exposure and contaminant inhalation from accidents during treatment is less than 1×10^{-7}, and there is no systemic toxicity risk.

D2.7.2.4 Abnormal Events

Cancer risks were estimated for exposure to contaminants released from an aircraft's crashing directly into the treatment plant or from a natural catastrophic event that similarly releases the entire daily inventory of waste to be treated. For ER Project workers at the treatment plant, estimated cancer risks were compared to a risk of injury or a fatality directly resulting from an accident rather than a release. For non-ER Project workers, the estimated cancer risks for exposure resulting from an aircraft crash were less than the risks associated with routine excavation or waste treatment operations. These risks were reduced by the low probability of an aircraft crashing directly into the treatment plant, approximately 1×10^{-7} to 1×10^{-8}. Risks estimated for this accident scenario were also assumed to apply to an aircraft crashing into a storage facility. Because risks associated with releases following an aircraft crash are very small compared to the risks from routine operations, these accidental releases risks were not considered further, consistent with the "sliding-scale" approach (DOE, 1993).

The total hazard index for releases associated with all accident scenarios was estimated at less than 1×10^{-5}, well below the hazard index of 1.0 associated with systemic toxicity. Because the estimated hazard index is inconsequential compared to the risk of accidental injury or fatality, the risk of systemic toxicity from exposure to contaminants in an accident is also very small compared to a nonrelease-related risk of injury or a fatality in the same accident. Therefore, systemic toxicity from accidental exposure is not discussed further.

D2.7.3 Occupational Fatalities and Injuries from Accidents and Abnormal Events Not Involving Contaminant Releases

Certain types of accidents associated with corrective measures undertaken at ER Project sites are expected to cause injuries to workers but not to involve contaminant releases. Although these risks do not reflect exposure to contamination, they are, nevertheless, associated with the decision to perform corrective measures. These occupational risks include:

- Traffic accidents associated with ER Project activities, including ER Project workers and other workers at SNL/NM.
- Occupational accidents associated with general waste-handling operations (e.g., forklift accidents) but not including heavy equipment operations.
- Occupational accidents associated with heavy equipment operations during excavation.
- Occupational accidents associated with construction, maintenance, decontamination and demolition, and closure at a CAMU and the treatment plant.

Estimated risks of accidental fatalities and injures associated with corrective measures operations are summarized in Table D2-17. Risks of transportation accident injuries dominate the total risk of corrective measures injuries, followed by risks of heavy equipment and waste-handling injuries. Risk of injuries from construction and aircraft crashes were smaller, although they were still larger than risks of exposure to contaminants released by the accidents. These accident risks are comparable to risks estimated for routine excavation operations (see Table D2-14) or risks from taking no action at ER Project sites (see Table D2-18).

Table D2-15
Total Incremental Cancer Risks to Human Health from Accidental Releases of Carcinogens[a]

	Population Group		
Accident Type	Incremental Cancer Risk ER Project Site Worker	Incremental Cancer Risk Non-ER Project Site Worker	Incremental Cancer Risk General Public (per 1,000 people)
Transportation	6.5×10^{-6}	8.2×10^{-6}	4.9×10^{-7}
Waste handling or treatment operations spills	9.4×10^{-7}	1.4×10^{-6}	2.3×10^{-8}
Explosion/fire during treatment	2.0×10^{-8}	3.0×10^{-8}	5.0×10^{-10}
Airplane crash	Very small relative injury or fatality risk (Table D2-17)	Very small relative to routine releases (Table D2-14)	Very small relative to routine releases (Table D2-14)
Total cancer risk from all events	7.5×10^{-6}	9.6×10^{-6}	5.1×10^{-7}
Cumulative risk to all exposure groups from all events	1.8×10^{-5}		

[a]Risk estimates were made based on data available at the time of the analysis (IT Corporation, 1994). Use of more recent information does not change conclusions in this analysis.

