2.2 ALTERNATIVES CONSIDERED BUT ELIMINATED

As set forth in ER Section 1.1, Purpose and Need for the Proposed Action, LES considered primary alternatives to the proposed action, i.e., alternatives to the construction and operation of the NEF. These alternatives include alternative sources of low-enriched uranium (LEU) currently available and potentially available to US nuclear utilities in the future, such as the future deployment of a gaseous centrifuge plant by USEC; expansion by Urenco of its centrifuge capability in Europe; increased sales of HEU-derived LEU under the US-Russia HEU Agreement; and increased availability of LEU derived from US-owned HEU. The alternatives considered do not meet the underlying need for the proposed NEF, which is to provide additional reliable and economical uranium enrichment capacity in the United States, in accordance with US energy and security policy objectives. The alternatives considered similarly fail to meet the important related commercial objectives of enhancing security of supply and eliminating dependence on a single domestic enricher. Additionally, various combinations of technical, economic, and political uncertainties associated with the alternatives identified in ER Section 1.1.2 warrant their elimination from further consideration in this ER. However, for completeness, the environmental impacts of several of the alternatives are compared to those of the proposed action in ER Section 2.4, Comparison of the Affected Environment.

LES also considered various secondary alternatives to the proposed action. These include alternative enrichment technologies, design alternatives, and alternative sites.

With respect to alternative technologies, LES considered the gaseous diffusion technology as an alternative method for enriching uranium, in so far as it is the only presently commercially viable process that allows for enrichment of uranium on the scale sought by LES for the proposed NEF. LES concluded that the gas centrifuge process is superior because the production of the same amount of separative work units (SWU) by the gaseous diffusion process requires approximately 50 times more electricity. Indeed, as evidenced by its Lead Cascade Project, USEC intends to replace its use of the gas diffusion technology with the use of a gas centrifuge technology.

With respect to alternative designs, LES considered six system design changes from the Claiborne Enrichment Center to the NEF that would reduce the impact to the environment (see ER Section 2.1.3.2, Alternative Designs). The systems changed to improve plant efficiency and reduce environmental impact include the Cascade System, Feed System, Product Take-Off System, Product Liquid Sampling System, Product Liquid Sampling System, Product Blending System, and Tails Take-Off System. Beyond minor changes, there are no other significant design alternatives that could lower the impact of the NEF on the environment.

With respect to alternative sites, six sites passed the first phase Go/No Go criteria (see ER Section 2.1.3.3). Eddy County and Lea County scored the highest (first and second, respectively) followed by Bellefonte third and Hartsville fourth, with Carlsbad and Portsmouth scoring fifth and sixth, respectively. Although the Eddy County Site scored highest, it is to be noted that the Eddy County Site is currently owned by the U. S. Bureau of Land Management (BLM), not by Eddy County or the City of Carlsbad. The Carlsbad Field Office of the BLM has stated that they will work hard to complete the National Environmental Policy Act (NEPA) process for transferring (or swapping) the land within 9 to 12 months, but they cannot guarantee the outcome of the NEPA process. There is a potential that the subject site may not be available for siting the new enrichment plant.

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2.3 CUMULATIVE EFFECTS

Cumulative impacts are those impacts that result from the incremental impact of an action added to other past, present, and reasonably foreseeable actions in the future. In conducting this analysis, LES considered past, current and potential facilities and activities that could have some potential for cumulative impacts.

The anticipated cumulative impacts of the proposed operation of NEF are expected to be inconsequential, thus any incremental accumulative impacts caused by NEF should also be inconsequential. Development as an enrichment facility would also avoid impacts to other more environmentally sensitive sites.

There are several local County and private activities in geographic proximity that could potentially combine with the NEF operations to produce a larger impact than the NEF alone. These facilities are: 1) the Waste Control Specialist, LLC facility that is 1.6 km (1.0 mi) due east from NEF; 2) the Wallach Concrete, Inc. quarry that is located just north of NEF; 3) the Lea County landfill which is across New Mexico Highway 234, approximately 1.6 km (1 mi) south; the Sundance Industries "produced water" treatment facility collocated with the Wallach quarry; and 5) the oil and gas industries that are pervasive throughout southeastern New Mexico. A summary assessment of the potential for cumulative impacts is shown in Table 2.3-1, Potential Cumulative Effects for the NEF.

The potential local cumulative effects with the greatest likelihood of occurring are: decrements in air quality (increases in Total Suspended Particulate (TSP)) from combined WCS, Lea County landfill and TSP releases that can occur during NEF construction; increased environmental noise levels from the Lea County landfill and Wallach Concrete, Inc. quarry operations combined with NEF construction; and small increases in the environmental radiation public dose and radiological waste inventories should WCS seek and obtain a low-level radiation waste burial site (10 CFR 61) license (CFR, 2003r). The former two cumulative impacts are transient and will potentially exist only during the 8-year NEF construction period. The latter cumulative effect is speculative since it is unknown at this time if WCS will apply for or be granted a 10 CFR 61 license. Even if these cumulative impacts come to fruition, the cumulative impacts will be limited by regulatory limits and/or the lack of general public receptors residing near these facilities.

A fourth potential cumulative effect is that from the DOE Waste Isolation Pilot Plant (WIPP), located approximately 80 km (50 mi) west of the NEF. The WIPP facility is storing high-level transuranic wastes generated from the DOE weapons program. Since these wastes are drastically different in composition and activity levels, approximately 80 km (50 mi) away, as well as the WIPP wastes being stored in deep underground salt mine shafts, it is not plausible that a cumulative effect would occur between WIPP and the NEF.

The only other non-local cumulative impact is the cumulative dose to the general public from transportation of UF_6 as feed, product or depleted material and solid waste. Also, there is a dose to the onlooker, worker and driver. LES calculations (see Section 4.2.7, Radioactive Material Transportation) have showed the "worst-case" dose to have minimal impact. Dose equivalent to the general public from the "worst case", for instance, equalled 2.33×10^{-6} Sv (2.33×10^{-4} rem). Similarly, the dose equivalent to the onlooker, driver and worker totaled 1.05×10^{-3}, 9.47×10^{-2}, 6.98×10^{-4} Sv (1.05×10^{-1}, 9.47 and 6.98×10^{-2} rem), respectively. These values

are well below the regulatory limits established by the NRC (10 CFR 20) or the EPA (40 CFR 190), (CFR, 2003q; CFR, 2003f).

The sum total of all local and non-local cumulative impacts and effects are expected to be insignificant or very minor when compared to the established federal, state and local regulatory limits. Negative cumulative effects will be balanced by positive cumulative effects, such as the expansion of job opportunities that will diversify the employment opportunities and expand the local tax base and revenues.

TABLES

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Table 2.3-1 Potential Cumulative Effects for the NEF

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ER Section Reference	Effect on:	NEF Effect	Cumulative Effects
4.1	Land Use	Insignificant	None, based on current and expected future activities. NEF is compatible with current land usage
4.2	Transportation	Minor, 1,400 additional heavy truck shipments per year	Cumulative effect will not be noticeable on the highway to the site because of existing traffic volume and mix
4.3	Geology & Soils	Minimal	None
4.4	Water Resources	Minor and not likely to affect water resources. Site groundwater will not be used	Not expected due to depth of groundwater and lack of surface waters.
4.5	Ecological	Minimal	None, no local habitats for RTE species
4.6	Air Quality	Minimal. Increased TSP emissions during construction	Potentially minor cumulative TSP effects when combined with WCS and Lea County landfill operations
4.7	Noise	Not significant. Increased noise levels during construction, but few nearby receptors	Potentially minor cumulative environmental noise effects when combined with WCS and Lea County landfill operations
4.8	Historic and Cultural	Minor negative effects that can be avoided or mitigated	No measurable change since effects are confined to onsite
4.9	Visual/Scenic Resources	Generally positive because of natural landscaping. None out of character with existing features.	Not significant since positive effects are confined to onsite

Table 2.3-1 Potential Cumulative Effects for the NEF
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ER Section Reference	Effect on:	NEF Effect	Cumulative Effects
4.10	Socioeconomic	Positive	Cumulative effects will be positive when combined with other local industries and increase job opportunities, income and tax revenues.
4.11	Environmental Justice	No disproportionate impact or effect.	None
4.12	Public & Occupational Health	Increased environmental radiation exposure that are below limits.	Potentially minor cumulative environmental radiation levels should WCS obtain a 10 CFR 61 license
4.13	Waste Management	Minimal. Minor increased quantities of hazardous and radiological wastes	Potentially minor cumulative waste effects (total local inventory) should WCS obtain a 10 CFR 61 license. Unlikely that any cumulative effect would result from the WIPP facility.

2.4 COMPARISON OF THE PREDICTED ENVIRONMENTAL IMPACTS

As noted in ER Section 1.1.2., there are various scenarios if the NEF is not built, i.e., the no-action alternative scenarios. However, only three of the eight scenarios discussed are relevant when comparing domestic environmental impacts (B, C and D). The other scenarios (A, E, F, G, and H) are irrelevant when comparing domestic environmental impacts because they either include the proposed action (A) or require an analysis of environmental impacts in Europe (E, F and G), which is outside of the scope required to be considered in the National Environmental Policy Act, or is a scenario that must be recognized as being highly speculative (H). The anticipated affect to the environment for these no-action alternative scenarios, Scenarios B, C, and D, are described below.

