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Site Selection Study for Sandia National Laboratories/New Mexico as an Alternative Site for the National Ignition Facility

Dennis Miller, Timothy Wheeler, Yvonne McClellan

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Abstract

This report documents the results of an assessment to select a preferred site for a proposed National Ignition Facility at Sandia National Laboratories/New Mexico. Sandia National Laboratories/New Mexico is one of the alternative sites for this facility which is proposed as part of the U.S. Department of Energy's Stockpile Stewardship and Management program. Candidate sites were evaluated in a two-step process. In the first step, sites were screened against pass/fail criteria to identify acceptable and unacceptable sites. The criteria were based on specific fundamental siting requirements for the National Ignition Facility. In the second phase all acceptable sites were evaluated with respect to site requirements and operational issues that established relative cost differentials associated with siting the National Ignition Facility in each of the candidate sites identified from the first step. All candidate sites met the fundamental siting requirements. A preferred site was selected on the basis of the cost differential analysis of the second step. The preferred site for the National Ignition Facility is a 27-acre tract of land in Technical Area II immediately north of and adjacent to Technical Area IV.

Acknowledgments

The authors acknowledge the contributions of Roger Jones, Gilbert Aldaz, and Orlando Trujillo of the SNL/NM Site Utilities Engineering Department 7909 for utilities and roadway improvement cost estimates provided for the various candidate sites presented in this report.

Contents

Figures

Tables

Nomenclature

AGEX	Above Ground Experimental
DoD	Department of Defense
DOE	Department of Energy
ICF	Inertial Confinement Fusion
IEEE	Institute of Electrical and Electronics Engineers
KAFB	Kirtland Air Force Base
LLNL	Lawrence Livermore National Laboratory
LTAB	Laser and Target Area Building
NEPA	National Environmental Policy Act
NIF	National Ignition Facility
NTS	Nevada Test Site
PBFA	Particle Beam Fusion Accelerator-II
PEIS	Programmatic Environmental Impact Statement
SNL/NM	Sandia National Laboratories/New Mexico
SSM	Stockpile Stewardship and Management
TA	Technical Area
TIOC	Technical Information and Outreach Center
USAF	United States Air Force

Abbreviations

ac	acre
ft	foot
gal	gallon
hr	hour
km	kilometers
kV	kilovolt
kW	kilowatt
m	meters
min	minute
MVA	mega volt amp
MW	megawatts
psig	pounds per square inch gauge
thm	therm
yr	year

Executive Summary

This study documents the process and results of a site selection study to identify a preferred site for the National Ignition Facility (NIF) at Sandia National Laboratories in Albuquerque, New Mexico (SNL/NM). This siting report supports the Department of Energy's Stockpile Stewardship and Management (SSM) Programmatic Environmental Impact Statement (PEIS) in which four alternative locations are evaluated for the NIF: Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Test Site, and Sandia National Laboratories/New Mexico (SNL/NM). The U.S. Department of Energy (DOE) proposes to construct and operate the NIF at one of these locations.

The goal of the NIF is to produce ignition and energy gain in Inertial Confinement Fusion (ICF) targets and perform high-energy-density and radiation-effects experiments in support of national security and civilian objectives. Achieving these goals will maintain U.S. world leadership in ICF and will directly contribute to DOE's National Security, Science and Technology, Energy Resources, and Industrial Competitiveness missions.

Eleven candidate sites that met basic requirements for a NIF were identified at SNL/NM. These eleven sites meet the minimum land space requirements for NIF. These sites also satisfy mandatory environmental requirements developed as part of the site selection process. Of the available sites, two are in Technical Area I (TA-I), two are in TA-II, and seven are in the remote TA-III site (see Table ES-1).

Table ES-1. Candidate Sites for the National Ignition Facility

Site Number	Description of Location	Tech Area	Size (Acres)	Shortest Length (ft)	Longest Length (ft)
1	O Street and Twentieth	I	22.4	721	1,246
2	Twentieth Street between H and O	I	18.4	683	835
3	Twentieth Street South of O Street	II	13.1	419	952
4	Ninth Street and Q Street	II	27.5	922	1,685
5	South Central Tech Area III	III	24.6	746	1,483
6	South Central Tech Area III	III	26.5	522	1,339
7	South Central Tech Area III	III	18.8	550	1,576
8	South Central Tech Area III	III	29.2	323	1,842
9	Central Tech Area III	III	34.8	597	1,609
10	South East Tech Area III	III	31.8	830	2,006
11	South East Tech Area III	III	40	345	2,183

Since the candidate sites meet fundamental criteria such as site size, minimal or no potential natural phenomena effects, and requisite environmental and safety

considerations, hazards associated with the NIF operations as well as potential hazards directed at the NIF from other activities were not factors in the selection of a preferred site. The key discriminators that establish a perspective from which to differentiate the candidate sites are personnel costs (security personnel and intersite transit costs) and the costs to provide adequate site utilities (electricity, water, sewer, natural gas, etc.) and infrastructure (roads, buildings, support functions, etc.). Many of the major capital costs associated with constructing the NIF are approximately equal for all of the SNL/NM candidate sites and, therefore, are not useful as cost discriminators.

The preferred site location at SNL/NM for the NIF is Site 4 in TA-II at Ninth Street and Q Street (see Table E-1). There are a number of recognizable benefits associated with this site: it is adjacent to facilities and support staff in technologically similar areas; close in proximity to utility distribution facilities with adequate capacity; close in proximity to support facilities; and TA-IV facilities and personnel can be easily shared. The other sites, while technically acceptable, lack these inherent advantages. In addition, relative to the other candidate sites, Site 4 requires the least amount of upgrade to facilities and infrastructure to meet the needs of the NIF program.

Site Selection Study for Sandia National Laboratories/New Mexico as an Alternative Site for the National Ignition Facility

1.0 Introduction

The Department of Energy (DOE) proposes to construct and operate the National Ignition Facility (NIF) in support of the Stockpile Stewardship and Management (SSM) Programmatic Environmental Impact Statement (PEIS). The National Environmental Policy Act requires the DOE to look at alternative sites for the NIF. The SSM PEIS will evaluate four alternative locations for the NIF: Lawrence Livermore Laboratory (LLNL); Los Alamos National Laboratory (LANL); the National Test Site (NTS); and Sandia National Laboratories/New Mexico (SNL/NM). This study documents the process and results of a site selection study for a preferred site for the NIF at SNL/NM.

The NIF research objectives are to provide the world's most powerful laser systems to be used in ignition of fusion fuel and energy gain to perform high energy density and radiation effects experiments in support of the DOE's national security, energy, and basic science research mission. The most immediate application of the NIF will be to provide nuclear-weapon-related physics data, since many phenomena occurring on the laboratory scale are similar to those that occur in weapons. The NIF may also provide an important capability for weapons effects simulation. The NIF is designed to achieve propagating fusion burn and modest energy gain for development as a source of civilian energy. This project was endorsed by the Secretary of Energy, the DOE's Fusion Policy Advisory Committee, and the National Academy of Sciences Inertial Fusion Review Group.

The NIF Site Requirements (LLNL 1994a) document provides requirements based on federal regulations, building code operations and safety requirements, and protection of the workers, public, and the environment. The NIF Site requirements cover the following areas (also see Appendix A):

- Appropriate DOE Orders, federal, state, and local regulations;
- IEEE 293 Recommended Practice for Design of Reliable Industrial and Commercial Power Systems, ANSI C2;
- NFPA 70, National Fire Protection Code;
- Physical Characteristics;
- Environmentally Sensitive Areas;
- Site Roads and Parking Areas;
- Transportation Network;
- Site Utilities;
- Security;
- Recovery Events; and
- Support Buildings and Special Equipment.

These site requirements were used to develop a three-step site selection process: 1) a survey of available plots of land to identify candidate sites at SNL/NM; 2) an initial site evaluation using regulatory pass/fail criteria that accounted for environmental and safety concerns; and 3) a costing discriminator criteria to evaluate each candidate site at SNL/NM. These criteria were developed on the basis of both the NIF requirements and factors specific to the infrastructure at SNL/NM. The pass/fail criteria were based on specific NIF requirements to which absolute compliance is required (see Section 2.1 for discussion). No reasonable expenditure of resources could bring non-compliant sites into conformance. The costing discriminators were developed to determine the relative difference in cost associated with locating, building, and operating the NIF facility at each site that successfully passed the second step. The cost discriminator criteria were divided into three categories: 1) General - physical and operational aspects of siting the NIF (Section 2.2.1); 2) Utilities - focusing directly on the infrastructure required to meet NIF operational requirements (Section 2.2.2); and 3) Support Services - based on the cost to provide the necessary NIF support services for each candidate site (Section 2.2.3). A preferred site for the NIF was then identified based on the evaluation.

1.1 Background

On June, 14, 1995, the DOE announced, in the Federal Register at 60 FR 31291, its intent to prepare a Programmatic Environmental Impact Statement (PEIS) for the Stockpile Stewardship and Management (SSM) Program. The SSM PEIS includes a programmatic assessment and a site specific assessment of the construction and operation impacts of the National Ignition Facility (NIF) at alternative candidate sites. SNL/NM was identified as an alternative site for the NIF facility in the Federal Register announcement.

The NIF, proposed by the DOE Office of Inertial Confinement Fusion (ICF), will be a key element in the DOE's aboveground experimental (AGEX) capabilities for maintaining nuclear competence and weapons effects simulation. In the absence of underground nuclear testing, assuring the nation's nuclear competence is dependent upon analysis and above ground experiments to evaluate the environment and effects of x-rays on materials, electronics, and weapons subsystems, and to address other weapons issues.

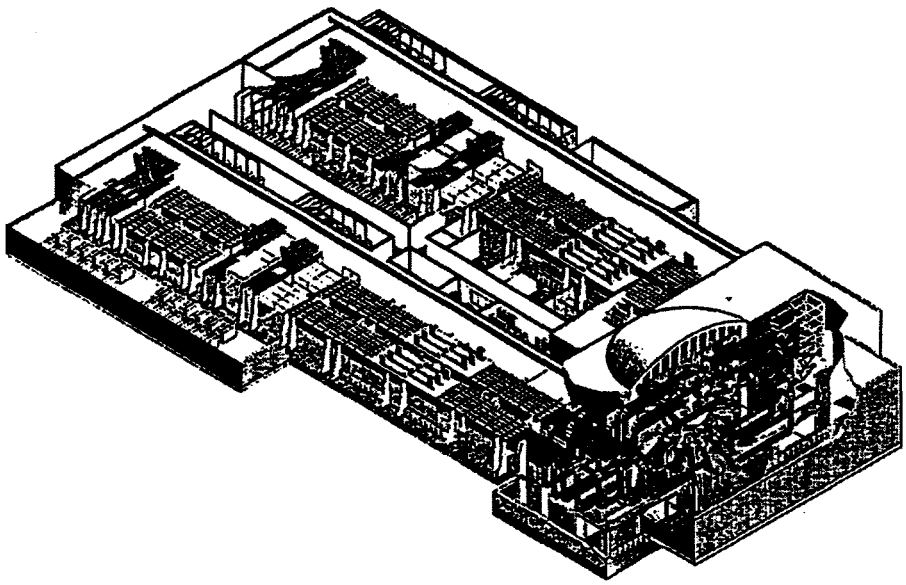
The conceptual design for the NIF has been prepared and documented by a multi-laboratory team within the Department of Energy's National Inertial Confinement Fusion Program (LLNL, 1994b). The team included personnel from LLNL, SNL/NM, and the University of Rochester Laboratory for Laser Energetics. Facility specifications and site requirements for the NIF are documented in the NIF site requirements document (LLNL, 1994a). The minimum land use requirements for the primary NIF facility, the Laser and Target Area Building (LTAB), the central support services, and ancillary support services are listed in Table 1-1.