Table D2-16
Total Hazards to Human Health from Accidental Releases of Noncarcinogens[a]

	Population Group		
Accident Type	Hazard Index ER Project Site Worker	Hazard Index Non-ER Project Site Worker	Hazard Index General Public (per 1,000 people)
Heavy Equipment (excavation)	Very small relative to routine releases (Table 4-3)	Very small relative to routine releases (Table 4-3)	Very small relative to routine releases (Table 4-3)
Transportation	4.9×10^{-6}	7.4×10^{-7}	7.4×10^{-10}
Treatment/waste handling	1.3×10^{-6}	1.8×10^{-10}	2.0×10^{-10}
Explosion/fire during treatment	1.7×10^{-7}	2.5×10^{-7}	4.2×10^{-9}
Airplane crash	Very small relative to injury or fatality risk (Table D2-17)	Very small relative to routine releases (Table D2-14)	Very small relative to routine releases (Table D2-14)
Total hazard index from all events	6.4×10^{-6}	9.9×10^{-7}	5.1×10^{-9}
Total hazard index for all exposure groups from all events	7.4×10^{-6}		

[a]Risk estimates were made based on data available at the time of the analysis (IT Corporation, 1994). Use of more recent information does not change conclusions in this analysis.

Estimated risks of transportation accident fatalities also dominate the total risk of corrective measures fatalities, followed by waste-handling and heavy-equipment accident fatalities (see Table D2-17). Estimated risk of fatalities from construction and aircraft crashes were smaller but were still larger than risks of exposure to contaminants released by the accidents. The latter risks are also comparable to risks estimated for routine excavation operations (see Table D2-14) or risks from taking no action at ER Project sites (see Table D2-18).

D2.7.4 Human Health Consequences from the No Action Alternative

To assess the short-term risks associated with the no action alternative, it was assumed that current waste management practices would continue without modification and that existing environmental monitoring measurements would reflect future contaminant levels. Although the baseline risk includes other sources of contaminants, "No action" means that no ER Project would be undertaken and that the risks would be the same as those currently incurred. Data on contaminants in soil reported in the SNL/NM Environmental Monitoring Report were used to assess potential baseline risks. These data are summarized in Table D2-18.

Soil concentrations for the indicator contaminants were reported for four groups of sites. The first two were on-site locations in the tech areas. The second two were at perimeter and off-site locations.

Risk estimates based on on-site sample data reflect potential exposures of workers at the tech areas. Estimates based on perimeter or off-site measurements were used to represent potential health risks from contaminant exposure from various sources to residents in the surrounding community or to the general public. There are no known incidents of accidental releases from undisturbed ER Project sites. The analysis in this EA assumes that current practices would continue and that such accidental releases would not be reasonable or foreseeable.

Long-term risks specifically associated with the no action alternative were not evaluated due to the lack of necessary site-specific characterization information and the inability to project specific air and ground-water migration pathways to long-term future receptors.

Table D2-18 summarizes the estimated baseline risks associated with taking no action at ER Project sites. Risks were estimated for workers at SNL/NM Tech Areas I through V, for residents at the SNL/NM perimeter, and for residents outside the SNL/NM site. These risks, estimated for exposure to indicator contaminants from continued current operations (i.e., the no action alternative) and other metropolitan contaminant sources, are comparable to or greater than risks associated with corrective measures at the ER Project sites. However, the risks from taking no action are substantially lower than the risks of injury or fatality from corrective measures (see Table D2-19). No industrial accidents were considered for ER Project sites associated with the no action alternative. Other site workers and members of the public could be exposed through inhalation of dispersed contaminants.

Table D2-17

Total Accidents Probable from Environmental Restoration Projects[a] Site Worker Injuries and Fatalities Not Associated with Contaminant Releases

Accident Type	Statistically Probable Accidents During 10-Year ER Project Duration
Heavy equipment fatality	1.6×10^{-1}
Heavy equipment injury	7.9×10^{-1}
Transportation fatality	6.2×10^{-1}
Transportation injury	6.2
Waste handling fatality	3.2×10^{-1}
Waste handling injury	1.4
Construction fatality	1.6×10^{-5}
Construction injury	7.0×10^{-4}
Explosion/fire fatality during waste treatment	Assumed similar to or less than fatality from airplane crash
Explosion/fire injury during waste treatment	Assumed similar to or less than injury from airplane crash
Aircraft crash fatality	6.0×10^{-4}
Aircraft crash injury	1.2×10^{-4}
Total fatality risk from all events	1.1
Total injury risk from all events	8.4

[a] Risk estimates were made based on data available at the time of the analysis (IT Corporation, 1994). Use of more recent information does not change conclusions in this analysis.