Table 2.4-1, Comparison of Potential Impacts for the Proposed Action and the No-Action Alternative Scenarios, summarizes the potential impacts of each scenario and compares them against the proposed action in terms of domestic capacity and supply. It also lists the summary of individual environmental categories used in Chapter 4, Environmental Impacts.

Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios, compares each scenario against the proposed action for Chapter 4 environmental categories in relative terms, i.e., impacts are the same, greater than, or less than those anticipated for the proposed action. Chapter 4 contains the detailed description of potential impacts of the proposed action on individual resources of the affected environment.

Proposed Action

Under the proposed action, LES deploys a 3 million SWU/yr centrifuge enrichment plant (NEF), and USEC deploys a 3.5 million SWU/yr centrifuge enrichment plant. USEC is assumed to cease enrichment production at the Paducah Gaseous Diffusion Plant (GDP) when the centrifuge plant comes on line.

Scenario B – No NEF; USEC Deploys Centrifuge Plant and Continues to Operate Paducah GDP

Under this scenario, there is a 3 million SWU per year supply deficit, but is made up by USEC, operating a 3.5 million SWU per year centrifuge enrichment plant and continuing to operate the Paducah GDP at 3 million SWU per year or less. This would, however, have a significant negative impact on operational efficiencies at the Paducah GDP. It would also continue to have negative environmental impacts due to the high energy costs of operating the Paducah GDP and the related air quality impacts from operating the coal-fired electric power stations that supply the required electrical needs of the plant.

While providing for indigenous US supply, the resulting concerns associated with the age of the Paducah GDP, its significant requirements for electric power, the low level at which it would have to be operated, and the lack of multiple competitive sources of indigenous US supply, would not alleviate concerns among US purchasers of enrichment services regarding either long-term security of supply or reasonable economics. Scenario B is not viewed by LES as an attractive long-term solution.

Scenario C – No NEF; USEC Deploys Centrifuge Plant and Increases Centrifuge Plant Capability

Under this scenario, there is a 3 million SWU per year supply deficit for which other sources of supply must compensate. This supply capability is made up by USEC, who would proceed to build and operate a 3.5 million SWU per year centrifuge enrichment plant, continue to operate the Paducah GDP on an interim basis longer than currently planned, and then rapidly increase its centrifuge enrichment plant capability to 6.5 million SWU per year. Negative environmental impacts would continue for a limited time with the operation of the Paducah GDP, as in Scenario B.

Scenario C provides for indigenous US supply. However, there are concerns that neither the performance nor economics of the updated version of the DOE centrifuge technology that USEC is planning to use have been successfully demonstrated at a commercial level nor will the outcome be known for a number of years. There also would remain an ongoing absence of multiple competitive sources of indigenous US supply. Accordingly, this may not alleviate concerns among US purchasers of enrichment services regarding either long-term security of supply or reasonable economics. Given the dependence on a single yet to be proven technology and the ongoing presence of a single indigenous US enricher, Scenario C is not viewed by LES as the most advantageous long-term solution.

Scenario D – No NEF; USEC Does Not Deploy Centrifuge Plant and Operates Paducah GDP at Increased Capacity

Under this scenario, there is a 6.5 million SWU per year supply deficit for which other sources of supply must compensate. USEC would then continue to operate the Paducah GDP at 6.5 million SWU per year. Given the unfavorable economics of continued GDP operation, this would be viewed as having a high economic cost associated with it and continued negative environmental impacts.

At some point in time, it is reasonable to assume that the Paducah GDP must ultimately be replaced. Accordingly, Scenario D does not represent a permanent solution, but only a postponement of the time when new uranium enrichment capacity must be constructed in the US The cost of such a postponement is likely to be high and the risk of supply disruption in the US would increase as the Paducah GDP continues to age. While providing for indigenous US supply, the resulting concerns associated with the age of the Paducah GDP, its significant electric power requirements, and the lack of multiple competitive sources of indigenous US supply, would not alleviate concerns among US purchasers of enrichment services regarding either long term security of supply or reasonable economics. Scenario D is not viewed by LES as a viable long-term solution.

USSummary

Not building the NEF could have the following consequences:

- A uranium enrichment supply deficit for which other sources of supply must compensate.

- Continued operation of an aging technology at a high-cost, electric power intensive facility, the Paducah GDP, or new technologies that have a larger production capacity, but concentrated in one location.
- Foster the continuation of a single, indigenous supplier, thereby eliminating competition.
- Diminish the objective of long-term security of supply.

Accordingly, LES considers that the NEF would be a complementary and competitive supplier for uranium enrichment service and would provide a means to offset both foreign enrichment supplies and the more energy-intensive production from the only US gaseous diffusion plant, with lesser environmental impacts.

While the no-action alternative scenarios would avoid any impacts to Lea County, New Mexico and Andrews County, Texas areas due to construction and operation of the NEF, it would lead to impacts at other locations. If the proposed NEF is not built, there will be a continued and increasing need for uranium enrichment services. The no-action alternative scenarios, as discussed above, would allow for at least three domestic options in regard to continued uranium enrichment supply, Scenarios B, C and D.

As summarized in Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios, the affects to the environment of all no-action alternative scenarios are anticipated to be greater than the proposed action in both the short and long term. There are potentially lesser impacts, in some environmental categories, but this is based on an unproven commercially demonstrated technology. In addition, the important objective of security of supply is delayed. Hence, it is reasonable to reject the no-action alternative scenarios because the affect to the environmental from the proposed action is minimal, as demonstrated in ER Chapter 4, Environmental Impacts, and the benefits desirable, as demonstrated in ER Chapter 7, Cost-Benefit Analysis.

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TABLES

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Table 2.4-1 Comparison Of Potential Impacts For The Proposed Action And The No-Action Alternative Scenarios

Potential Impact	Proposed Action[1]	Alternative Scenarios		
		B - No NEF; USEC Deploys Centrifuge Plant and Continues to Operate Paducah GDP	C - No NEF; USEC Deploys Centrifuge Plant and Increases Centrifuge Plant Capability	D - No NEF; USEC Does Not Deploy Centrifuge Plant and Operates Paducah GDP at Increased Capacity
Domestic Capacity	Provides 3 million SWU/yr supply (NEF only)	3 million SWU/yr deficit; make up from continued operation of Paducah GDP at 3 million SWU/yr	3 million SWU/yr deficit; make up by USEC building gaseous centrifuge plant (GCP), operating Paducah on interim basis longer than planned, and then rapidly increasing GCP capability to 6.5 million SWU/yr	6.5 million SWU/yr deficit; make up from continued operation of Paducah GDP at 6.5 million SWU/yr
Domestic Supply	Fosters competition; two suppliers; secures long-term supply; reduces security of supply concerns by providing replacement supply for inefficient and noncompetitive gaseous diffusion enrichment plants	One supplier only; does not alleviate security of supply; unproven commercially demonstrated technology; reliance on aging high-cost, inefficient GDP technology	One supplier only; does not alleviate security of supply; unproven commercially demonstrated technology	One supplier only; not permanent, only maintains status quo; does not alleviate security of supply concerns because of reliance on aging, high-cost, inefficient GDP technology
Summary of Environmental Impacts (see Table 2.4-2 for list of categories)	Total Scoring[2]: 0	Total Scoring[2]: -4	Total Scoring[2]: -5 to -2	Total Scoring[2]: -7

[1]Proposed action assumes both LES and USEC deploy centrifuge plants and GDP is shutdown when USEC centrifuge plant comes on line. The proposed action receives a neutral score of zero (i.e., baseline impact on the environment).

[2]Scoring Methodology (all Alternative Scenarios compared against Proposed Action). Positive score means less impacts on the environment than proposed action. Negative score means greater impacts on the environment than proposed action.

Table 2.4-2 Comparison of Environmental Impacts For The Proposed Action And The No-Action Alternative Scenarios

Environmental Category	Proposed Action[2]	Alternative Scenarios[1,3]		
		B: No NEF, USEC Deploys Centrifuge Plant and Continues to Operate Paducah GDP	C: No NEF, USEC Deploys Centrifuge Plant and Increases Centrifuge Plant Capability	D: No NEF, USEC Does Not Deploy Centrifuge Plant and Operates Paducah GDP at Increased Capacity
Land Use	Minimal for NEF (see ER Section 4.1)	Less impact since only one of two gas centrifuge plants (GCPs) are built Scoring: +1	Same impact if undisturbed land, less impact if already disturbed land Scoring: 0 or +1 (use +0.5)	Less impact Scoring: +1
Transportation	Minimal for NEF (see ER Section 4.2)	Greater impact if at Paducah because concentrating shipments at one location or same impact if at other location Scoring: -1 or 0 (use -0.5)	Greater impact because concentrating shipments at one location Scoring: -1	Greater impact because concentrating shipments at one location Scoring: -1
Geology and Soils	Minimal for NEF (see ER Section 4.3)	Less impact since only one of two GCPs are built Scoring: +1	Same impact if undisturbed land, less impact if already disturbed land Scoring: 0 or +1 (use +0.5)	Less impact Scoring: +1
Water Resources	Minimal for NEF; low water use (see ER Section 4.4)	Greater impact because of greater water use by GDP and high water use to meet GDP electricity needs Scoring: -1	Greater impact for short term because of greater water use by GDP and high water use to meet GDP electricity needs; same or greater impact for the long term Scoring: -1 or -0.5	Significantly greater impact than Alternative Scenario B because of increased GDP capacity Scoring: -1.5
Ecological Resources	Minimal for NEF (see ER Section 4.5)	Greater impact since continued GDP operation and associated electric generation demand increases impact on ecological resources	Same or greater impact if concentrating at one location	Significantly greater impact than Alternative Scenario B because of increased electric energy demand to support increased GDP capacity