In Figure 1-1 the proposed NIF LTAB is illustrated.

Table 1-1. Summary of NIF Facility Requirements

Building	Building Size
Laser and Target Area Building (LTAB)	
Laser Bays	63,480 ft^2
Target Area	16,000 ft^2
LTAB Footprint	500 ft x 375 ft
Central Support Buildings	
Offices	80,000 ft^2
Target Receiving Area	15,000 ft^2
Target Assembly Area	22,000 ft^2
General Assembly Area	30,000 ft^2
Optics Maintenance	40,000 ft^2
Optics Storage	20,000 ft^2
Warehouse	30,000 ft^2
Ancillary Support Services	
Electrical/Mechanical Shops	12,000 ft^2
Shipping/Receiving	14,000 ft^2
Medical Building	7,500 ft^2
Cafeteria	8,000 ft^2
Garage/Gas Station	5,000 ft^2
Fire Station	18,750 ft^2
Security/Badging	1,200 ft^2

Figure 1-1. Conceptual Design of the NIF Laser and Target Area Building



1.2 Current SNL/NM ICF Programs

The SNL/NM light ion ICF program has provided direct benefit to the DOE Defense Programs mission since the early 1970s. The SNL/NM ICF program is part of a national collaborative ICF program involving the three DOE nuclear weapons laboratories, as well as the Naval Research Laboratory, the University of Rochester Laboratory for Laser Energetics, and General Atomics Corporation.

The principle objective of the current light ion ICF program at SNL/NM is to develop the technology required to demonstrate high yield from a fusion capsule for application to weapons effects, weapons physics, and energy production. The primary experimental facilities used for light ion ICF research at SNL/NM are the Particle Beam Fusion Accelerator-II (PBFA-II) and SATURN accelerator.

The technology demands of the ICF program have led to advances in energy storage devices, pulse forming components, high power switching technology, and magnetically insulated transmission lines. This program has also driven the development of new x-ray and particle diagnostics and computer codes to explore the physics of radiation/hydro-dynamics, intense particle beams, and plasmas.

1.3 Description of SNL/NM Installation

SNL/NM is located on the Kirtland Air Force Base (KAFB) installation immediately southeast of Albuquerque (Figure 1-2). Major transportation services are provided by the Albuquerque International Airport, the Atcheson, Topeka, and Santa Fe Railroad, and Interstates 40 and 25. KAFB and SNL/NM are located directly west of the Manzano Mountain Range foothills.

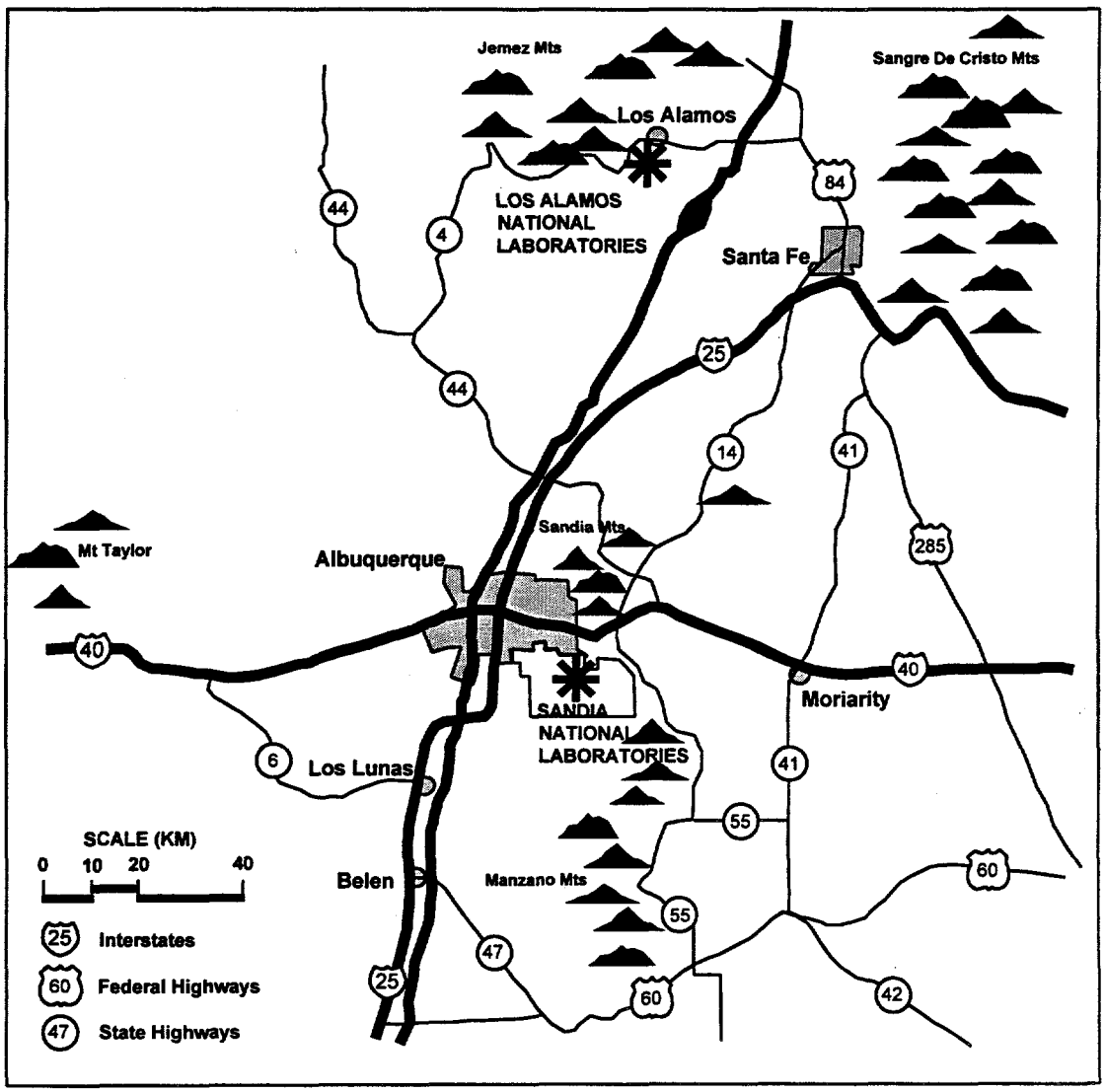
SNL/NM is operated by Sandia Corporation, a subsidiary of Lockheed Martin, for the U.S. Department of Energy (DOE). The area in which SNL/NM is located is administratively known as KAFB East and comprises the facilities necessary to conduct research consistent with the SNL/NM mission. Approximately 25,000 ac of land on KAFB and 23,000 ac of adjoining National Forest land have been set aside for use by both the Department of Defense (DoD) and DOE. DOE actually owns 2,800 ac of this land (ERDA 1977). SNL/NM's facilities are spread over this leased and owned land and are generally organized by function. Similar R&D activities at SNL/NM are generally grouped within the same physical location or Technical Area.

Currently, there are five SNL/NM Technical Areas. These areas and their general functions are as follows:

- Technical Area I: Administration, site support, technical support, component development, research, energy programs, microelectronics, defense programs, and exploratory systems.

- Technical Area II: Testing explosive components.
- Technical Area III: Testing and simulating a variety of natural and induced high-energy environments, including two rocket-sled tracks, two centrifuges, and a radiant-heat facility.
- Technical Area IV: Applied pulsed-power sciences such as x-ray, gamma-ray, and particle-beam fusion accelerators which are used to simulate nuclear weapon effects, research on inertial-confinement fusion and particle-beam weapons.
- Technical Area V: Research and testing of various materials, such as electronics, in a radiation environment provided by low power nuclear reactors.

Figure 1-2. Location of Sandia National Laboratories/New Mexico



1.4 Candidate Sites

The host site must be of adequate size and shape for the needed buildings and structures as defined in NIF Site Requirements, Section 2.3, "Buildings and Special Equipment," and Section 3, "NIF Building Description" (see Table 1-1) (LLNL, 1994a). Approximately 25 ac would be required for all operational spaces required to perform the primary functions and the central and ancillary support functions required by the NIF. Many of the support functions would be satisfied by using existing SNL/NM and KAFB facilities. Thus, sites smaller than 25 ac could be host to the NIF.

Table 1-2 presents the list of candidate sites, description of the location, technical area, and site size. The process by which these sites were identified is discussed in Section 2.1. Sites 1 and 2 are located within the undeveloped area east of TA-I. Site 3 is located in the northeast quadrant of TA-II and Site 4 is located on the southern boundary of TA-II adjacent to the northern boundary of TA-IV. The candidate sites in TA-I and II are shown in Figure 1-3. Seven of the candidate sites are located in the remote area of TA-III, four miles to the south-southwest of the other technical areas. The location of the candidate sites in TA-III are shown in Figure 1-4.

Table 1-2. List of Candidate Sites

Site Number	Description of Location	Tech Area	Size (Acres)	Shortest Length (ft)	Longest Length (ft)
1	O Street and Twentieth	I	22.4	721	1,246
2	Twentieth Street between H and O	I	18.4	683	835
3	Twentieth Street South of O Street	II	13.1	419	952
4	Ninth Street and Q Street	II	27.5	922	1,685
5	South Central Tech Area III	III	24.6	746	1,483
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9	Central Tech Area III	III	34.8	597	1,609
10	South East Tech Area III	III	31.8	830	2,006
11	South East Tech Area III	III	40	345	2,183