Table D2-18
Risks to Human Health Associated with Environmental Restoration Project Site, Current Sandia National Laboratories/New Mexico Operations Releases, and Other *Metropolitan Contaminant Sources Under the No Action Alternative*[a]

	Health Effect	
Population Group	Incremental Cancer Risk	Hazard Index
Tech Area I, II, IV Workers[b]	8.99×10^{-6}	2.94×10^{-3}
Tech Area III, V Workers[b]	9.65×10^{-6}	3.16×10^{-3}
General public at the perimeter (adults)	2.25×10^{-5}	7.51×10^{-3}
General public at the perimeter (children)	1.71×10^{-4}	5.88×10^{-2}
General public off site (adults)	3.02×10^{-5}	9.99×10^{-3}
General public off site (children)	2.31×10^{-4}	7.82×10^{-2}
TOTAL (adults)	7.13×10^{-5}	2.36×10^{-2}
TOTAL (children)	4.02×10^{-4}	1.37×10^{-1}
Grand Total (rounded)	4.7×10^{-4}	1.6×10^{-1}

[a]Based on contaminant concentration measurements reported (Culp et al. 1994).
[b]*These data were reported for these Tech Areas separately (Culp et al. 1994).*
Reference:

Culp, T., C. Cheng, W. Cox, N. Durand, M. Irwin, A. Jones, F. Lauffer, M. Lincoln, Y. McClellan, K. Molley, and T. Wolff, 1994. "1993 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND94-1293-UC-630, Sandia National Laboratories, Albuquerque, New Mexico.

D2.8 ECOLOGICAL EFFECTS OF RADIOLOGICAL AND HAZARDOUS CHEMICAL RELEASES

Airborne releases of contaminants during routine corrective measure operations and subsequent deposition would result in exposures to plant and animal receptors. This section discusses the potential for other adverse impacts from such exposures to natural populations of plants and wildlife at and around KAFB. The impacts considered are based primarily on toxic effects to individual organisms, although the potential for broader effects at the population, community, and ecosystem levels are discussed. Of particular significance are the potential effects on sensitive species of plants that have been identified in the areas of the ER Project sites. It is recognized that the proposed action might also entail the physical disturbance of habitat that could result in adverse effects to populations of plants and wildlife. These impacts are not included in this assessment of contaminant releases.

The general approach used in this assessment was to derive benchmarks for soil concentrations of indicator contaminants in the natural environment at KAFB that are estimated to be protective of biotic resources. These benchmarks were then compared to predicted soil concentrations in excess of the background level that would derive from the yearly deposition of the contaminants for each of the site groups. Potential impacts to natural populations adjacent to the point of release were assessed based on this comparison.

Many of the assumptions used in modeling human health risk were maintained in this assessment. For example, it was assumed that the site types can be used to evaluate all ER Project sites of those types, regardless of their actual location. It was also assumed that each operation would be conducted over a period of one year and that the effects of that operation would not be influenced by other operations that might be occurring simultaneously. Finally, the contaminants evaluated in this assessment are the same indicator contaminants as are used in the human-health risk assessment.

D2.8.1 Relating Releases to Ecological Effects

D2.8.1.1 Plant and Wildlife Benchmarks for Soil Concentrations

Plant toxicity benchmarks for chemical concentrations in soil were primarily taken from Suter et al. (1993). These were based on a threshold of a 20-percent reduction in growth of a variety of test species (mostly agricultural). Because very little information is available on the toxicity of the indicator contaminants to wild plants, it is assumed that these benchmarks are applicable to all plant species on KAFB. The dominance of grasses, legumes, and composites in the vegetation of KAFB support this assumption, because these families of plants are commonly used as test plants. Essentially, no information is available on the toxic responses of members of the cactus family to the indicator contaminants. It is assumed that cacti and (therefore) the three species of state-protected cacti known to occur at KAFB are also protected under these benchmark concentrations, despite their differences in morphology and physiology.

Table D2-19
Summary of Risks to Human Health from
the Sandia National Laboratories/New Mexico
Environmental Restoration Project for Proposed Action and No Action Alternative[a]

	Health Effect				
ER Project Alternative	Total Incremental Cancer Risk[b]	Hazard Index[c]	Injury	Fatality	Appendix D2, Table
Corrective measures, routine operations releases	4.2×10^{-5} [d]	3.0×10^{-1}	—	—	D2-14
Corrective measures, accidental releases	1.8×10^{-5}	7.4×10^{-6}	—	—	D2-15, D2-16
Corrective measures, accidents	Not applicable	Not applicable	1.1	8.4	D2-17
Summary Proposed Action Impacts	1.0×10^{-4}	3.0×10^{-1}	1.1	8.4	D2-19
No action	4.7×10^{-4}	1.6×10^{-1}	0	0	D2-18

[a]Risk estimates were made based on data available at the time of the analysis (IT Corporation, 1994). Use of more recent information does not change conclusions in this analysis.