Table 2.4-2 Comparison of Environmental Impacts For The Proposed Action And The No-Action Alternatives

Environmental Category	Proposed Action[2]	Alternative Scenarios[1,3]		
		B No NEF, USEC Deploys Centrifuge Plant and Continues to Operate Paducah GDP	C No NEF, USEC Deploys Centrifuge Plant and Increases Centrifuge Plant Capability	D No NEF, USEC Does Not Deploy Centrifuge Plant and Operates Paducah GDP at Increased Capacity
		Scoring: -1	Scoring: -0.5	Scoring: -1.5
Air Quality	Minimal for NEF; less than regulatory limits (see ER Section 4.6)	Greater impact since continued GDP operation and associated electric generation demand increases impact on air quality Scoring: -1	Greater impact in short term because of continued GDP operation and associated electric generation demand; same or greater impact in long term due more production at one location Scoring: -1 or -0.5	Significantly greater impact than Alternative Scenario B because of increased electric energy needs to support increased GDP. capacity Scoring: -1.5
Noise	Minimal for NEF; within HUD and EPA limits (see ER Section 4.7)	Greater impact due to operation of electric generation to support GDP Scoring: -1	Greater impact in short term due to operation of electric generation to support GDP and concentration in one location; same or greater impact in long term due to concentration in one location Scoring: -1 or -.5	Significantly greater than Alternative Scenario B because of increased electric energy demand to support increased GDP capacity Scoring: -1.5
Historic and Cultural	Minimal for NEF; impacts can be avoided or mitigated (see ER Section 4.8)	Same or less impact Scoring: +0.5	Same or less impact Scoring: +0.5	Less impact since no new facility is constructed Scoring: +1
Visual/Scenic	Minimal for NEF; no visual impacts out of character with existing site (see ER Section 4.9)	Less impact since only one of two GCPs are built	Same or less impact	Less impact since no new facility is constructed

Table 2.4-2 Comparison of Environmental Impacts For The Proposed Action And The No-Action Alternatives

Environmental Category	Proposed Action[2]	Alternative Scenarios[1,3]		
		B: No NEF; USEC Deploys Centrifuge Plant and Continues to Operate Paducah GDP	C: No NEF; USEC Deploys Centrifuge Plant and Increases Centrifuge Plant Capability	D: No NEF; USEC Does Not Deploy Centrifuge Plant and Operates Paducah GDP at Increased Capacity
		Scoring: +1	Scoring: +0.5	Scoring: +1
Socioeconomic	Positive impact to economy due to NEF (see ER Section 4.10)	Less impact positive impact since only building one versus two plants Scoring: -1	Same or less positive impact Scoring: -0.5	Less positive impact since not building two new plants Scoring: -1
Environmental Justice	No disproportionate impact for NEF (see ER Section 4.11)	Same impact Scoring: 0	Same impact Scoring: 0	Same impact Scoring: 0
Public and Occupational Exposure	Minimal for NEF; doses below NRC and EPA regulatory limits (see ER Section 4.12)	Greater impact due to more effluents and operational exposure at GDP Scoring: -1	Greater impact in short term due to more effluents and operational exposure at GDP; same or greater impact in long term Scoring: -1 or -.5	Even greater impact than Alternative Scenario B because of increased GDP capacity Scoring: -1.5
Waste Management	Minimal for NEF; reduced waste streams due to new and highly efficient technology (see ER Section 4.13)	Greater impact because GDP waste stream larger Scoring: -1	Greater impact in short term because GDP waste stream larger; same in long term Scoring: -1 or 0	Even greater impact than Alternative Scenario B because of increased GDP capacity Scoring: -1.5

[1]If impact was unknown, the impact was conservatively assumed to be the same or less than proposed option.

[2]Proposed action assumes both LES and USEC deploy centrifuge plants and GDP is shutdown when USEC centrifuge plant comes on line. The proposed action receives a neutral score of zero (i.e., baseline impact on the environment).

[3]Scoring Methodology (all Alternative Scenarios compared against Proposed Action). Positive score means less impacts on the environment than proposed action. Negative score means greater impacts on the environment than proposed action.

Less +1
Same or less +0.5
Same 0
Same or less positive -0.5
Same or greater -0.5
Less positive -1
Greater -1
Significantly greater -1.5

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3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

This chapter provides information and data for the affected environment at the proposed National Enrichment Facility (NEF) and surrounding vicinity. Topics include land use (3.1), transportation (3.2), and geology and soils (3.3), as well as various resources such as water (3.4), ecological (3.5), historic and cultural (3.8), and visual/scenic (3.9). Other topics included in this chapter are meteorology, climatology, and air pollution (3.6), environmental noise (3.7), socioeconomic information (3.10), public and occupational health (3.11), and waste management (3.12).

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3.1 LAND USE

This section describes land uses near the proposed NEF site. It also provides a discussion of off-site areas and the regional setting and includes a map of major land use areas. Major transportation corridors are identified in Section 3.2.

The proposed NEF site is situated within Lea County, on the north side of New Mexico Highway 234, about 0.8 km (0.5 mi) from the New Mexico/Texas state line. It is currently owned by the State of New Mexico and a 35-year easement has been granted to LES. Except for a gravel covered road which bisects the east and west halves of the property, it is undeveloped and utilized for domestic livestock grazing. A barbed wire fence runs along the east, south and west property lines. The fence along the north property line has been dismantled. An underground carbon dioxide pipeline, running southeast-northwest, traverses the site and an underground natural gas pipeline is located along the south property line.

Surrounding property consists of vacant land and industrial developments. A railroad spur borders the site to the north. Beyond is a sand/aggregate quarry. A vacant parcel of land is situated immediately to the east. Cattle grazing is not allowed on this vacant parcel. Cattle grazing on nearby sites occurs throughout the year. Further east, at the state line and within Andrews County, Texas is a hazardous waste treatment and disposal facility. A landfill is south/southeast of the site, across New Mexico Highway 234 and a petroleum contaminated soil treatment facility is adjacent to the west. Refer to ER Section 2.1.2, Proposed Action, for further discussion of these facilities. Land further north, south and west has been mostly developed by the oil and gas industry. Refer to Section 3.3, Geology and Soils, for further discussion on mineral resources in the site vicinity. Land further east is ranchland. The nearest residences are situated approximately 4.3 km (2.63 mi) west of the site. Beyond is the city of Eunice, which is approximately 8 km (5 mi) to the west. There are no known public recreational areas within 8 km (5 mi) of the site. There is a historical marker and picnic area approximately 3.2 km (2 mi) from the site at the intersection of New Mexico Highways 234 and 18. Transportation corridors are discussed in ER Section 3.2, Transportation. A discussion of schools and hospitals is included in ER Section 3.10, Socioeconmic.

The site and vicinity are located near the boundary between the Southern High Plains Section (Llano Estacado) of the Great Plains Province to the east and the Pecos Plains Section to the west. The boundary between the two sections is the Mescalero Escarpment, locally referred to as Mescalero Ridge. The Elliott Littman field is to the north, Drinkard field to the south and the Monument Jal field to the west. On-site soils are primarily of the Brownfield-Springer association and Kermit Soils and Dune Land. These soils consist of fine sand, loamy fine sand and loose sands surrounding large barren sand dunes. On-site soils are common to areas used for rangeland and wildlife habitat.

Referring to Table 3.1-1a, Land Use Within 8 km (5 mi) of the NEF Site Classification and Area, and Table 3.1-1b, Land Use Within 8 km (5 mi) of the NEF Site Classification Descriptions, and Figure 3.1-1, Land Use Map, rangeland comprises 98.5% of the area within an 8-km (5-mi) radius of the NEF site, encompassing 12,714 ha (31,415 acres) within Lea County, New Mexico and 7,213 ha (17,823 acres) in Andrews County, Texas. Rangeland is an extensive area of open land on which livestock wander and graze and includes herbaceous rangeland, shrub and brush rangeland and mixed rangeland. Built-up land and barren land constitute the other two land use classifications in the site vicinity, but at considerably smaller percentages. Land cover

due to built-up areas, which includes residential and industrial developments, makes up 1.2% of the land use. This equates to a combined total of 243 ha (601 acres) for Lea and Andrews Counties. The remaining 0.3% of land area is considered barren land which consists of bare exposed rock, transitional areas and sandy areas. The above, indicated land use classifications are identical to those used by the United States Geological Survey (USGS). No special land use classifications (i.e., Native American reservations, national parks, prime farmland) are within the vicinity of the site.

Wildlife observed on and near the subject site included quail, owls, turtles, white tail and jack rabbits, horny toads, and several javelinas. There are also coyotes, fox and mule deer in addition to emus and ostriches that have been released into the wild by local residents. Dove and quail hunting grounds are located north and west of the site. There are no known game harvests near the site. A nomination has been submitted (Stinnett, 2002) to the Bureau of Land Management (BLM) to designate two public land parcels within Lea County as an Area of Critical Environmental Concern (ACEC) for the lesser prairie chicken (*Tympanuchus pallidicinctur*). The nearest nominated ACEC is about 48 km (30 mi) northwest of the proposed NEF site. The other nominated ACEC is further north. Currently, the BLM is evaluating this nomination and expects to make a decision within the next several years. See ER Section 3.5, Ecological Resources, for a discussion of other unusual animals that may be found near the site.