Figure 1-3. SNL/NM Candidate Sites in Technical Areas I and II

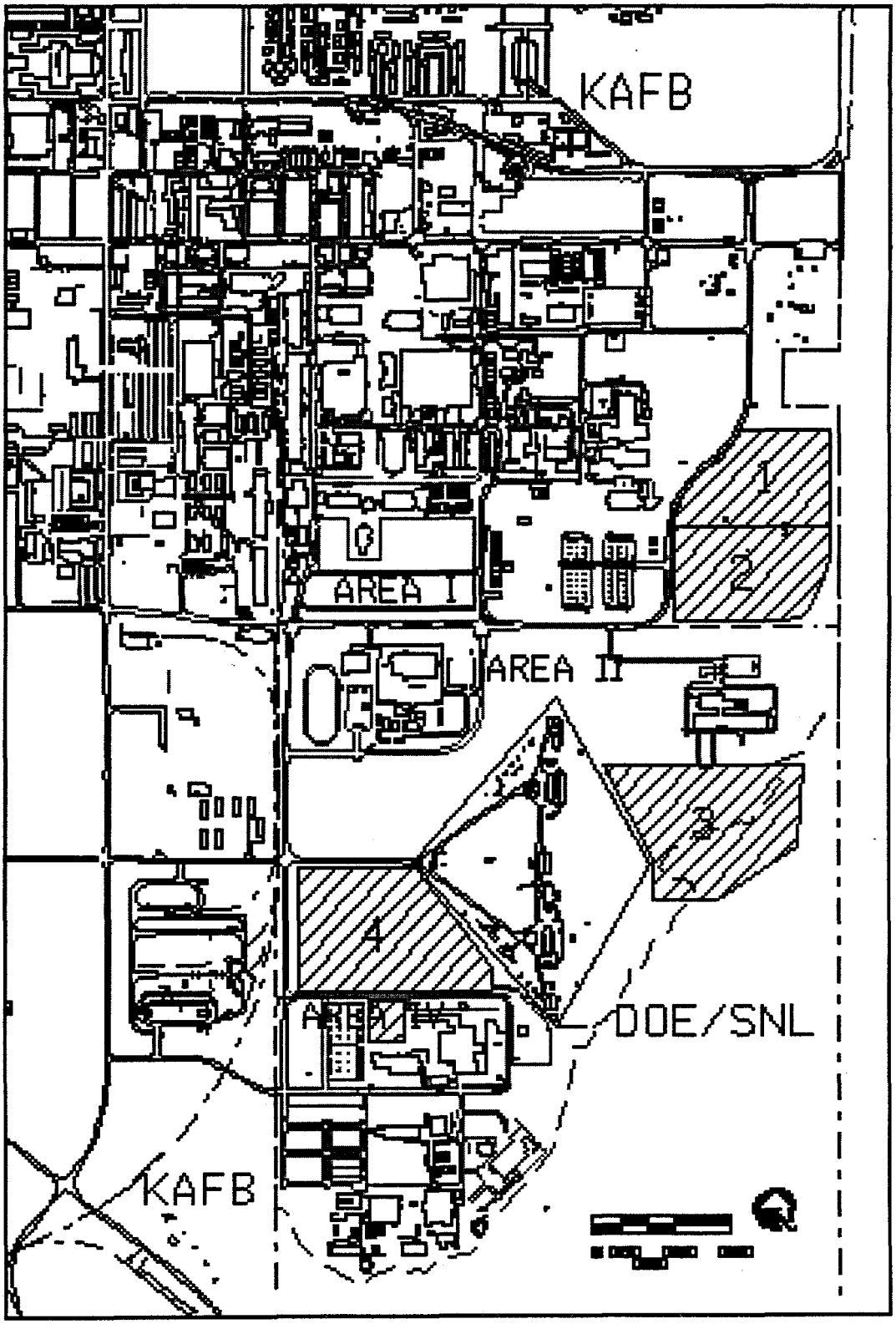
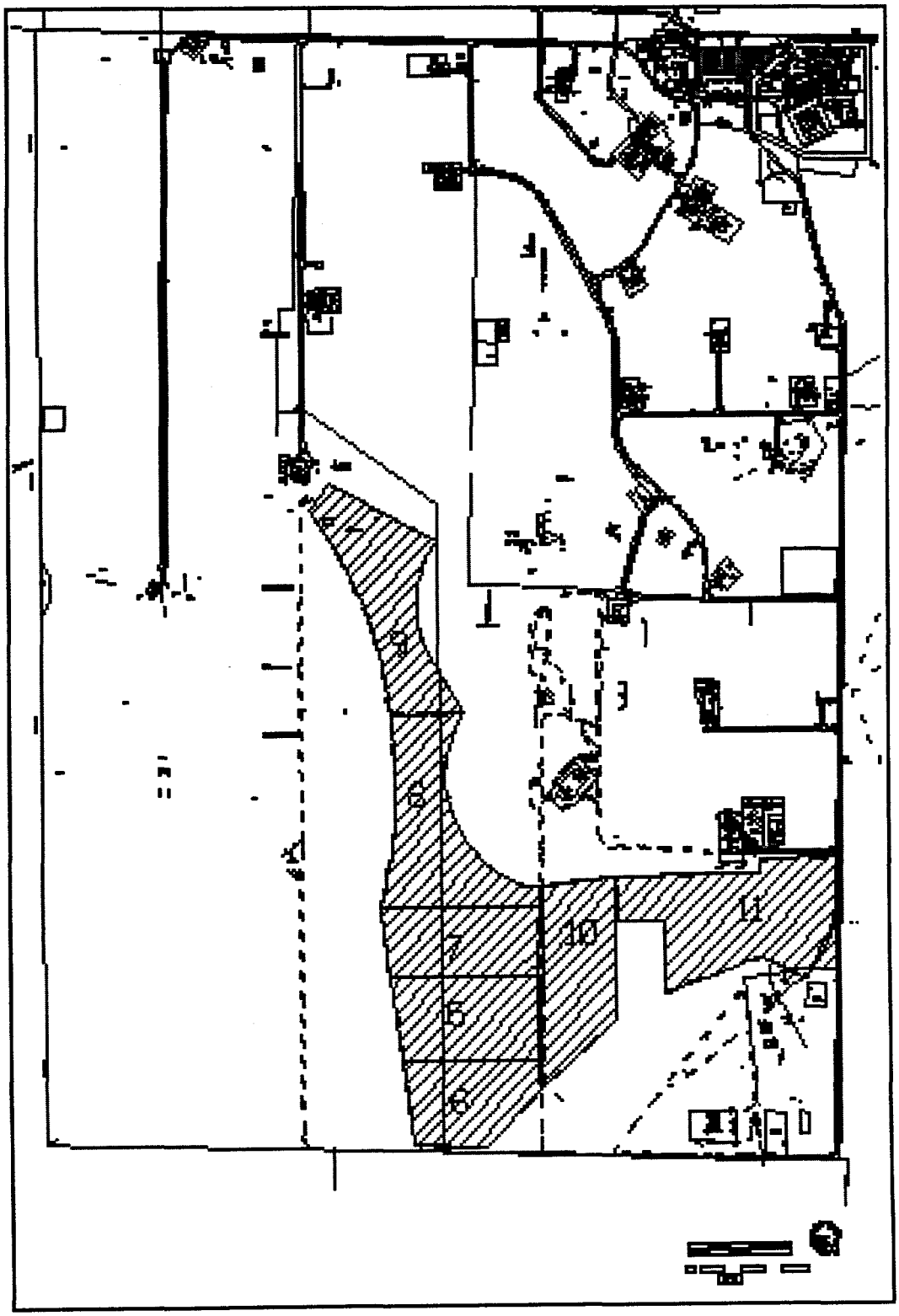


Figure 1-4. SNL/NM Candidate Sites in Technical Area III



2.0 PREFERRED SITE SELECTION PROCESS

The site evaluation consisted of a three-step process: 1) identification of candidate sites; 2) pass/fail criteria; and 3) cost discriminator criteria (see Figure 2-1). In the first step, candidate sites were identified based on minimum land use requirements. Eleven candidate sites were identified. In the second step, the eleven candidate sites were evaluated against a set of pass/fail criteria developed from the NIF Site requirements (LLNL 1994a) to which absolute compliance was determined to be required. Any site that passed all of the pass/fail criteria was considered to be acceptable. Each of these acceptable sites were then evaluated by the cost discriminator criteria of the third step that differentiate between sites on the basis of costs associated with locating, building, and operating the NIF at each site.

This three-step structure ensured a comprehensive and balanced evaluation of all possible locations in a way that accounted for:

1) available land space,
2) environmental, safety, and health issues, and
3) cost issues.

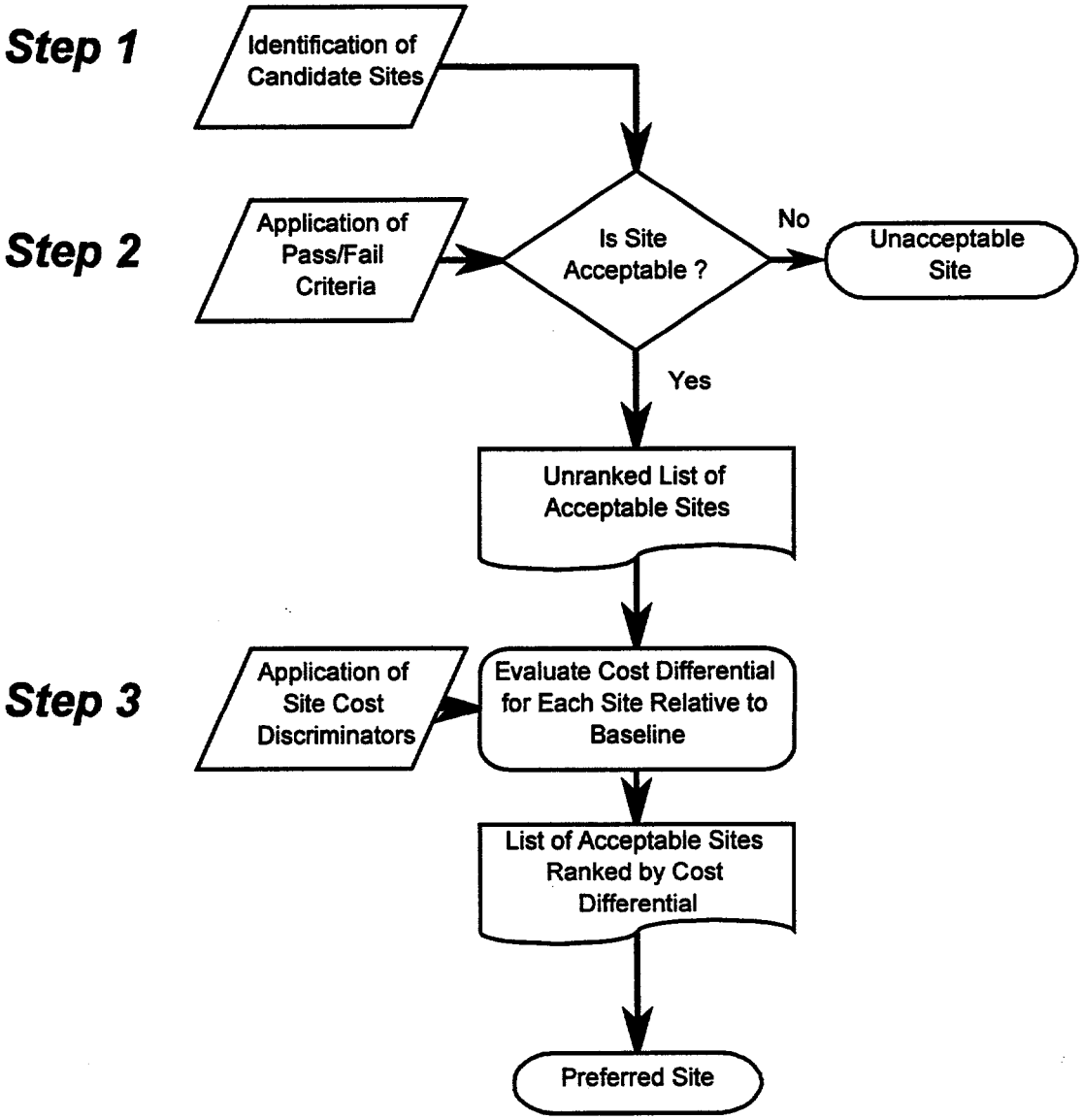
2.1 Site Selection Process Step 1 - Identification of Candidate Sites

In 1994 a site selection analysis was performed for the proposed joint DOE/DoD Jupiter Accelerator Project at KAFB (ARC, 1994). The SNL/NM Sites Planning Department performed a survey of available plots of open space on KAFB. A set of 30 sites from land belonging to DOE and the DoD was compiled. The list of sites from the Jupiter Project site selection study was used as a starting point for this study. For the NIF site selection project all sites owned by the DoD were eliminated since NIF is not a joint DOE/DoD program. Additionally, those sites in the Jupiter study that would clearly be too small to accommodate the NIF facility were eliminated. The SNL/NM Sites Planning Department judged that sites smaller than 13 acres would be too small to effectively host the LTAB and its central support facilities. The result is a set of eleven (11) sites that are reasonable candidate sites for the NIF facility.