[b]U.S. Environmental Protection Agency acceptable range 10^{-4} to 10^{-6} (55 FR 30796).

[c]U.S. Environmental Protection Agency acceptable threshold hazard index <1.

[d]If the assumed volatile organic compounds contribution is eliminated, the incremental cancer risk would be 7.5×10^{-7}.

Wildlife toxicity benchmarks were based on the no observed adverse effect level (NOAEL) for chronic oral intake of the contaminant by a small rodent. The species of rodent was not specified because the species exposed will vary between affected habitats. The assumed weight of the rodent (16 grams) was selected to fit the ranges of several common species at KAFB, including the rock pocket mouse (*Perognathus intermedius*), the deer mouse (*Peromyscus maniculatus*), and the western harvest mouse (*Reithrodontomys megalotis*). It was assumed that the rodent receives its exposure to the contaminant by the ingestion of plant material in a uniformly contaminated home range. A small rodent was used to represent all other classes of wildlife for the following reasons:

- Rodents are year-round residents in relatively small areas that can be assumed to be uniformly contaminated. Larger animals and those capable of flight are more likely to move between areas of different contamination levels.

  Rodents have a higher metabolic rate per unit of body weight than larger species and poikilothermic ("cold-blooded") species and will have a greater exposure due to their higher food requirement.

- The use of mice and rats as laboratory test species has resulted in a large data base of toxicity information for this order of mammals.

NOAEL values for chronic oral exposure of a small mammal to the indicator contaminants were based on toxicity information gleaned from electronic databases and the open literature. Because this information is often available only for other species or is reported as toxicity endpoints other than NOAELs, the reported values were converted to the desired NOAELs for the desired species.

D2.8.1.2 Conversion of Deposition Amounts to Soil Concentrations

The principal releases of contaminants from ER Project site operations are expected to be through the airborne dispersal of dust and vapors and their ultimate deposition in the surrounding environment. For assessing the potential impacts of this deposition to surrounding plants and wildlife, the deposition amount, summed over a year, was converted to soil concentration units. This was done by making the following assumptions:

- Contaminants deposited on other surfaces (e.g., leaves, litter, stones, etc.) would be washed to the soil surface by rainfall.
- Contaminants deposited on the surface of the soil would migrate or be leached to a depth not exceeding 4 inches (10 cm) in a year.
- The density of the soil is 93 pounds per cubic foot (1.5 grams per cubic cm).

Based on these assumptions, a square meter of soil surface represents 3.5 cubic feet (99,000 cubic cm) of potentially contaminated soil volume, or 330 pounds (150 kg) of potentially contaminated soil. Therefore, the aerial deposition of 1 mg/m^2 of a contaminant over a year is equal to 1 mg per 150 kg, or 0.007 mg/kg of the contaminant averaged at the top 4 inches (10 cm) of soil. Table D2-20 shows the benchmark concentrations used in this risk assessment.

D2.8.1.3 Comparisons of Benchmarks to Modeled Contaminant Releases

The potential yearly deposition of contaminated dust from excavations at the specific ER Project sites of operations was modeled as for human exposure assessment. In all cases, the nearest modeled concentration contour to the site was generally within a 1-mile (1.6 kilometer) radius of the site. Soil concentrations resulting from the depositions at this nearest contour around the four sites were calculated. The highest modeled contaminant concentrations on this contour at each of the four site groups are as follows:

- Surface impoundment analogies (ER Site 4)—5.6×10^{-12} mg/kg cadmium.
- Firing site analogies (ER Site 107)—5.3×10^{-11} mg/kg lead.
- Burn pit analogies (ER Site 114)—3.3×10^{-11} mg/kg lead.
- Septic system analogies (ER Site 165)—9.2×10^{-13} mg/kg chromium.

After comparing these values to the benchmark toxicity values, it is evident that the addition of contaminants at these levels would have no effect on the plants and wildlife beyond the effect from background levels. The fact that these modeled concentrations are more than ten billion times below their respective benchmark values leads to the conclusion that the radius of potential adverse ecological effects around the site of operations is much less than 1.6 km. It is unlikely that these benchmark values would be exceeded beyond the area of physical habitat disturbance (see Section 4.1.5) surrounding the site of operations.