Known sources of water in the site vicinity include the following: a manmade pond on the adjacent quarry property to the north which is stocked with fish for private use; Baker Spring, an intermittent surface water feature situated a little over 1.6 km (1 mi) northeast of the site which only contains water seasonally; several cattle watering holes where groundwater is pumped by windmill and stored in above ground tanks; a well by an abandoned home about 4 km (2.5 mi) to the east and Monument Draw, a natural, shallow drainageway situated several miles west of the site. Several longtime, local residents indicated that Monument Draw only contains water for a short period of time following a significant rainstorm. There are also three "produced water" lagoons for industrial purposes on the adjacent quarry property to the north and a manmade pond at the Eunice golf course approximately 15 km (9.5 mi) west of the site.

Although various crops are grown within Lea and Andrews Counties, local and county officials reported that there is no agricultural activity in the site vicinity, except for domestic livestock ranching (see Table 3.1-2, Agriculture Census, Crop and Livestock Information). The principal livestock for both Lea and Andrews Counties is cattle. Although milk cows comprise a significant number of cattle in Lea County, the nearest dairy farms are about 32 km (20 mi) north of the site, near the city of Hobbs, New Mexico. There are no milks cows in Andrews County, Texas. As Table 3.1-2 also shows, the number of farms and acres of farmland decreased slightly within Lea County between 1992 and 1997, whereas the number of farms in Andrews County increased during this same timeframe, but decreased in size (USDA, 2001a; USDA, 2001b; USDA, 2002a; USDA, 2002b). Note that the 1997 census data is the most current information presently available.

Except for the proposed construction of the NEF and the potential citing of a low-level radioactive waste disposal site in Andrews County, Texas, there are no other known current, future or proposed land use plans, including staged plans, for the site or immediate vicinity. Similarly, as the site is not subject to local or county zoning, land use planning or associated review process requirements, there are no known potential conflicts of land use plans, policies or controls.

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TABLES

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Table 3.1-1a Land Use Within 8 km (5 mi) of the NEF Site
Classification and Area
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Classification	Area (Hectares)			Area (Acres)			Percent
	New Mexico	Texas	Total	New Mexico	Texas	Total	
Built Up	243	0	243	601	0	601	1.2
Rangeland	12,714	7,213	19,927	31,415	17,823	49,238	98.5
Barren	69	0	69	170	0	170	0.3
Total	13,026	7,213	20,239	32,186	17,823	50,009	100.0

Table 3.1-1b Land Use Within 8 km (5 mi) of the NEF Site
Classification Descriptions

Classification	Description
Built Up	Residential; industrial; commercial services
Rangeland	Herbaceous rangeland; shrub and brush rangeland; mixed rangeland
Barren	Bare exposed rock; transitional areas; beaches; sandy areas other than beaches

Table 3.1-2 Agriculture Census, Crop, and Livestock Information

Page 1 of 2

Information	County			
	Lea (New Mexico)		Andrews (Texas)	
Census Data (1992 & 1997)	1997	1992	1997	1992
Number of Farms	528	544	142	134
Total Land in Farms ha (acres)	810,161 (2,001,931)	869,861 (2,149,450)	335,431 (828,859)	389,545 (962,576)
Avg. Farm Size ha (acres)[1]	1,535 (3,792)	1,599 (3,951)	2,362 (5,837)	2,907 (7,183)
Crop Annual Average Yields (Most Current)	Area Harvested Hectares (Acres) in 2001	Yield per Hectare (Acre) in 2001	Area Harvested Hectares (Acres) in 2002	Yield per Unit Area in 2001
Chili Peppers	324 (800)	4.49 MT/ha (2.0 tons/acre)	0	0
Wheat	3,035 (7,500)	3.91 m^3/ha (45.0 bu/acre)	81 (200)	2.61 m^3/ha (30 bu/acre)
Grain Sorghum	688 (1,700)	3.66 m^3/ha (42.1 bu/acre)	688 (1,700)	1,384 kg/ha (1,235 lbs/acre)
Peanuts	5,828 (14,400)	3,182 kg/ha (2,840 lbs/acre)	2,266 (5,600)	4,521 kg/ha (4,035 lbs/acre)
All Hay	4,047 (10,000)	10.9 MT/ha (4.72 tons/acre)	0	0
Alfalfa Hay	2,428 (6,000)	13.6 MT/ha (6.0 tons/acre)	0	0
Pecans[2]	213 (526)	-		-
Upland Cotton	8,984 (22,200)	703 kg/ha (627 lbs/acre)	7,811 (19,300)	435 kg/ha (388 lbs/acre)

Table 3.1-2 Agriculture Census, Crop, and Livestock Information

Information	County	
	Lea (New Mexico)	Andrews (Texas)
Livestock (Most Current)	Number in 2001	Number in 2002
All Cattle	82,000	13,000
Beef Cows	27,000	6,000
Milk Cows	25,000	0
Other Cattle (includes cattle on feed)	30,000	0
Sheep and Lambs	4,000	0

[1] Average value per ha (acre) [1998]: New Mexico $536 ($217) / Texas $1,465 ($593) (USDA, National Agricultural Statistical Service)
[2] 1997 Census Data
Source: (USDA, 2001a; USDA, 2001b; USDA, 2002a; USDA, 2002b)

FIGURES

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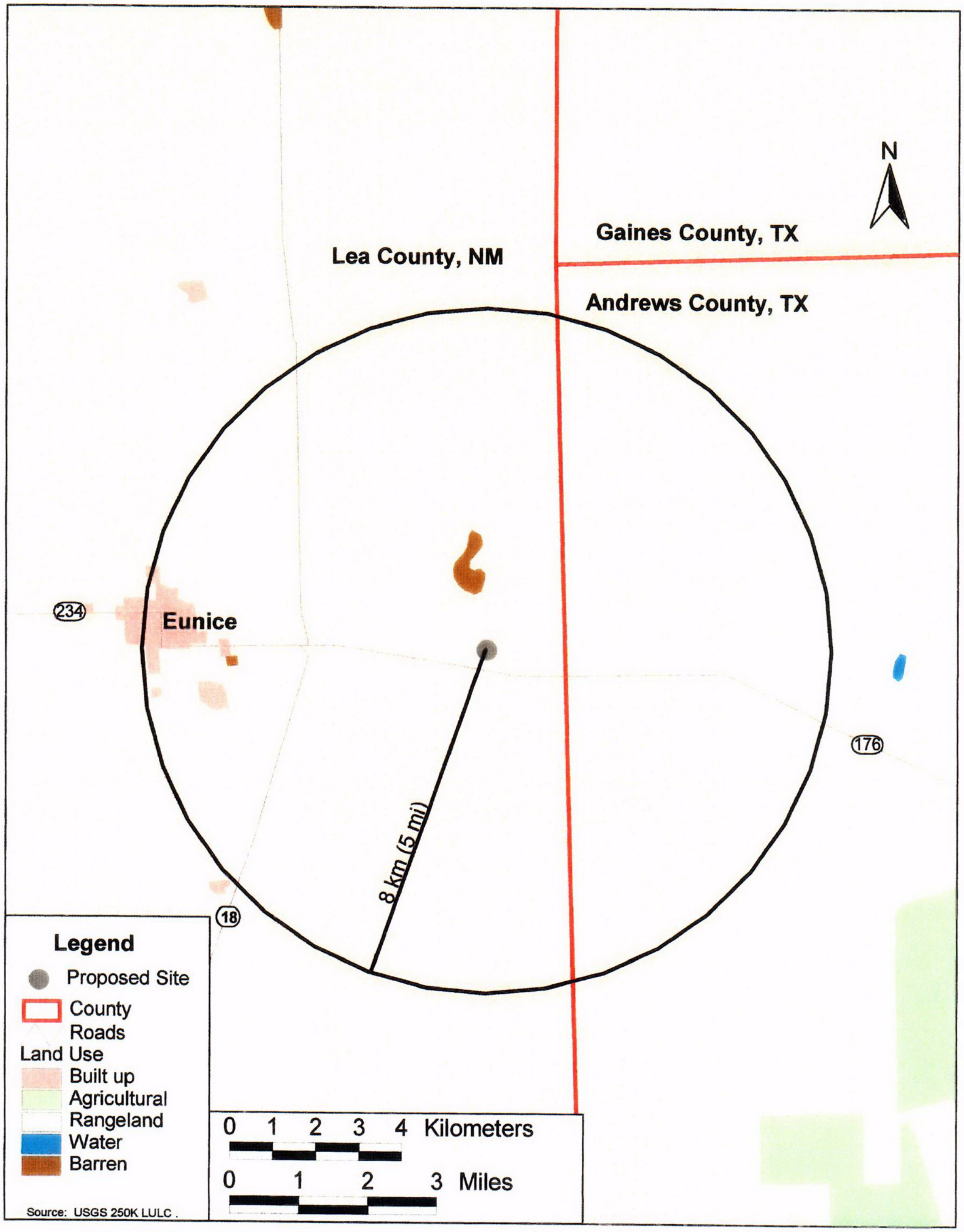

SOURCE: (USGS, 1986)

REFERENCE NUMBER
Figure 3.1–1.doc

FIGURE 3.1-1
LAND USE MAP

ENVIRONMENTAL REPORT
REVISION DATE: DECEMBER 2003

C17

3.2 TRANSPORTATION

This section describes transportation facilities at or near the NEF site. The section provides input to various other sections such as 3.11, Public And Occupational Health and 3.12, Waste Management, and includes information on access to and from the plant, proposed transportation routes, and applicable restrictions.