2.2 Site Selection Process Step 2 - Pass/Fail Criteria

The Pass/Fail Criteria were developed from the NIF Site Requirements (LLNL, 1994a). These criteria contain environmental and safety requirements which had to be satisfied in order for a site to be considered an acceptable candidate for the NIF. These criteria all have features in which no reasonable expenditure of resources could bring non-compliant sites into conformance. The sites that conformed to the pass/fail criteria were considered to be acceptable sites for further evaluation. The following are the list of Pass/Fail Criteria developed to evaluate the candidate sites.

Figure 2-1. SNL/NM NIF Site Selection Process



Wetlands Location

The NIF shall avoid development, modification, or occupancy of flood plains and wetlands where practical alternatives exist (per Executive Orders 11988 and 11990).

Endangered Species

The construction and operation of the NIF shall not adversely impact threatened, endangered, other species of concern, or their habitats per the Endangered Species Act of 1973, as amended and applicable to the State Endangered Species Acts.

ES&H - Air Emission of Radionuclides

The NIF Site shall be located such that the emission of radionuclides from the facility shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent to 10 mrem/yr from all SNL/NM activities combined, including the NIF.

Wildlife Communities

The NIF Site construction and operation shall not adversely affect or impact the wildlife communities.

Native American Religious Sites

The NIF Site construction and operation shall avoid impact as a result of building on a traditional or cultural place, per the American Indian Religious Freedom Act.

Historic and Cultural Resources Sites

The NIF Site construction and operation shall not impact as a result of building on a historic and/or cultural resources site, as defined by the Archeological and Historic Preservation Act of 1974.

2.3 Site Selection Process Step 3 - Site Cost Discriminator Criteria

The cost discriminator criteria were defined on the basis of both NIF facility requirements (LLNL 1994a) and factors specific to the infrastructure at SNL/NM. The cost discriminator criteria were divided into three categories: 1) General - a combination of physical and operational aspects of siting the NIF (Section 2.2.1); 2) Utilities - focusing directly on the infrastructure required to meet NIF operational requirements (Section 2.2.2); and 3) Support Services - based on the cost to provide the necessary NIF support services to each candidate site (Section 2.2.3). The following is a brief description of the criteria, assumptions, and the cost estimates used for this evaluation.

2.3.1 General Site Cost Discriminators

Security Systems

The NIF will be designed and operated in conformance with the DOE 5632 series of orders, which establishes departmental policies and requirements for the physical protection of DOE property and security interests. Requirements include those for physical protection of classified matter; physical protection of DOE property and unclassified facilities; protective program operation; and personnel security, including issuance, control, and use of badges, passes, and credentials.

Differences in security costs associated with the operation of NIF at each of the candidate sites were estimated by assessing the increased number of security personnel who would be needed to provide security 24 hours a day, 7 days a week at each candidate site. Specific site security personnel requirements were estimated using the following factors: site size; proximity to existing secured areas; and status of existing security apparatus at each site. Security personnel costs were estimated at $150,00 per man-year. It was estimated that the NIF project would last 20 years.

Soil Stability

The NIF experimental buildings should not be located in an area that is affected by extensive ground failure caused by surface faulting, liquefaction, and other soil instability factors.

ER Contaminated Soil

The NIF site should not have a pre-existing condition of contaminated soil requiring significant environmental remediation. For example, the soil should not have been contaminated with materials such as gasoline, chromium, specific volatile organic or radioactive materials. Potential environmental restoration costs associated with each site were taken from the SNL/NM Environmental Restoration Project site specific database. The database catalogs the project status and the restoration costs. This information was used to establish the expected cost to clean up an area prior to locating the NIF at that site.

Flood Areas

The NIF LTAB shall be located at a site above or otherwise protected from flood levels that meets or exceeds the criteria for the "low hazard" category defined in UCRL 15910, including a combination of events established by the document. The costs associated for remediation of any flood risk associated with the location of a flood plain within a candidate site would depend heavily on the characteristics of the particular site and water shed. The costs associated with protecting the LTAB from flooding risks were estimated on a site specific basis and are presented in Appendix B.

Site roads and Parking Areas

Site roads and parking areas should be able to handle an additional 600 people per day, 1,200 site visitors per year, and an additional 1,500 truck shipments per year. There should be access to a transportation network sufficient to accommodate transportation of targets from facilities across the continental U.S. in support of NIF activities.

Each site was assessed for the need to build new roads or improve existing roads. Costs associated with roadway improvements and construction were estimated at $\$2/ft^2$ for new roads and $\$1/ft^2$ for the improvement of existing roads. It is assumed that 30 ft of road width would be required to serve the NIF site adequately. The road costs were divided into two categories: new road costs and improved road costs. These categories were evaluated for the distance over which roads would have to be improved or constructed for each site.

Intersite Transit

The potential cost savings of locating the NIF adjacent to technologically similar facilities, attributable to operational efficiency factors such as travel time of personnel that work or interact at NIF and other SNL/NM sites is a cost criterion. The following assumptions were used to evaluate this criteria:

- Each day, 10 percent of the estimated 300 NIF personnel make one business related trip from the NIF site to Technical Areas I or IV and an equivalent number of other SNL personnel make one trip to the NIF site per day.
- The lost time per round trip is estimated to be 90 minutes between TA-IV and III, and 20 minutes between TA-IV and I.
- The average cost per employee for lost time is $50/hr.
- A work year consists of 235 work days.
- This cost is evaluated as an ongoing operational expense for 20 years.

Cost of Site Modifications

The cost of any required demolition of existing site structures and relocation of existing site utilities are cost criteria.

2.3.2 Utilities Site Cost Discriminators

Water Supply

Water supply shall be capable of meeting the full raw water needs of the NIF, which are estimated at approximately 30,000,000 gal/yr.

A determination was made for each site as to whether sufficient water service from the KAFB and City of Albuquerque water systems existed. New water distribution line costs were estimated at $50/ft of 14-inch line required to extend water service to an area. The distance of water line needed for each site was estimated by the SNL/NM Site Utilities Engineering Department.

Sanitary Water

The quantity of sanitary (potable) water available to the NIF should be 60,000 gal/day at 60 psig, with a peak flow capacity of 250 gal/min. The NIF's sanitary water needs would be met by the regular water supply (previous criterion).

Fire Protection Water

The quantity of water available for fire protection on the NIF is 2,000 gal/min. At this delivery rate, water pressure shall not drop below 20 psig. At this flow rate and pressure, the water flow shall be maintained for a minimum of 2 hours and include a redundant fire protection system. The NIF's fire protection would be met by the regular water supply.

Sewer Capacity

The system of sewage water lines to the NIF site must be capable of handling a peak flow of 500 gal/min. The sewer service at each candidate site was evaluated to determine new service requirements or if existing service would be sufficient. New sewer line costs were estimated at $30/ft. The distance of sewer lines needed were estimated by the SNL/NM Site Utilities Engineering Department.

Storm Drains

Adequate storm drain capacity shall be provided to remove rainwater from the selected site. The storm drain requirements were estimated by the SNL/NM Site Utilities Engineering Department.

Electricity Power Distribution

The NIF electrical power supply would require a 25 MVA electrical power distribution system with a 18/21/24 MVA transformer capacity. The NIF electrical supply would be served by a 115 kV power line. SNL/NM's Sites Utilities Engineering Department also determined that to ensure electrical reliability for a facility such as the NIF, two electrical substations would be required. One substation would be fully dedicated to the NIF while the other would serve as a backup and could serve other facilities as well. Any site that would be served by a 115 kV "radial" power supply line would also require a breaker station to ensure the quality of the electrical supply. This feature would be indicative of sites in TA-III. The sites in TA-I and IV would be served by 115 kV "loop" power lines that would not require such a feature.

Electrical requirements for the NIF were compared to the existing electrical service available at each of the candidate sites. The need for new power lines, the availability of existing substations and power lines, the need for additional electrical substations, and the need for breaker stations were assessed for each site. The cost of building new 115 kV lines was estimated at $1,000,000/mile. Construction costs were estimated at $1,500,000 for a new electrical power substations and $1,500,000 for a new breaker station.

Natural Gas

Annual energy use requirements (natural gas or equivalent fuel) for the NIF LTAB and Support Facilities are 24,000 thm/yr and 15,000 thm/yr, respectively. Natural gas service to each site was evaluated for adequacy.

New gas line costs were estimated at $10/ft. Another potential cost associated with new gas lines would be a metering and regulator station, should the existing gas service to the area of the site require such a facility to accommodate the NIF gas loads. The cost of a new metering and regulator station was estimated at $25,000.

2.3.3 Support Facilities Site Cost Discriminators

Electrical and Mechanical Shop Capability

Approximately 12,000 ft^2 of space will be needed to house machine tools for fabricating components and an electrical fabrication and testing area. This area can be a part of the host site infrastructure and need not be dedicated to the NIF.

Shipping, Receiving, and Central Stores

Approximately 14,000 ft^2 for receiving, storage, distribution and shipment of materials, equipment and supplies.

Medical Buildings

Approximately 7,500 ft^2 for medical offices, dispensary, examination, and therapy.

Cafeteria

Approximately 8,000 ft^2 of space and seating for 250 people.

Garage and Gas Station

Approximately 5,000 ft^2 for routine light maintenance, repair, refueling, and cleaning of plant vehicles and heavy equipment.

Security and Badging

Approximately 1,200 ft^2 for the NIF site security and badging of personnel.

Fire/Emergency Response Station

Approximately 18,750 ft^2 for fire and emergency equipment, emergency communications, living quarters for personnel and training facilities.

Office Space

This functional space will provide office space, conference rooms, computer facilities, drafting space, and utilities for telecommunications with other facilities. The office space should accommodate the permanent technical staff and visiting scientists. The total floor area is estimated to be 80,000 ft^2. The cost of new office building space was estimated at \$187.5/ ft^2.

Target Receiving

This 15,000 ft^2 functional space will provide laboratories and equipment for receiving and inspecting targets for the NIF.

Assembly Area (Clean Room/Optics Fabrication)

A 22,000 ft^2 area consisting of approximately 11,000 ft^2 of clean room space (60% Class 100 and 40% Class 1000) will be required.

Assembly Area (General)

Approximately 30,000 ft^2 of industrial type building will be used to assemble mechanical and electrical components that do not require a clean room environment. This assembly area can be shared with other operations at the test site.

Optics Maintenance and Refurbishing Area

Approximately 40,000 ft^2 of controlled-environment laboratory space is required for optical fabrication, optical testing, and inspections. This capability can be a part of the host site infrastructure. Approximately 5,000 ft^2 of this space will contain Class 100 clean rooms.

Optics Storage

Approximately 20,000 ft^2 of temperature- and humidity-controlled storage and inventory area will house the high value optical components during assembly and spare inventory during operation of the NIF.

Warehouse

Approximately 30,000 ft^2 of industrial-quality space will be required for the bulk storage of NIF components, equipment and supplies for operation of the NIF.