With regard to gamma-emitting radionuclides (e.g., cesium-137), concentrations resulting from the aerial dispersal of contaminated dust at the modeled rates are unlikely to result in dose rates exceeding 0.1 rad per day to surrounding plant and wildlife communities. In other words, the NOAELs would be achieved.

D2.8.2 Potential Effects of Airborne Releases to Plants and Wildlife

Based on the magnitude of the difference between the maximum modeled soil concentrations and the benchmark toxicity values for plants and wildlife, it was concluded that no ecological effects are expected to occur from airborne releases beyond a short distance from the operation, if at all. This conclusion is further supported by the fact that the benchmark values were conservatively estimated to be protective of individual organisms. Exceeding these benchmark values indicates that some individual organisms might be adversely affected by the contaminant. This would be of concern if the area contained populations of sensitive species.

Table D2-20
Ecological Benchmark Toxicity Values for Sandia National Laboratories/New Mexico

Contaminant	Phytotoxicity Benchmark Screening Value mg/kg in soil (dry weight)[a]	Wildlife Benchmark Screening Value mg/kg in soil (dry weight)[b]
Organic Contaminants		
Benzene	NA	1.69
Carbon tetrachloride	NA	0.122
Polychlorinated biphenyl	40	8.93
Toluene	200	31.8
Trichloroethene	NA	63.0
Xylene	NA	1,320
Inorganic Contaminants		
Arsenic	10	1.62
Beryllium	10	83.5
Cadmium	2	0.590
Chromium	2	493
Lead	50	26.8
Mercury	0.3	0.0413
Explosives and Residues		
Homo-cyclonite (HMX)	NA	NA
Cyclonite (RDX)	NA	0.0371
Trinitrotoluene (TNT)	NA	0.131
Radionuclides		
Cesium-137[c]	0.1 rad/day	0.1 rad/day
Uranium-235	NA	NA

[a]Values obtained from Suter et al., 1993. (Twenty-percent reduction in growth or yield was used as the threshold for significant effects.)
[b]Wildlife benchmark toxicity values are based on an herbivorous mouse (ppm equals mg/kg).
[c]Benchmark value for cesium-137 is based on a total dose rate that is protective of terrestrial communities.
NA = Not applicable
mg/kg = milligram per kilogram

Reference:
Suter, G.W., II, M.E. Will, and C. Evans, 1993. "Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants," ES/ER/TM-85, Oak Ridge National Laboratories, Oak Ridge, Tennessee.

Typically, however, soil concentrations greater than individual-based benchmarks are required to produce observable effects at the population, community, and higher levels of organization.

D2.9 SUMMARY OF HUMAN HEALTH AND ENVIRONMENTAL RISKS FOR THE ER PROJECT

D2.9.1 Human Health Impacts of the ER Project

Except for the Chemical Waste Landfill (ER Site 74), data available for the example sites do not indicate that VOCs were present. Based on historical information and process knowledge, however, VOCs were known or suspected to be present at many sites. It is likely that VOCs that may have been present were not detected because they had already volatilized. For the purpose of the EA analysis, VOCs were conservatively assumed to be present in order to estimate the upper end of potential cumulative impacts. Each indicator was assigned an average unit risk concentration of one part per billion. If this risk contribution from assumed concentrations of VOCs were not considered, the cumulative routine release incremental cancer risk risks would be lower by a factor of about 200, or in the range of 7.5×10^{-7}.

The greatest contributor to the human health impacts of alternative ER Project measures was estimated to be accidental injuries and fatalities associated with corrective measures operations (see Table D2-19). The incremental cancer risk for adults and children associated with the no action alternative was estimated to be somewhat greater than the incremental cancer risk for routine corrective measures operations. However, it should be noted that this risk estimate is actually a baseline risk because it is based on measured environmental concentrations that include contributions from operational releases, contaminants at ER Project sites, and contaminants from other metropolitan sources. When risks from corrective measures accidents were included, however, both the cancer risks from taking no action and from implementing routine corrective measures were far less than the total risk of at least one fatality and nine lost-time accidents occurring during corrective measures.

The total estimated hazard index to all potential exposure groups was less than 1.0. As a result, no systemic toxicity is expected for either the no action alternative or the proposed corrective measure.

D2.9.2 Ecological Impacts of ER Project Alternatives

There would be no anticipated ecological impact from contaminants released from ER Project corrective measures (see Section D2.8).

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