3.2.1 Transportation of Access

The proposed NEF is located in southeastern New Mexico near the New Mexico/Texas state line in Lea County, New Mexico. The site lies along the north side of New Mexico Highway 234, which is a two-lane highway with 3.7-m (12-ft) driving lanes, 2.4-mm (8-ft) shoulders and a 61-m (200-ft) right-of-way easement on either side. New Mexico Highway 234 provides direct access to the site. To the north, U.S. Highway 62/180 intersects New Mexico Highway 18 providing access from the city of Hobbs south to New Mexico Highway 234. New Mexico Highway 18 is a four-lane divided highway which was rehabilitated within the last four to six years north of its intersection with New Mexico Highway 234. It was recently improved south of its intersection with New Mexico Highway 234. To the east in Texas, U.S. Highway 385 intersects Texas Highway 176 providing access from the town of Andrews west to New Mexico Highway 234. To the south in Texas, Interstate 20 intersects Texas Highway 18 which becomes New Mexico Highway 18. West of the site, New Mexico Highway 8 provides access from the city of Eunice east to New Mexico Highway 234. Refer to Figure 2.1-1, 80-Kilometer (50-Mile) Radius With Cities and Roads. Additional information regarding corridor dimensions, corridor uses, and traffic patterns and volumes is provided in ER Section 4.2, Transportation Impacts.

The nearest active rail transportation (the Texas-New Mexico Railroad) is in Eunice, New Mexico to the west about 5.8 km (3.6 mi) from the site. This rail line is used mainly by the local oil and gas industry for freight transport. A train may travel on the rail once a day. There is an active rail spur along the north property line of the site that is owned by the neighboring property to the east (Waste Control Specialists LLC). On average, a train consisting of five to six cars may travel on the rail spur once a week. The speed limit for the rail spur is 16 km (10 mi) per hour.

The nearest airport is in Eunice approximately 16 km (10 mi) west of the site. The airport is used by privately-owned planes.

3.2.2 Transportation Routes

3.2.2.1 Plant Construction Phase

The transportation route for conveying construction material to the site is New Mexico Highway 234, which leads directly into the site. The mode of transportation will consist of over-the-road trucks, ranging from heavy-duty 18-wheeled delivery trucks, concrete mixing trucks and dump trucks, to box and flatbed type light-duty delivery trucks.

3.2.2.2 Plant Operation Phase

All radioactive material shipments will be transported in packages that meet the requirements of 10 CFR 71 (CFR, 2003e) and 49 CFR 171-173 (CFR, 2003k; CFR, 2003l). Uranium feed,

product and associated low-level waste (LLW) will be transported to and from the NEF. The following distinguishes each of these conveyances and associated routes.

Uranium Feed

The uranium feed for the NEF is natural uranium in the form of uranium hexafluoride (UF_6). The UF_6 is transported to the facility in 48Y or 48X cylinders. These cylinders are designed, fabricated and shipped in accordance with American National Standard Institute N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Feed cylinders are transported to the site by 18-wheeled trucks, one per truck (48Y) or two per truck (48X). In the future, rail transport may also be used to bring uranium feed to the site. Since the NEF has an operational capacity of 690 feed cylinders per year (type 48Y and 48X), between 345 and 690 shipments of feed cylinders per year will arrive at the site.

Uranium Product

The product of the NEF is transported in 30B cylinders. These cylinders are designed, fabricated and shipped in accordance with ANSIN14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Product cylinders are transported from the site to fuel fabrication facilities by modified flat bed truck - typically two per truck although up to five product cylinders could be transported on the same truck. In the future, rail transport may be used to ship product cylinders from the site. A maximum of 11,500 kg (25,353 lbs) (2,300 kg (5,071 lbs) per cylinder) of enriched uranium could be transported per shipment. There will be approximately 350 product cylinders shipped per year, which would typically result in a shipment frequency of one shipment per three days (122 shipments per year).

Uranium Wastes

Waste materials are transported in packages by truck via highway in accordance with 10 CFR 71 and 49 CFR 171-173 (CFR, 2003e; CFR, 2003k; CFR 2003l). Detailed descriptions of radioactive waste materials which will be shipped from the NEF facility for disposal are presented in ER Section 3.12, Waste Management. Table 3.12-1, Estimated Annual Radiological and Mixed Wastes, presents a summary of these waste materials.

Depleted Uranium

Depleted uranium in UBCs will be shipped to conversion or storage facilities via truck in 48Y cylinders similar to feed cylinders. These cylinders are designed, fabricated and shipped in accordance with ANSI N14.1, Uranium Hexafluoride – Packaging for Transport (ANSI, applicable version). UBCs will be transported from the site by 18-wheeled trucks, one per truck (48Y). In the future, rail transport may also be used for ship UBCs from the site. Since the NEF has an operational capacity of 627 UBCs per year (type 48Y), 627 shipments of UBCs per year will leave the site. At present, UBCs will be temporarily stored onsite until conversion or storage facilities are available.

3.2.3 Transportation Modes, Route, and Distances

Construction material would be transported by truck from areas north and south of the site via New Mexico Highway 18 to New Mexico Highway 234. From the east, the transportation route would be Texas Highway 176 which becomes New Mexico Highway 234. From the west, New Mexico Highway 8, which becomes New Mexico Highway 234 near the city of Eunice, would serve as the route of transportation. New Mexico Highway 234 provides direct access to the site.

The feed and product materials of the facility will be transported by truck via highway travel only, although use of rail is being considered. Most of the feed material is expected to be obtained from UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL, although a small amount could come from non-domestic sources. The product could be transported to fuel fabrication facilities near Hanford, WA, Columbia, SC, and Wilmington, NC. The designation of the supplier of UF_6 and the product receiver is the responsibility of the utility customer. Waste generated from the enrichment process may be shipped to a number of disposal sites or processors depending on the physical and chemical form of the waste. Potential disposal sites or processors are located near Barnwell, SC; Clive UT; Oak Ridge, TN; Paducah, KY; and Portsmouth, OH. Refer to ER Section 3.12.2.1, Radioactive and Mixed Wastes, for disposition options of other wastes.

The primary transportation route between the site and the conversion, fuel fabrication and disposal facilities is via New Mexico Highway 234 to northbound New Mexico Highway 18. These two highways intersect one another a short distance west of the site. New Mexico Highway 18 is accessible from eastbound and westbound highways in the city of Hobbs, approximately 32 km (20 mi) north of the site. Table 3.2-1, Possible Radioactive Material Transportation Routes, lists the approximate highway distances from the NEF site to the respective conversion facilities, fuel fabrication facilities, and radioactive waste disposal sites.

The highways in the vicinity of the site serve as trucking routes for the local area. Traffic volume on these highways varies greatly during the day. The condition and design basis for these roadways are adequate to meet current traffic flow requirements and future minor changes to traffic patterns brought about by the construction and operation of the NEF.

3.2.4 Land Use Transportation Restrictions

The proposed NEF site is on land currently owned by the State of New Mexico and LES has been granted a 35-year easement for the site. Highway easements associated with state trust land is for highway use only, although application for other uses (i.e., installation of utilities) may be submitted to the state. There are no known restrictions on the types of materials that may be transported along the important transportation corridors. This was confirmed with both the State of New Mexico and Texas officials.

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TABLES

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Table 3.2-1 Possible Radioactive Material Transportation Routes

Facility	Description	Estimated Distance, km (mi)
UF_6 Conversion Facility Port Hope, Ontario	Feed	2,869 (1,782)
UF_6 Conversion Facility Metropolis, IL	Feed	1,674 (1.040)
Fuel Fabrication Facility Hanford, WA	Product	2,574 (1,599)
Fuel Fabrication Facility Columbia, SC	Product	2,264 (1,406)
Fuel Fabrication Facility Wilmington, NC	Product	2,576 (1,600)
Barnwell Disposal Site Barnwell, SC	LLW Disposal	2,320 (1,441)
Envirocare of Utah Clive, UT	LLW and Mixed Disposal	1,636 (1,016)
GTS Duratek[1] Oak Ridge, TN	Waste Processor	1,993 (1,238)
Depleted UF_6 Conversion Facility[2] Paducah, KY	Depleted UF_6 Disposal	1,670 (1,037)
Depleted UF_6 Conversion Facility[2] Portsmouth, OH	Depleted UF_6 Disposal	2,243 (1,393)

[1]Other off-site waste processors may also be used.
[2]To be operational in approximately 3-5 years.

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3.3 GEOLOGY AND SOILS

This section identifies the geological, seismological, and geotechnical characteristics of the National Enrichment Facility (NEF) site and its vicinity. Some areas immediately adjacent to the site have been thoroughly studied in recent years in preparation for construction of other facilities including the Waste Control Specialists (WCS) site and the former Atomic Vapor Laser Isotope Separation (AVLIS) site. Data remain available from these investigations in the form of reports (WBG, 1998; TTU, 2000). These documents and related materials provide a significant description of geological conditions for the NEF site. In addition, Louisiana Energy Services (LES) performed field investigations, where necessary, to confirm site-specific conditions.