3.0 SITE SELECTION PROCESS RESULTS

The NIF assessment evaluated the site physical characteristics, environmental sensitive areas, radionuclide air emissions, and hazardous safety zones according to the pass/fail criteria. A cost was not associated with the pass/fail criteria. The list of candidate sites that qualified from the pass/fail evaluation were then evaluated based on cost discrimination criteria. The cost discrimination criteria evaluated the relative cost differences associated with locating the NIF at the potential candidate site. The cost discrimination criteria included: transportation network, roads and parking areas, site utilities, security, and building and special equipment requirements. A candidate site selection profile was developed based on the cost discriminators.

3.1 Pass/Fail Criteria Results

The eleven candidate sites identified from the survey of available sites (Step 1) were evaluated based on the pass/fail criteria in this section. Table 3-1 lists the candidate sites, a brief description of the location and the technical area, and the size of the sites. The pass/fail evaluation included environmental issues and air emissions of radionuclides. The candidate sites had to pass all the criteria or they were excluded from further evaluation. All eleven candidate sites passed the pass/fail criteria of Step 2 and were then considered for the third step, cost discrimination criteria evaluation.

Table 3-1. List of Candidate Sites

Site Number	Description of Location	Tech Area	Size (Acres)	Shortest Length (ft)	Longest Length (ft)
1	O Street and Twentieth	I	22.4	721	1,246
2	Twentieth Street between H and O	I	18.4	683	835
3	Twentieth Street South of O Street	II	13.1	419	952
4	Ninth Street and Q Street	II	27.5	922	1,685
5	South Central Tech Area III	III	24.6	746	1,483
6	South Central Tech Area III	III	26.5	522	1,339
7	South Central Tech Area III	III	18.8	550	1,576
8	South Central Tech Area III	III	29.2	323	1,842
9	Central Tech Area III	III	34.8	597	1,609
10	South East Tech Area III	III	31.8	830	2,006
11	South East Tech Area III	III	40	345	2,183

Wetlands Location

An examination of the candidate sites was performed to identify potential wetlands. The only potential wetlands at SNL/NM are associated with springs and intermittent drainage

associated with the canyons and arroyos of KAFB. These springs and arroyos are not located near the candidate NIF sites. Therefore, none of the candidate sites involve the disturbance of wetlands.

Endangered Species

No species listed as endangered or threatened by the U.S. Fish and Wildlife Service (50 CFR 17.11 and 17.12, as amended through March 14, 1990) or the New Mexico Department of Game and Fish (Regulation 657, January 9, 1988) are known to occur on KAFB. Five species listed by the state may potentially occur on KAFB. The following is a list of potential species: willow flycatcher, gray vireo, spotted bat, grama grass cactus and pincushion cactus. These species have not been found at any of the candidate sites. No State or Federally listed amphibian, reptile, or invertebrate are expected to occur on KAFB (ITC, 1990).

Wildlife Communities

An evaluation of the SNL/NM wildlife communities determined that the construction of the NIF would have minimal adverse effect on wildlife communities at the candidate sites. Because many of the candidate sites are located within close proximity of existing SNL facilities and technical areas, the impact on wildlife communities would be considerably reduced. The candidate sites are not located on or near a sensitive habitat (ITC, 1990).

Native American Religious Sites

No Native American religious sites are within the boundaries of the candidate sites for the NIF (ITC, 1990).

Historic and Cultural Resources Sites

There are no prehistoric, historic archaeological sites or structures, or cultural resources on the candidate NIF sites (ITC, 1990).

ES&H - Air Emission of Radionuclides

A complete evaluation of the potential radiological and hazardous chemical impacts resulting from normal operations and postulated accidents at the NIF at SNL/NM were documented in the Project-Specific Analysis for Construction and Operation of the National Ignition Facility (ANL, 1995). The estimated radiation dose to a maximally exposed member of the public living about 2,165 ft north-northwest of the NIF would be 0.003 mrem/yr. This increment of individual dose would be added to the current total estimate for boundary receptors at SNL/NM, 0.00024 mrem/yr (SNL/NM, 1994). The total would still be much less than the dose limit of 10 mrem/yr required for NIF (LLNL, 1994a).

3.2 Site Cost Discriminator Results

Candidate sites that met the mandatory environmental conditions (which were all eleven sites) were then evaluated on the basis of costs for meeting NIF infrastructure needs. The site cost discriminator evaluation was designed to address only the costs that were different among the candidate sites. If a cost discriminator was common to all sites, the category was dropped from further evaluation. The site cost discriminator profile is presented in Table 3-2. The site cost discrimination data tables are presented in Appendix B. Cost estimates for utility categories (i.e., water supply, sanitary water, and fire protection water) were lumped into a single cost estimate for some of the candidate sites and estimated in detail for other sites. The level of detail for utility cost estimates for each site was determined by the Sites Utilities Engineering Department.

3.2.1 General Site Cost Discriminators

Security Systems

The security costs associated with the operation of NIF at each of the candidate sites were estimated by assessing the increased number of security personnel who would be required to serve each candidate NIF site security needs 24 hours a day, 7 days a week. It was determined that incremental security costs would range from $9,000,000 to $18,000,000 million for the entire projected time of the project.

Security personnel requirements were based on the proximity of each site to existing security infrastructure. Sites 1, 2, and 3 are close to TA-I and the main security force at SNL/NM. However, each site would be totally isolated from existing secured areas. Each site would require its own new security facility including perimeter fencing, access gate, and additional personnel assignments to the SNL/NM security force. This cost for Sites 1, 2, and 3 was estimated to be $9,000,000 over a 20-year operating period.

Site 4 is adjacent to TA-IV, which has existing security gates and assigned security personnel. The existing perimeter fencing would have to be extended to include Site 4. It was assumed that the existing security forces currently assigned to TA-IV could accommodate much of the additional security and patrol needs associated with NIF. However, it was assumed that one additional security guard would be required at TA-IV. This cost was estimated at $3,000,000 over a 20-year operating period.

Sites 5 through 11, all remotely located in TA-III, would require a higher security infrastructure upgrade. Each site would require perimeter fencing, access gates, and additional security personnel. The remote nature of these sites would require a greater degree of additional security personnel relative to the other candidate sites. It was estimated that each of these sites would require six additional security personnel at a cost of $18,000,000 over 20 years.

Table 3-2. NIF Candidate Site Cost Discriminator Results

Cost Criteria	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
Utilities											
Water	$635,000†	$635,000†	$635,000†	$73,000	$582,000	$582,000	$582,000	$582,000	$582,000	$582,000	$582,000
Sewer	See Footnote	See Footnote	See Footnote		$349,000	$349,000	$349,000	$349,000	$349,000	$349,000	$349,000
Storm	See Footnote	See Footnote	See Footnote	$300,000							
Natural Gas Line	$10,000	$10,000	$20,000	$0	$50,000	$60,000	$41,000	$60,000	$80,000	$30,000	$10,000
Natural Gas Metering Station	$25,000	$25,000	$25,000	$0	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
Electrical Power Line	$0	$0	$0	$0	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
Electrical Substation	$0	$0	$0	$0	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Electrical Breaker Station	$0	$0	$0	$0	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000
Utility Subtotal	$670,000	$670,000	$680,000	$373,000	$5,006,000	$5,016,000	$4,997,000	$5,516,000	$5,036,000	$4,986,0000	$4,966,000
Site/Infrastructure Modifications											
Flood Plain Remediation	$0	$0	$0	$0	$0	$0	$500,000	$500,000	$0	$500,000	$500,000
New Road Costs	$0	$0	$0	$0	$175,000	$175,000	$175,000	$175,000	$175,000	$175,000	$175,000
Improved Road Costs											
Improved Road Costs	$700,000	$700,000	$700,000	$0	$349,000	$349,000	$349,000	$349,000	$349,000	$349,000	$349,000
Site Environmental Restoration	$0	$0	$52,000	$0	$0	$0	$0	$0	$0	$0	$0
Office Space	$15,000,000	$15,000,000	$15,000,000	$7,500,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000
Site/Infrastructure Modification Subtotal	$15,700,000	$15,700,000	$15,752,000	$$7,500,000	$15,524,000	$15,524,000	$16,024,000	$16,024,000	$15,524,000	$16,024,000	$16,024,000
Personnel											
Security Personnel	$9,000,000	$9,000,000	$9,000,000	$3,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000
Intersite Transit Cost	$2,348,000	$2,348,000	$2,347,650	$0	$10,575,000	$10,575,000	$10,575,000	$10,575,000	$10,575,000	$10,575,000	$10,575,000
Personnel Cost Subtotal	$11,348,000	$11,348,000	$11,348,000	$3,000,000	$25,575,000	$25,575,000	$25,575,000	$25,575,000	$25,575,000	$25,575,000	
Total Cost	$27.718.000	27.718.000	$27.779.007	$10.873.000	$49.105.000	$49.115.000	$49.596.000	$49.615.000	$49.135.000	$49.585.000	$49.565.000

† This value is an aggregate estimate of cost to provide water service, sewer service, and storm drains for Sites 1, 2 & 3 based on previous estimates prepared for the proposed Technical Information and Outreach Center (TIOC).

Soil Stability

No soil stability issues were found at any of the sites. No cost differential was associated with this criterion.

ER Contaminated Soil

Site 3 is the only candidate site with any expected costs associated with environmental restoration issues. This cleanup cost has been estimated at $51,447 based on the information from the SNL/NM Environmental Restoration Database. Site 4 contains four environmental restoration sites that have been proposed as no further action (NFA) sites. NFA means that the ER site is either scheduled to be cleaned and closed or the site contamination is below background or below a level of concern and no cleanup will be required. Sites 1, 2, and 5 through 11 did not have environmental restoration costs associated with the construction of the NIF at those locations (see Table 3-3).

Flood Areas

Sites 7, 8, 10, and 11 are located within a 100-year flood plain. All other sites are outside of a 100-year flood plain. Based on the surface topography of Sites 7, 8, 10, and 11, the SNL/NM Site Utilities Engineering Department estimated that each site would require approximately $500,000 in costs associated with protecting the NIF facility from flood levels that would exceed the low level hazard criteria in UCRL 15910.

Site Roads and Parking Areas

Sites 1 through 4 had no additional new road costs associated with locating the NIF at those particular sites. However, the SNL/NM Sites Utilities Engineering Department advised that Sites 1 through 3 would require combined street, curb, and storm drainage ditch upgrades to safely handle the additional traffic associated with NIF operations. These road improvements for Sites 1 through 3 would cost $700,000. Site 4 would not require improvement of existing roads.

Both new and improved road construction would be required for all of the TA-III sites at an estimated total cost of $523,800. A principle access road from the gate at the northeast corner of TA-III would have to be improved over a distance of approximately two miles at a cost of $390,000 and each site would require approximately 0.5 miles of new roads at a cost of $175,000.

Intersite Transit

Intersite transit cost for Sites 1 through 3 was estimated at $2,347,650 per site. Intersite travel costs for Sites 5 through 11 were greater because of the distance between TA-III and the rest of SNL/NM. The intersite travel costs for these sites were estimated at $10,575,000 per site over a twenty-year period.

Table 3-3. Environmental Restoration Site Cleanup Cost Estimates

Candidate NIF Site Number	SNL/NM ER Sites	ER Site Name	Costs/Status
1	None	N/A	N/A
2	None	N/A	N/A
3	50	Old Centrifuge Site	None/Proposed No Further Action Status (NFA)
	228	Centrifuge Dump Site	$51,447
4	43	Radioactive Material Storage Yard	None/Proposed NFA
	114	Explosive Burn Pit	None/Proposed NFA
	165	Building 901 Septic System	None/Proposed NFA
	167	Building 940 Septic System	None/System is scheduled to be pumped, closed and proposed for NFA
5	None	N/A	N/A
6	None	N/A	N/A
7	None	N/A	N/A
8	None	N/A	N/A
9	None	N/A	N/A
10	None	N/A	N/A
11	None	N/A	N/A

For Site 4, adjacent to TA-IV, there would be no costs associated with lost employee time from travel between the SNL/NM ICF facilities and NIF. Environmental impacts related to transportation between the NIF and other SNL/NM facilities were not evaluated in this study. However, it is evident that environmental impacts associated with transportation would be minimized by siting the NIF at Site 4.

Cost of Site Modifications

None of the candidate sites required demolition of existing site structures or relocation of existing site utilities.

3.2.2 Utilities Site Cost Discriminators

Water Supply

Sites 1 through 3 estimations for water, sewer, and storm drain services were based on estimates prepared by the Sites Utilities Engineering Department for the proposed Technical Information and Outreach Center (TIOC). It was assumed that the utility infrastructure upgrade costs associated with construction of the TIOC would be similar to those for the NIF at Sites 1 through 3. The TIOC would be located close to these sites and would be of similar size. The other candidate sites were evaluated based on information specific to each site. Site 4 would need 1,455 ft of additional water lines at a cost of $72,750. Sites 5 through 11 would need two miles of additional water lines at a cost of $582,000.

Sanitary Water

The cost of sanitary water was included with the Water Supply costs.

Fire Protection Water

This cost was included with the Water Supply costs.

Sewer Capacity

As stated before, sewer costs for Sites 1 through 3 were evaluated in combination with water and storm drain estimates based on the TIOC project estimates. Site 4 would not require modification of sanitary water associated with the operation of NIF. Sites 5 through 11 would need a two-mile sewer line extension from the existing sewer lines in TA-V. The cost to build the sewer lines was estimated at $349,200 for Sites 5 through 11.

Storm Drains

As stated before, storm drain costs for Sites 1 through 3 were evaluated in combination with water and sewer estimates based on the TIOC project estimates. The cost to move a storm drain that currently runs across Site 4 was estimated to be $300,000 dollars. There would be no additional cost for storm drain upgrades for Sites 5 through 11. The SNL/NM Site Utilities Engineering Department does not have adequate data to estimate the need for new storm drains at the undeveloped sites in TA-III. Storm drains for these sites would be designed specifically based on site surface features.

Electricity Power Distribution

There would not be a cost associated with upgrading the electrical power supply for Sites 1 through 4. These sites are located close to a high quality, reliable 115 kV loop line. No

upgrade to the line would be required, and the need for a new substation to support the NIF load would be satisfied by existing plans to add a new substation near sites 1, 2, and 3, and a new substation near Site 4.

Electrical service for all of the TA-III sites would require that a 115 kV line extension be run into TA-III from an existing 115 kV line that runs north and south just to the east of TA-III. The length of this extension was roughly estimated at 0.5 miles for all of the TA-III sites for a cost of $500,000. Two electrical substations would be required for all of these sites at $1,000,000 per station. A breaker station at the junction of the main 115 kV line and the extension into TA-III would be required at a cost of $1,500,000.

Natural Gas

It was estimated that Sites 1, 2, and 10 would require 1,000 ft of new gas lines at a cost of $10,000. Site 3 would require 2,000 ft of new gas lines at a cost of $20,000. Sites 1 through 3 would also require a meter/regulator station at a cost of $25,000 per site. Natural gas service to Sites 5 through 11 would require that a 2-inch line be tapped off of a gas supply line that is proposed to be run from the KAFB Eubank gate all the way to DOE's Lovelace Inhalation Toxicology Research Institute on the southern border of KAFB. The gas supply line would run just to the east of TA-III. The required additional gas lines for Site 5 would cost $50,000. Site 6 and 8 would require 6,000 ft of new gas lines at a cost of $60,000. Site 7 would require 4,100 ft of additional gas lines at a cost of $4,100. Site 9 would require 8,000 ft of additional gas lines at a cost of $80,000. Site 10 would require 3,000 ft of new gas lines at a cost of $30,000. Site 11 would require 1,000 ft of new gas lines at a cost of $10,000. All sites in TA-III would require a meter/regulator station. This cost is estimated to be $25,000.

3.2.3 Support Buildings Site Cost Discriminators

Existing buildings and support functions located at candidate sites would be utilized where possible to prevent additional costs. The following support facilities and services are summarized in Appendix B with regard to the need for new construction or the ability to utilize existing buildings and services. All site cost discriminators were dropped from further evaluation with the exception of the office space discriminator.

3.2.3.1 Central Support Services

The following central support facilities would have to be constructed regardless of which site was selected for the NIF. Thus, costs associated with the construction of these facilities were not used as cost discriminators between sites:

- Target Receiving,
- Assembly Area (Clean Room/Optics Fabrication),
- Assembly Area (General),
- Optics Maintenance and Refurbishing Area,

- Optics Storage,
- Warehouse.

3.2.3.2 Ancillary Support Services

Electrical and Mechanical Shop Capability

SNL/NM has adequate electrical/mechanical shop capabilities located in Building 840 of TA-I. These existing shops could be used for all candidate sites. No cost was associated with using existing facilities. However, there exists the potential for environmental impacts and lost employee time associated with transportation of people and supplies between the NIF and the Shops. No such analysis was performed for this study, but it is expected that impacts would increase as the distance between the NIF and the Shops increases.

Shipping, Receiving, and Central Stores

SNL/NM has an existing shipping/receiving facility located in Building 857 of TA-I. These existing facilities could be used for all the candidate sites. No cost was associated with using existing facilities. However, there exists the potential for environmental impacts and lost employee time associated with transportation of people and supplies between the NIF and Shipping and Receiving. No such analysis was performed for this study, but it is expected that impacts would increase as the distance between the NIF and shipping and Receiving increases.

Medical Buildings

SNL/NM has existing medical facilities located in Building 831 of TA-I that serves all Technical Areas. No additional cost was associated with using the existing medical facilities. However, there exists the potential for lost employee time from trips to and from the medical facilities. These costs were not estimated in this study, but it is expected that lost employee time would be minimized by locating NIF at one of the candidate sites in TA-I or TA-II.

Cafeteria

SNL/NM has an existing cafeteria that is located in Building 861 of TA-I. No additional cost was associated with using the existing cafeteria facility. However, there exists the potential for environmental impacts and lost employee time associated with transportation of people between the NIF and the cafeteria. No such analysis was performed for this study, but it is expected that impacts would increase as the distance between the NIF and the cafeteria increases.

Garage and Gas Station

SNL/NM has existing facilities that provide maintenance and repair services for DOE vehicles. These facilities are located in Buildings 873, 874, 875, and 876 of TA-1.

Security and Badging

SNL/NM has existing facilities for security and badging. The security facilities are distributed throughout the various Technical Areas. Badging is conducted in Building 800 of TA-I and at specific satellite locations. No additional cost was associated with using the existing security and badging facilities.

Fire/Emergency Response Station

Fire response for all SNL/NM facilities is provided by KAFB. No additional cost was associated with using the existing KAFB fire response team.

Office Space

All candidate sites would require the construction of 80,000 ft^2 of office space, with the exception of Site 4. Site 4 could share 40,000 ft^2 of office space with other facilities in TA-IV. The cost to construct 40,000 ft^2 of office space for Site 4 was estimated at $7,500,000. The cost to construct 80,000 ft^2 of office space for all other sites was estimated to be $15,000,000.

3.2.4 Cost Discriminator Conclusions

Examination of Figure 3-1 shows that there are three distinct site groupings based on cost. Group 1 consists solely of Site 4, located within TA-II and adjacent to the TA-IV facilities. Group 2 consists of Sites 1, 2 and 3 which are within the physical confines of TA-1 but are outside of existing security perimeters (fences) and are not adequately serviced by utility feeds that are available nearby. Group 3 consists of the sites within the TA-III remote site. Within each of these groups, there are only minor cost variations; hence, for the purpose of this study there is not a sufficient basis to favor one site over other sites in the same group based on cost.

It is apparent from Figure 3-2 that the cost to provide utilities to the sites contributes less than 10 percent of the total cost. The site and infrastructure modifications such as new or upgraded roads and a new office building contribute between 35 percent (TA-III sites) and 70 percent (Site 4) of the total cost. Personnel costs for additional security and for lost work time for travel between other SNL/NM facilities account for between 27 percent (Site 4) and 55 percent (TA-III sites) of the total cost.

While the cost differences revealed in the cost discriminator evaluation may be small relative to the total construction and operational costs associated with NIF, they are useful

in comparing candidate sites against one another. A discussion of the evaluation of each candidate site with respect to each of the costing criteria follows.

Figure 3-1. Bar Chart Summary of Total Site Costs

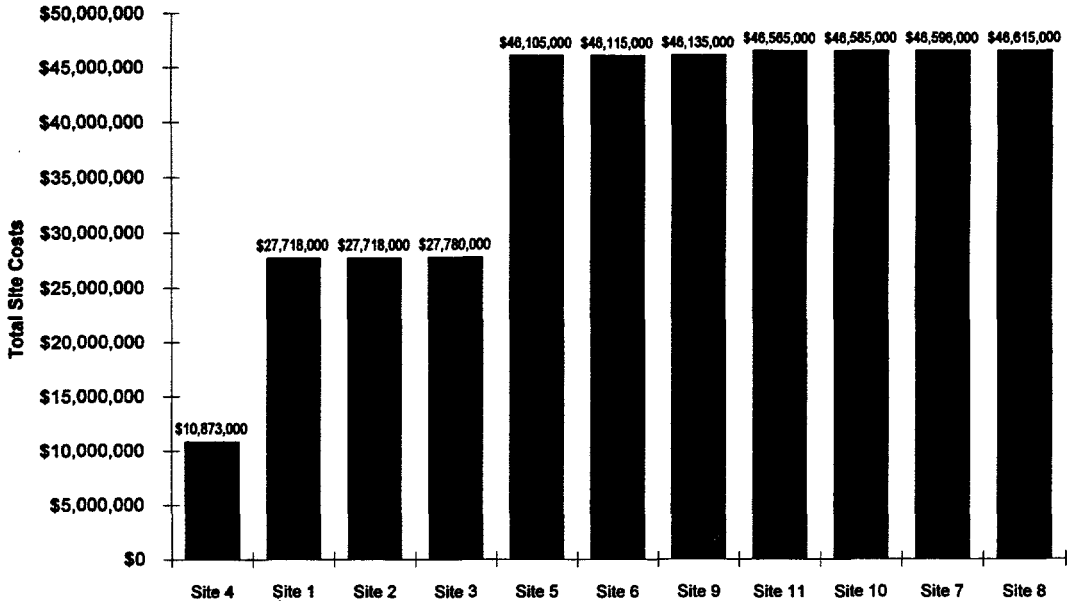
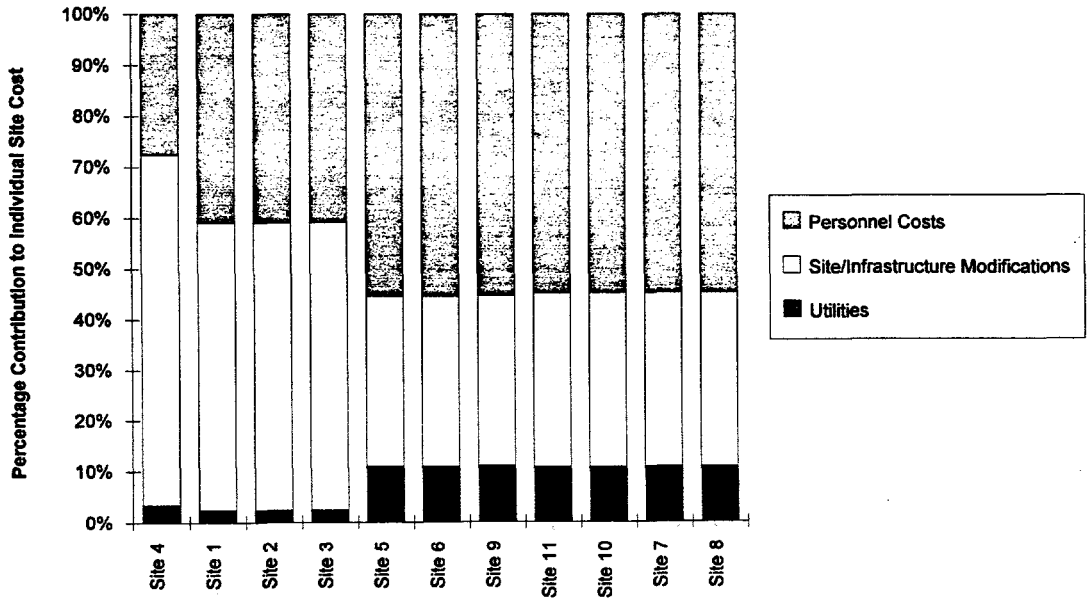