The NEF site is located in New Mexico west of the Texas border about 48 km (30 mi) from the southeast corner of the state and about 90 km (56 mi) east of the Pecos River. The east edge of the site is 0.8 km (0.5 mi) from the Lea County, New Mexico – Andrews County, Texas border. The site is contained in the Eunice New Mexico, Texas-New Mexico USGS topographic quadrangle (USGS, 1979).

Figure 3.3-1, Regional Physiography, (Raisz, 1957) shows the site is located near the boundary between the Southern High Plains Section (Llano Estacado) of the Great Plains Province to the east and the Pecos Plains Section to the west. The boundary between the two sections is the Mescalero Escarpment, locally referred to as Mescalero Ridge. That ridge abruptly terminates at the far eastern edge of the Pecos Plains. The ridge is an irregular erosional topographic feature in southern Lea County where it exhibits relief of about 9 to 15 m (30 to 50 ft) compared with a nearly vertical cliff and relief of approximately 45 m (150 ft) in northwestern Lea County. The lower relief of the ridge in southeastern Lea County is due to partial cover by wind deposited sand (WBG, 1998).

Locally, the proposed NEF site is located on the Eunice Plain just northwest of Rattlesnake Ridge in Section 32, Township 21 South, Range 38 East. The Eunice Plain gently slopes towards Monument Draw, a north to south traversing arroyo. Monument Draw being north of the city of Eunice following a southeasterly trend, and then turns southerly presumably diverted by Mescalero Ridge.

The dominant geologic feature of this region is the Permian Basin. The NEF site is located within the Central Basin Platform area (Figure 3.3-2, Regional Geology of the Permian Basin). This platform occurs between the Midland and Delaware Basins, which comprises the Permian Basin. The basin, a 250 million-year-old feature, is the source of the region's prolific oil and gas reserves. The late Cretaceous to the early Tertiary periods (65 to 70 million years ago) marked the beginning of the Laramide Orogeny, which formed the Cordilleran Range to the west of the Permian Basin. That orogeny uplifted the region to its present elevation.

The primary difference between the Pecos Plains and the Southern High Plains physiographic sections is a change in topography. The High Plains is a large flat mesa which uniformly slopes to the southeast. In contrast, the Pecos Plains section is characterized by its more irregular erosional topographic expression (WBG, 1998). Topographic relief on the site is generally subdued. NEF site elevations range between about +1,033 and +1,045 m (+3,390 and +3,430 ft), mean sea level (msl). Finished site grade will be about +1,041 m (+3,415 ft), msl (Figure 3.3-3, Site Topography). The NEF site itself encompasses approximately 220 ha (543 acres), of which approximately 73 ha (180 acres) will be developed. Small-scale topographic features within the boundary of the proposed NEF site include a closed depression evident at the

northern center of the site, the result of eolian processes, and a topographic high at the southwest corner of the site that was created by dune sand. In general the site slopes from northeast to southwest with a general overall slope of about 0.5%. Red Bed Ridge (TTU, 2000) is an escarpment of about 15 m (50 ft) in height that occurs just northwest of the NEF site.

Geologically the site is located in an area where surface exposures consist mainly of Quaternary-aged eolian and piedmont sediments along the far eastern margin of the Pecos River Valley (NMIMT, 2003). Figure 3.3-4, Surficial Geologic Map of the NEF Site Area is a portion of the Surficial Geologic Map of Southeast New Mexico (NMIMT, 1977), which includes the area of the NEF site. The surficial unit shown on this map at the NEF site is described as a sandy alluvium with subordinate amounts of gravel, silt and clay. Figure 3.3-4 also describes other surficial units in the site vicinity including caliche, a partly indurated zone of calcium carbonate accumulation formed in the upper layers of surficial deposits including tough slabby surface layers and subsurface nodules, fibers and veinlets; loose sand deposits, some gypsiferous, and subject to wind erosion. Other surficial deposits in the site area include floodplain channel deposits along dry channels and playa sands.

Recent deposits of dune sands are derived from Permian and Triassic rocks. These so-called Mescalero Sands (also known as the Blackwater Draw Formation) occur over 80% of Lea County and are generally described as fine to medium-grained and reddish brown in color. The USDA Soil Survey of Lea County identifies the dune sands at the site as the Brownsfield-Springer Association of reddish brown fine to loamy fine sands (USDA, 1974).

Figure 3.3-5, Site Boring Plan and Profile, includes the NEF site, adjacent site borings and a geologic profile from the immediately adjacent parcel to the east that provides a representation of site geology. The profile shows alluvial deposits about 9 to 15 m (30 to 60 ft) thick, cemented by a soft caliche layer of 1 to 4 m (3 to 13 ft) that occurs at the top of the alluvium. Locally on the site, dune sand overlies both these deposits. The alluvium rests on the red beds of the Chinle Formation, a silty clay with lenses of sandy clay or claystone and siltstone. Information from recent borings initiated by LES on the NEF site in September 2003 is consistent with the data shown on the profile in Figure 3.3-5 as discussed in ER Section 3.3.1, Stratigraphy and Structures.

Borings on the NEF site depicted on Figure 3.3-5 include:

- Three borings/monitoring wells (MW-1, MW-2, and MW-3)
- Nine site groundwater exploration borings (B-1 through B-9)
- Five geotechnical borings (B-1 through B-5).

Other borings depicted on Figure 3.3-5, not on the NEF site, were performed by others. See Safety Analysis Report (SAR) Section 3.2, Site Description, for additional information and boring logs.

The Southeast New Mexico-West Texas area presently is structurally stable. The Permian Basin has subsided slightly since the Laramide Orogeny. This is believed to be a result of dissolution of the Permian evaporite layers by groundwater infiltration and possibly from oil and gas extraction (WBG, 1998).

The NEF site lies within the Landreth-Monument Draws Watershed. Site drainage is to the southwest with runoff not able to reach any water body before it evaporates. The only major

regional drainage feature is Monument Draw, which is located just over 2.5 km (1.0 mi) west of the site, between the proposed NEF site and the city of Eunice, New Mexico (USDA, 1974). The draw begins with a southeasterly course to a point north of Eunice where it turns south and becomes a well defined cut approximately 9 m (30 ft) in depth and 550 to 610 m (1,800 to 2,000 ft) in width. The draw does not have through-going drainage and is partially filled with dune sand and alluvium.

Along Red Bed Ridge (TTU, 2000), approximately 1.6 km (1 mi) northeast of the NEF site is Baker Spring (Figure 3.3-5, Site Boring Plan and Profile). The depression contains water only intermittently (see ER Section 3.4.1.1, Major Surface and Subsurface Hydrological Systems). No defined drainage features are present at the site. Rainfall on the site will be collected in detention/retention basins. Rainfall that is not collected is expected to infiltrate, or evaporate without creating any runoff that flows beyond site boundaries.

Within Lea County, New Mexico and Andrews County, Texas there are water-bearing strata used for water production. North and east of the NEF site, beneath the High Plains, the Ogallala Aquifer is the most productive of these regional aquifers. West of the site, in the alluvial deposits of Monument Draw, subsurface flow is also locally used as a minor aquifer. Lastly, the Santa Rosa Formation of the Lower Dockum Group and sandy lenses in the Upper Dockum Chinle formation are occasionally used as aquifers on a regional basis.

The most shallow strata to produce measurable quantities of water is an undifferentiated siltstone seam of the Chinle approximately 61 to 73 m (200 to 240 ft) below ground surface. The uppermost aquifer capable of producing significant volumes of water is the Santa Rosa Formation located approximately 244 m (800 ft) below ground surface (WBG, 1998).

With respect to the environment, geologic conditions at the NEF site will not be significantly affected by construction or operation of the NEF. (See ER Section 4.3, Geology and Soils Impact.)

3.3.1 Stratigraphy and Structures

The Permian Basin, a massive subsurface bedrock structure, is a downward flexure of a large thickness of originally flat-lying, bedded, sedimentary rock. It dominates the geologic structure of the region. It extends to 4,880 meters (16,000 feet) below msl. The NEF site is located above the Central Basin Platform that divides the Permian Basin into the Midland and Delaware sub-basins, as shown in Figure 3.3-2, Regional Geology of the Permian Basin. The base of the Permian basin sediments extends about 1,525 m (5,000 ft) deep beneath the NEF site.

The top of the Permian deposits are approximately 232 m (760 ft) below ground surface. Overlying the Permian are the sedimentary rocks of the Triassic Age Dockum Group. The upper formation of the Dockum Group is the Chinle. Locally, the Chinle Formation consists of red, purple and greenish micaceous claystone and siltstone with interbedded fine-grained sandstone. The Chinle is regionally extensive with outcrops as far away as the Grand Canyon region in Arizona (WBG, 1998). Locally overlying the Chinle Formation in the Permian Basin is either the Tertiary Ogallala, Gatuña or Antlers Formations, or Quaternary alluvium. The Tertiary Ogallala Formation underlies all of the High Plains (to the east) and mantles several ridges in Lea County. Unconsolidated sediments northeast of the NEF site are recognized as the Ogallala and deposits west of the NEF site are mapped as the Gatuña or Antlers Formations. This sediment is described as alluvium (WBG, 1998) and is mined as sand and gravel in the NEF site area.