Figure 3-2. Bar Chart Summary of Percentage Contribution to Individual Site Cost



4.0 SNL/NM Site Selection Summary

All of the candidate sites meet fundamental criteria such as site size, potential natural phenomena effects, and requisite environmental and safety considerations. Thus, cost was used as the key site discriminator for selecting a site for the NIF at SNL/NM.

The preferred site based on the cost discrimination evaluation is Site 4 (see Table 3-1). Site 4 had the lowest construction and operation siting costs associated with the NIF. Relative to the other candidate sites, Site 4 would require the least costly upgrades to general, utilities, and building costs to meet the needs of the NIF program. There would be other inherent benefits to placing the NIF on this site as well. Site 4 is the only candidate site adjacent to facilities and support staff whose expertise is in technologically similar areas; it is the closest in proximity to existing utility outlets (i.e., sewer, gas lines, and electrical services) with adequate capacity for NIF; it would not require improvement of existing roads; intersite travel costs would be minimized; and it would be the most convenient site with respect to programmatic sharing of facilities and personnel located in TA-IV. Site 4 would also have the lowest cost associated with office space and security personnel.

The preferred site and its surroundings is shown in Figure 4-1. A close up schematic of the NIF conceptual layout at the preferred site is shown in Figure 4-2. Site 4 is located on land adjacent to TA-IV. TA-IV currently accommodates a number of pulsed-power, inertial confinement, and various other facilities which are technologically relevant to the mission of NIF. In addition to being the lowest cost alternative by a large margin, placing the NIF on this site has a number of recognizable benefits including:

- being adjacent to facilities and support staff in technologically compatible areas;
- close proximity to utility distribution facilities with adequate capacity, reliability, and quality;
- close proximity to support facilities;
- and the ability to conveniently share existing co-located TA-I and TA-IV facilities and personnel.

The other potential sites, while technically acceptable, lack the inherent advantages discussed above. While the cost differences revealed in this evaluation may be small relative to the total construction and operational costs associated with NIF, they are useful in comparing candidate SNL/NM sites against one another.

Figure 4-1. Vicinity of Candidate Site 4 - The Preferred Site

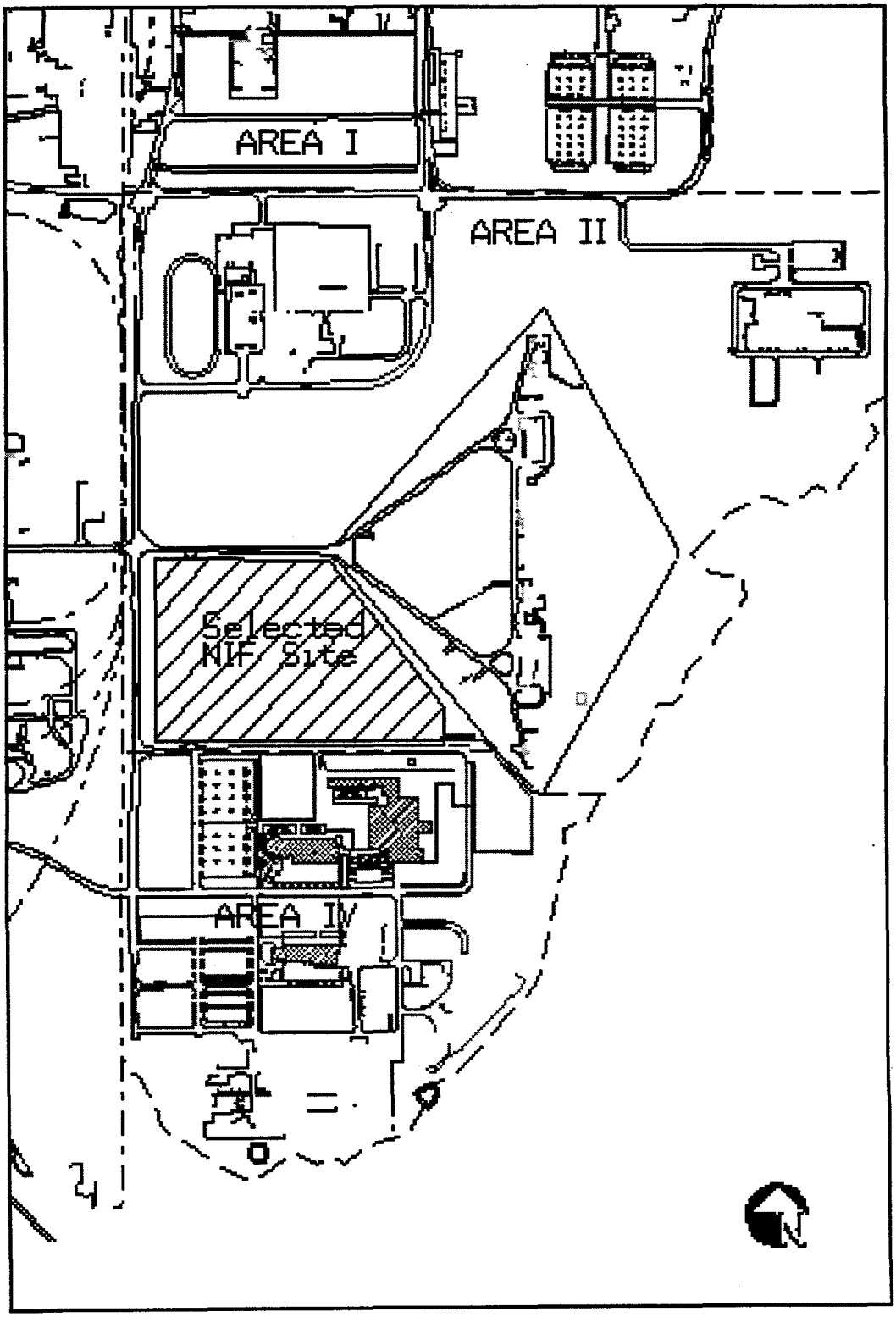
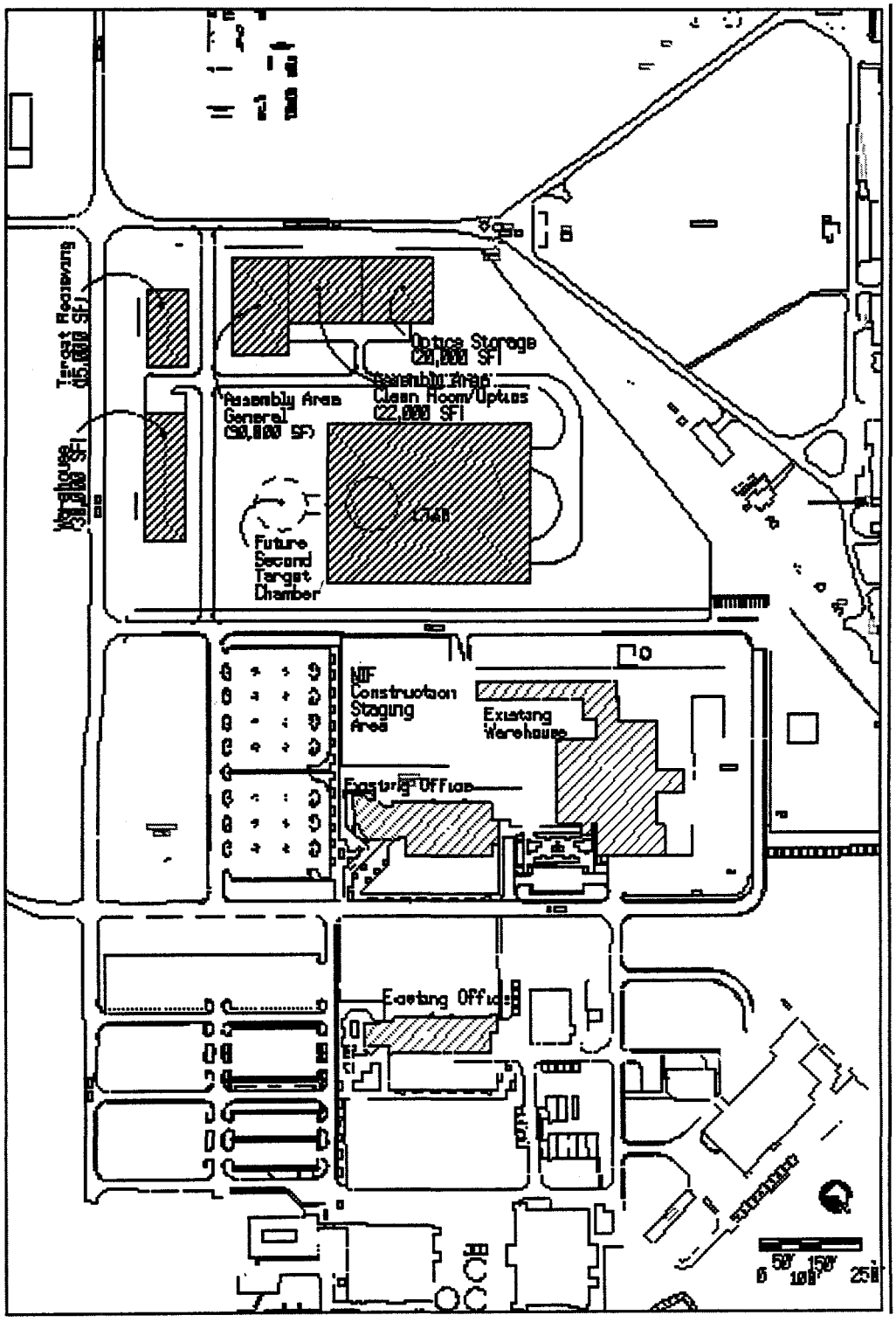


Figure 4-2. NIF Conceptual Layout at Candidate Site 4



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APPENDIX A

NIF SITE REQUIREMENTS

NIF Site and Facility Requirements

Facility specifications and site requirements for the NIF are documented in the NIF site requirements document (LLNL, 1994a). Significant site and facility requirements are summarized in Table A-1 and Table A-2, respectively. The site and facility requirements are discussed below.