As shown in Table 3.3-1, Geological Units Exposed At, Near, or Underlying the Site, the uppermost 367 m (1,200 ft) of the subsurface in the NEF site vicinity can include up to about 3 m (10 ft) of dune sand, 3.5 m (12 ft) of caliche, and 26 m (85 ft) of alluvium overlying the Chinle Formation of the Triassic Age Dockum Group. The Chinle Formation is predominately red to purple moderately indurated claystone, which is highly impermeable (WBG, 1998). Red Bed Ridge is a significant topographic feature in this regional plain that intersects the extreme northeast corner of the NEF site, and is capped by relatively resistant caliche. Ground surface elevation increases about 15 m (50 ft) from +1,045 m (+3,430 ft) to +1,059 m (+3,475 ft) across the ridge.

Recent deposits at the site and in the site area are primarily dune sands derived from Permian and Triassic rocks of the Permian Basin. These so-called Mescalero Sands cover approximately 80% of Lea County, locally as active sand dunes.

Information from recent borings done on the NEF site is consistent with the data shown on the profile in Figure 3.3-5, Site Boring Plan and Profile. This includes a thin layer of loose sand at the surface; about 12 m (40 ft) of high blow count alluvial silty sand and sand and gravel locally cemented with caliche; and the Chinle clay at a depth of about 12 m (40 ft) below the ground surface and extending to a depth of at least 30 m (100 ft). No sandy clay layers were reported in the clay.

The boring logs for the NEF site geotechnical borings (Borings B-1 through B-5) are provided in the Safety Analysis Report (SAR) Figures 3.2-10 through 3.2-15.

Two types of faulting were associated with early Permian deformation. Most of the faults were long, high-angle reverse faults with well over a hundred meters (several hundred feet) of vertical displacement that often involved the Precambrian basement rocks. The second type of faulting is found along the western margin of the platform where long strike-slip faults, with displacements of tens of kilometers (miles), are found. The closest fault to the site as defined by the New Mexico Bureau of Geology and Mineral Resources (NMIMT, 2003) and is over 161 km (100 mi) to the northwest associated with the deeper portions of the Permian Basin.

The large structural features of the Permian Basin are reflected only indirectly in the Mesozoic and Cenozoic rocks, as there has been virtually no tectonic movement within the basin since the Permian period. Figure 3.3-2, Regional Geology of the Permian Basin, shows the structure that causes the draping of the Permian sediments over the Central Basin Platform structure, located approximately 2,134 m (7,000 ft) beneath the present land surface. The faults that uplifted the platform do not appear to have displaced the younger Permian sediments.

In addition to the lack of regional information indicating the presence of post-Permian faulting, the local information does not indicate Holocene displacement of faults near the proposed NEF site. Site investigations carried out for the WCS site provide an indication that faulting is absent in the subsurface beneath that site. The majority of Quaternary age faults within New Mexico are mapped along the north-south trending Rio Grande Rift located approximately 290 km (180 mi) west of the site.

According to Machette et al. (Machette, 1998), Quaternary age faults are not identified in New Mexico within 161 km (100 mi) of the site. Quaternary age faults within 240 km (150 mi) of the site include the Guadalupe fault, located approximately 185 km (115 mi) west of the site in New Mexico, and in Texas, the West Delaware Mountains fault zone, East Sierra Diablo fault, East Flat Top Mountain fault, and the East Baylor Mountain-Carrizo Mountain fault located 180 km

(110 mi) southwest, 190 km (120 mi) southwest, 190 km (120 mi) west-southwest and 190 km (120 mi) southwest of the site, respectively.

3.3.1.1 Potential Mineral Resources at the Site

No significant non-petroleum mineral deposits are known to exist in the vicinity of the NEF site. The surface cover of silty sand and gravel overlies a claystone of no economic value. No mineral operations are noted in Lea County by the New Mexico Bureau of Mines Inspection (NMBMI, 2001). Mining and potential mining of potash, a commonly extracted mineral in New Mexico, is followed by the New Mexico Energy, Minerals and Natural Resources Department, which maintains a map of areas with potash mines and mining potential (NMEMNRD, 2003). Those data indicate neither mining nor potential for mining of potash in the site area.

The topographic quadrangle map that contains the site (USGS, 1979) contains 10 locations where sand and gravel have been mined from surface deposits, spread across the quadrangle, an area about 12 by 14 km (7.5 by 8.9 mi), suggesting that suitable surficial deposits for borrow material are widespread.

Exploratory drill holes for oil and gas are absent from the site area and its vicinity, but are common 8 km (5 mi) west in and around the city of Eunice, New Mexico. See ER Figure 3.4-7, Water and Oil Wells in the Vicinity of the NEF Site, for nearby well locations. That distribution and the time period of exploration since the inception of exploration for this area suggest that the potential for productive oil drilling at the NEF site is not significant.

3.3.1.2 Volcanism

No volcanic activity exists in the NEF site region.

3.3.2 Site Soils

Soil development in the region is generally limited due to its semi-arid climate. The site has a minor thickness of silty soil (generally less than 0.2 m (0.7 ft)) developed from subaerial weathering. Caliche deposits are common in the near-surface soils. A small deposit of active dune sand is present at the southwest corner of the site.

The U. S. Department of Agriculture soil survey for Lea County, New Mexico (USDA, 1974) categorizes site soils as hummocky loamy (silty) fine sand. Near-surface caliche deposits may locally limit (limiting soil porosity) or enhance (fractured caliche) surface drainage. Figure 3.3-6, Site Soils Map Per USDA Data, shows the soil map for the NEF site (USDA, 1974). The legend for that map lists each of the soils present at the NEF site, describing them and citing their Unified Soil Classification designations (ASTM, 1993).

3.3.2.1 Geotechnical Investigations

The granular soils in the uppermost 12 m (40 ft) of the subsurface provide potentially high-quality bearing materials for building and heavy machine foundations. For extremely heavy or settlement intolerant facilities, foundations can be founded in the Chinle Formation which has an unconfined compressive strength of over 195,000 kg/m^2 (20 ton/ft^2) (WBG, 1998).

Topsoil occurs as 0.3 m (1 ft) or less of brown organic silty sand that overlies a formation of white or tan caliche. The caliche consists of very hard to friable cemented sand, conglomerate

limestone rock, silty sand and gravel. A sand and gravel layer varying from 0 to 6 m (0 to 20 ft) in thickness occurs at the bottom of the caliche strata. Below the caliche is a reddish brown silt clay that extends to the termination of the borings, 30 to 91 m (100 to 300 ft) below grade. The red beds consist of a highly consolidated, impervious clay:

- mottled reddish brown-gray clay;
- purple-gray silty clay;
- yellowish brown-gray silty clay; and
- siltstones and sandstone layers found at various depths with varying thicknesses

The depth to the top of the red beds in borings done for engineering purposes ranged from about 3.6 to 9.1 m (12 to 30 ft).

The dry density of the clay ranges from 1.86 to 2.32 g/cm^3 (116 to 145 lbs/ft^3), averaging 2.11 g/cm^3 (132 lbs/ft^3). The red, reddish-brown or purple silty clays range in moisture content from 2.5% to 25%, averaging 8% to 12% for most samples. Liquid limits for the clays range from 35% to 55% with plasticity indices ranging from 24 to 38. Percent passing the #200 sieve for the clays ranges from 87% to 99.8%.

Permeabilities were measured for the reddish brown silty clays, sandstones and siltstones. Ranges were determined as shown in Table 3.3-2, Measured Permeabilities Near the NEF Site. The values for the clay indicate that it is highly impervious. Siltstones are slightly more permeable, but still having relatively poor permeability.

Unconfined compressive tests on the clay resulted in values from 136,000 kg/m^2 to 485,000 kg/m^2 (13.9 to 49.7 tons/ft^2) with an average value of 293,000 kg/m^2 (30 tons/ft^2).

Given a depth to groundwater of at least 61 to 67 m (200 to 220 ft), there is no potential for liquefaction at the site.

A geotechnical investigation of the site conducted in September 2003 consisted of 5 widely-spaced test borings that extended to depths of about 12 to 30.5 m (40 to 100 ft) using a hollow-stem auger and split-spoon sampling. Based on the boring results, up to 0.6 m (2 ft) of loose eolian sand underlain by dense to very dense, fine- to medium-grained sand and silty sand of the Gatuña Formation was encountered. These sands are locally cemented with caliche deposits. Beneath the Gatuña is the Chinle claystone, a very hard highly plastic clay, which was encountered at depths of about 10.7 to 12.2 m (35 to 40 ft). One boring extended to 30.5 m (100 ft) deep and ended in the Chinle Formation. Blow-count N-values for about the top 7.6 m (25 ft) of sand and gravel ranged from about 20 to 76. Beneath that horizon the unit becomes denser or contains gravel to the extent that useful blow counts are not obtained. Where caliche cements the sand and gravel, N-values of over 60 are typical. Standard N-values were not available for samples in the underlying clay due to its hardness causing blow counts to range upwards of 100.

For samples from the shallow sand and gravel unit, California Bearing Ratio values of 10.5 and 34.4 were obtained along with a maximum dry density value of 1.97 g/cm^3 (123 lbs/ft^3). Fines in this material were generally non-plastic with 17% to 31% of samples finer than 200 sieve size. Clay samples had relatively high liquid limits of 50% to 60% and plastic limits of 18% to 23%, suggesting high silt content.

Footings bearing in the firm and dense sandy soils below the upper loose eolian soils are estimated to have an allowable bearing pressure of 34,177 kg/m^2 (7,000 lbs/ft^3).