Table A-1. Summary of NIF Site Requirements

Site Criteria	Criteria Statement
Flood	Low Hazard - UCRL 15910
Soil Instability	No surface faulting, liquifaction, or other instabilities.
Environmentally Sensitive Area Impacts	
Wetlands	No impact.
Endangered Species	No adverse impact.
Wildlife	No adverse impact.
Native American Religious Sites	No adverse impact.
Historical/Cultural Sites	No adverse impact
Pre-existing soil contamination	Must be environmentally restored.

Table A-2. Summary of NIF Facility Requirements

Building	Building Size	Electrical Power Requirements
LTAB		
Laser Bays	63,480 ft^2	15 MW
Target Area	16,000 ft^2	3 MW
LTAB Footprint	500 ft x 375 ft	N/A
Support Buildings		
Offices	80,000 ft^2	200 kW
Target Receiving Area	15,000 ft^2	200 kW
Target Assembly Area	22,000 ft^2	500 kW
General Assembly Area	30,000 ft^2	200 kW
Optics Maintenance	40,000 ft^2	300 kW
Optics Storage	20,000 ft^2	100 kW
Warehouse	30,000 ft^2	100 kW
Electrical/Mechanical Shops	12,000 ft^2	200 kW
Shipping/Receiving	14,000 ft^2	100 kW
Medical Building	7,500 ft^2	100 kW
Cafeteria	8,000 ft^2	100 kW
Garage/Gas Station	5,000 ft^2	100 kW
Fire Station	18,750 ft^2	200 kW
Security/Badging	1,200 ft^2	200 kW

APPENDIX B

DATA TABLES USED FOR THE COST DISCRIMINATOR EVALUATION

B.1 Cost Discriminator Data

The data and cost factors used to estimate the cost discriminators for the candidate sites are shown in Table B-1.

B.2 New Construction Required for all SNL/NM Sites

The following NIF buildings/functions will require new construction regardless of the SNL/NM candidate site that is chosen:

1) Laser and Target Area Building (LTAB)
2) Assembly Area (Clean Room/Optics)
3) Assembly Area (General)
4) Optics Maintenance
5) Optics Storage
6) Warehouse

B.3 Existing SNL/NM Buildings/Functions Available for NIF Support

The following functions could be supported by existing SNL/NM structures and personnel. These existing capabilities could be used to support the NIF regardless of the SNL/NM site that is chosen.

1) Electrical/Mechanical Shop, TA-I, Building 840
2) Shipping/Receiving, TA-I, Building 857
3) Medical Building, TA-I, Building 831
4) Cafeteria, TA-I, Building 861
5) Garage/Gas Station, TA-I, Buildings 873, 874, 875, 876
6) Fire Station, Kirtland Air Force Base
7) Security/Badging, TA-I, Building 800

B.4 Endangered Species

A recent study conducted for SNL/NM has identified nine sensitive plant species and thirteen sensitive wildlife species that could potentially occur on KAFB (ITC, 1995). These plant and wildlife species are identified in Table B-2 and Table B-3, respectively. The species that could potentially be found have such a low probability of inhabiting the area that one cannot assume they occur without actually sighting them in the field. Thus, no endangered group is known to occur, nor do the candidate sites contain any critical habitat areas (Fischer, 1990). However, a walk-through survey for endangered species would be performed prior to Title II design to verify the absence of endangered species. For this site evaluation, it is assumed that no endangered species exist on the candidate sites.

Table B-1. Cost Discriminator Data

NIF Site			1	2	3	4	5	6	7	8	9	10	11
Jupiter Site			1	7	9	11	18	19	20	21	22	23	24
COST DIFFERENTIAL CRITERIA													
Flood Plane Remediation			$0	$0	$0	$0	$0	$0	$500,000	$500,000	$0	$500,000	$500,000
Water													
Supply	Dist needed (ft)					1455	11640	11640	11640	11640	11640	11640	11640
	Cost ($50/ft)		$0	$0	$0	$72,750	$582,000	$582,000	$582,000	$582,000	$582,000	$582,000	$582,000
Sewer	Dist needed (ft)					0	11640	11640	11640	11640	11640	11640	11640
	Cost ($30/ft)		$0	$0	$0	$0	$349,200	$349,200	$349,200	$349,200	$349,200	$349,200	$349,200
Storm						$300,000	$0	$0	$0	$0	$0	$0	$0
Similar to TIOC Costs			$635,000	$635,000	$635,000								
Natural Gas	Dist needed (ft)		1000	1000	2000	0	5000	6000	4100	6000	8000	3000	1000
	Cost ($10/ft)		$10,000	$10,000	$20,000	$0	$50,000	$60,000	$41,000	$60,000	$80,000	$30,000	$10,000
	Meeter/Regulator Station		$25,000	$25,000	$25,000	$0	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
Electricity 115 Kv	Dist needed (mi)		0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Cost ($1 mil/mi.)		$0	$0	$0	$0	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
	Substation (18/21/24)		$0	$0	$0	$0	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
	Breaker Station		$0	$0	$0	$0	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000
Utility Subtotal			$670,000	$670,000	$680,000	$72,750	$5,006,200	$5,016,200	$5,497,200	$5,516,200	$5,036,200	$5,486,200	$5,466,200
Road Costs													
New Roads	Area	Dist (ft)				0	2910	2910	2910	2910	2910	2910	2910
		Width (ft)				0	30	30	30	30	30	30	30
	Cost ($2/ft2)		$0	$0	$0	$0	$174,600	$174,600	$174,600	$174,600	$174,600	$174,600	$174,600
Improve-ments	Area	Dist (ft)					11640	11640	11640	11640	11640	11640	11640
		Width (ft)					30	30	30	30	30	30	30
	Cost ($1/ft2)		$0	$0	$0	$0	$349,200	$349,200	$349,200	$349,200	$349,200	$349,200	$349,200
General Estimate			$700,000	$700,000	$700,000								
Road Subtotal			$700,000	$700,000	$700,000	$0	$523,800	$523,800	$523,800	$523,800	$523,800	$523,800	$523,800
Additional Buildings													
	Offices (80,000 ft2)		$15,000,000	$15,000,00	$15,000,000	$7,500,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000
Security Personnel Costs													
	Number of Personnel Needed		3	3	3	1	6	6	6	6	6	6	6
	Cost per Person-year ($150K)		$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
	Project Years		20	20	20	20	20	20	20	20	20	20	20
	Total Security Personnel Costs		$9,000,000	$9,000,000	$9,000,000	$3,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000	$18,000,000
Shared Personnel Resource Costs													
	Person Trips/day		30	30	30	0	30	30	30	30	30	30	30
	Round Trip Time from TA-IV (hr)		0.333	0.333	0.333	0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Employee Cost ($50/hr)		50	50	50	50	50	50	50	50	50	50	50
	Days/yr		235	235	235	235	235	235	235	235	235	235	235
	Project Years		20	20	20	20	20	20	20	20	20	20	20
	Total Lost Costs		$2,347,650	$2,347,650	$2,347,650	$0	$10,575,000	$10,575,000	$10,575,000	$10,575,000	$10,575,000	$10,575,000	$10,575,000
Environmental Restoration Costs					$51,447								
TOTAL COST DIFFERENTIAL			$27,717,650	$27,717,65	$27,779,097	$10,572,750	$49,105,000	$49,115,000	$49,596,000	$49,615,000	$49,135,000	$49,585,000	$49,565,000

Table B-2. Sensitive Plant Species Potentially Occurring on Kirtland Air Force Base, New Mexico

Common Name	Scientific Name	Status[1]	Comments
Cyanic milkvetch	*Astragalus cyaneus*	L2	Known to occur in Bernalillo County but not recorded on KAFB
Santa Fe milkvetch	*Astragalus feensis*	L2	Known to occur on KAFB
Wright's pincushion cactus	*Mammillaria wrightii*	L1	Known to occur on KAFB
Visnagita cactus	*Neolloydia intertexta*	L1	Known to occur on KAFB
Strong prickly pear	*Opuntia valida*	L3	Known to occur in Bernalillo County but not recorded on KAFB
Grama grass cactus	*Pediocactus (Toumeya) papyracanthus*	L1, C2, FSS	Known to occur on KAFB
Simpson's cactus	*Pediocactus simpsonii*	L1	Known to occur in Bernalillo County but not recorded on KAFB
Plank's catchfly	*Silene plankii*	L2, 3C	Known to occur in Bernalillo County but not recorded on KAFB
Great Plains lady tresses	*Spiranthes magnicamporum*	L1	Known to occur in Bernalillo County but not recorded on KAFB

[1]Status codes:

L1 - New Mexico Forestry and Resource Conservation Division List 1, endangered
L2 - New Mexico Forestry and Resource Conservation Division List 2, rare and sensitive
L3 - New Mexico Forestry and Resource Conservation Division List 3, under review
C2 - U.S. Fish and Wildlife Service C2 candidate species
3C - U.S. Fish and Wildlife Service dropped from review list
FSS - U.S. Forest Service sensitive

Table B-3. Sensitive Wildlife Species Potentially Occurring on Kirtland Air Force Base, New Mexico

Common Name	Scientific Name	Status[2]	Comments
	Reptiles		
Texas horned lizard	*Phrynosoma cornutum*	C2	Known to occur on KAFB
	Birds		
"Apache" northern goshawk	*Accipiter gentilis apache*	C2	Migrant; known to occur in Bernalillo County but not recorded on KAFB
Ferruginous hawk	*Buteo regalis*	C2	Known to occur in Bernalillo County but not recorded on KAFB
Peregrine falcon	*Falco peregrinus*	FE, G1	Known to occur in Bernalillo County but not recorded on KAFB
Mexican spotted owl	*Strix occidentalis lucidia*	FT	Not know from KAFB
Southwestern willow flycatcher	*Empidonax traillii extimus*	C1, G2	Known to occur in Bernalillo County but not recorded on KAFB
Gray vireo	*Vireo vincinior*	G2	Known to occur on KAFB
Baird's sparrow	*Ammodramus bairdii*	G2	Known to occur in Bernalillo County but not recorded on KAFB
	Mammals		
Spotted bat	*Euderma maculatum*	C2, G2	Known to occur in Bernalillo County but not recorded on KAFB
Greater western mastiff bat	*Eumops perotis californicus*	C2	Known to occur in Bernalillo County but not recorded on KAFB
Occult little brown bat	*Nyotis lucifugus occultus*	C2	Known to occur in Bernalillo County but not recorded on KAFB
Black-footed ferret	*Mustela nigripes*	FE	No records to occur in New Mexico
"New Mexican" meadow jumping mouse	*Zapus hudsonius luteus*	C2, G2	Known to occur in Bernalillo County but not recorded on KAFB

[2]Status codes:

FE - Federally listed as endangered
FT - Federally listed as threatened
C1 - U.S. Fish and Wildlife Service C1 candidate species
C2 - U.S. Fish and Wildlife Service C2 candidate species
G1 - New Mexico Department of Game and Fish endangered group 1
G1 - New Mexico Department of Game and Fish endangered group 2

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