3.3.3 Seismology

The majority of earthquakes in the United States are located in the tectonically active western portion of the country. However, areas within New Mexico and the southwestern United States also experience earthquakes, although at a lower rate and at lower intensities. Earthquakes in the region around the NEF site include: isolated and small clusters of low to moderate size events toward the Rio Grande Valley of New Mexico and in Texas, southeast of the NEF site.

3.3.3.1 Seismic History of the Region and Vicinity

The NEF site is located within the Permian Basin as shown on Figure 3.3-7, Tectonic Subdivisions of the Permian Basin (Talley, 1997). Specifically, the site is located near the northern end of the Central Basin Platform (CBP). The CBP became a distinct dividing feature within the Permian Basin as a result of Pennsylvanian and early Permian compressional stresses. This tectonism resulted in a deeper Delaware Basin to the west and shallower Midland Basin to the east of the ridge-like CBP.

The last episode of tectonic activity centered on the late Cretaceous and early Tertiary Laramide Orogeny that formed the Cordilleran Range to the west of the Permian Basin. The Permian Basin region was uplifted to its present position during this orogenic event. There has not been any further tectonic activity since the early Tertiary. Structurally, the Permian Basin has subsided slightly since the Larmaide tectonic event. Dissolution of Permian evaporate layers by groundwater infiltration or possibly from oil and gas extraction is suggested as a possible cause for this observed subsidence.

The 250-million year old Permian Basin is the source of abundant gas and oil reserves that continue to be extracted. These oil fields in southeast New Mexico are characterized as "in a mature stage of secondary recovery effort" (Talley, 1997). Water flooding began in the late 1970's followed by carbon dioxide (CO_2) flooding now being used to enhance recovery in some fields. Industry case studies describe hydraulic fracturing procedures used in the Queen and San Andres formations near the NEF site that produced fracture half-lengths from 170 to 259 m (560 to 850 ft) in these formations.

No Quaternary faults are mapped for the site locale. The nearest recent faulting is situated more than 161 km (100 mi) west of the site (Machette, 1998).

The study of historical seismicity includes earthquakes in the region of interest known from felt or damage records and from more recent instrumental records (since early 1960's). Most earthquakes in the region have left no observable surface fault rupture.

Figure 3.3-8, Seismicity Map for 322-Kilometer (200-Mile) Radius of the NEF Site indicates the location of earthquakes which have occurred within a 322 km (200 mi) radius of the NEF site with magnitude greater than or equal to zero (≥ 0). The earthquakes are also listed in Table 3.3-3, Earthquakes Within a 322 Kilometer (200 Mile) Radius of the NEF Site. Figure 3.3-9, Seismicity in the Immediate Vicinity of the NEF Site, indicates the location of earthquakes within about 97 km (60 mi) of the NEF site. Earthquakes, which have occurred within a 322 km (200 mi) radius of the NEF site with a magnitude of 4.0 and greater, are listed in Table 3.3-4, Earthquakes of Magnitude 4.0 and Greater Within 322 Kilometers (200 Mile) of the NEF Site.

The data reflected in the above figures and tables are from earthquake catalogs from the University of Texas Institute for Geophysics (UTIG, 2002), New Mexico Tech Historical Catalog (NMIMT, 2002), Advanced National Seismic System (USGS, 2003a) and the New Mexico Tech Regional Catalog, exclusive of Socorro New Mexico events (NMIMT, 2002).

Earthquake data for a 322 km (200 mi) radius of the NEF site were acquired from public domain resources. Table 3.3-5, Earthquake Data Sources for New Mexico and West Texas, lists organizations and data sources that were identified and earthquake catalogs were obtained.

Earthquake parameters (e.g., date, time, location coordinates, magnitudes, etc.) from the data repositories listed in Table 3.3-5 were combined into a uniformly formatted database to allow statistical analyses and map display of the four catalogs. Through a process of comparison of earthquake entries among the four catalogs, duplicate events were purged to achieve a composite catalog. In addition, aftershocks and aftershock sequences were purged from one version of the catalog for computation of earthquake recurrence statistical models, which describe recurrence rates of earthquake main shocks. The composite list of earthquakes, with aftershocks and aftershock sequences purged, for the 322 km (200 mi) radius of the NEF site is provided in Table 3.3-3, Earthquakes Within a 322 Kilometer (200 Mile) Radius of the Site. The regional seismicity map is shown on Figure 3.3-8, Seismicity Map for 322-Kilometer (200-Mile) Radius of the NEF Site. Local seismicity is shown on Figure 3.3-9, Seismicity in the Immediate Vicinity of the NEF Site. The large majority of events (i.e., 82%) in the composite catalog originate from the Earthquake Catalogs for New Mexico (exclusive of the Socorro New Mexico immediate area) (NMIMT, 2002) as observed in the event counts in Table 3.3-5, Earthquake Data Sources for New Mexico and West Texas. Earthquake magnitudes in these catalogs (NMIMT, 2002) are tied to the New Mexico duration magnitude scale, M_d, that in turn approximate Local Magnitude, M_L. All events in the composite catalog are specified to have an undifferentiated local magnitude.

Table 3.3-4, Earthquakes of Magnitude 4.0 and Greater Within 322 Kilometer (200 Mile) of the NEF Site, shows all earthquake main shocks of magnitude 4.0 and larger within a 322 km (200 mi) radius of the NEF site. The largest earthquake within 322 km (200 mi) of the NEF is the August 16, 1931 earthquake located near Valentine, Texas. This earthquake has an estimated magnitude of 6.0 to 6.4 and produced a maximum epicentral intensity of VIII on the Modified Mercalli Intensity (MMI) Scale. The intensity observed at the NEF site is IV on the MMI scale (NMGS, 1976). A copy of the MMI scale is provided in Table 3.3-6, Modified Mercalli Intensity Scale.The closest of these moderate earthquakes occurred about 16 km (10 mi) southwest of the site on January 2, 1992.

It is noted that the University of Texas Geophysics Institute Catalog of West Texas Earthquakes reports a smaller magnitude of 4.6 and a more easterly epicenter location in Texas for the January 2, 1992 earthquake. Table 3.3-7, Comparison of Parameters for the January 2, 1992 Eunice, New Mexico Earthquake, shows the location and size parameters for the January 2, 1992 earthquake. Parameters given by the New Mexico Tech Regional Catalog were adopted for the seismic hazard assessment of the NEF site.

3.3.3.2 Correlation of Seismicity with Tectonic Features

Earthquake epicenters scaled to magnitude for the site region are plotted over Permian Basin tectonic elements on Figure 3.3-10, Regional Seismicity and Tectonic Elements of the Permian Basin. Most epicenters lie within the Central Basin Platform, however, earthquake clusters also occur within the Delaware and Midland Basins. Although events local to the NEF site are likely

induced by gas/oil recovery methods, the resulting ground motions are transmitted similar to earthquakes on tectonic faults and impacts at the NEF site are analyzed using standard seismic hazard methods. In addition, the January 2, 1992 event is attributed to a tectonic origin due to its determined focal depth of about 12 km (7.5 mi) (DOE, 2003d).

Analysis of the spatial density of earthquakes in the composite catalog is shown on Figure 3.3-11, Earthquake Frequency Contours and Tectonic Elements of the Permian Basin. This form of spatial analysis has historically been used to define the geometry of seismic source zones for seismic hazard investigations (USGS, 1997; USGS, 1976). Seismic source areas for the NEF site region are determined on the basis of the earthquake frequency pattern shown on Figure 3.3-11. The NEF site is located near the northern end of the region of highest observed earthquake frequency within the Central Basin Platform of the Permian Basin.

The Waste Isolation Pilot Project (WIPP) Safety Analysis Report (SAR) (DOE, 2003d) suggests that the cluster of small events located along the Central Basin Platform (Figure 3.3-10, Regional Seismicity and Tectonic Elements of the Permian Basin) are not tectonic in origin, but are instead related to water injection and withdrawal for secondary recovery operations in oil fields in the Central Basin Platform area. Such a mechanism for the Central Basin Platform seismic activity could provide a reason why the Central Basin Platform is separable from the rest of the Permian Basin on the basis of seismicity data but not by using other common indicators of tectonic character. Both the spatial and temporal association of Central Basin Platform seismicity with secondary recovery projects at oil fields in the area are suggestive of some cause and effect relationship of this type.

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TABLES

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Table 3.3-1 Geological Units Exposed At, Near, or Underlying the Site
Page 1 of 1

Formation	Geologic Age	Descriptions	Estimates for the NEF Site Area	
			Depths: m (ft)	Thickness: m (ft)
Topsoils	Recent	Residual silty topsoil	0.2 (0.7)	0.2 (0.7)
Mescalero Sands/ Blackwater Draw Formation	Quaternary	Dune or dune-related sands	0 to 3.0 (0 to 10)	0 to 3.0 (0 to 10)
Mescalero Caliche	Quaternary	Soft to hard calcium carbonate deposits	0 to 6.1 (0 to 20)	0 to 6.1 (0 to 20)
Gatuña/ Antlers Formation	Pleistocene/mid-Pliocene	Pecos Valley alluvium: Sand and silty sand with interbedded caliche near the surface and a sand and gravel base layer	12 to 38 (40 to 125)	26 (85)
Chinle Formation	Triassic	Claystone and silty clay: red beds	38 to 137 (125 to 450)	99 (325)
Santa Rosa Formation	Triassic	Sandy red beds, conglomerates and shales	137 to 232 (450 to 760)	95 (310)
Dewey Lake	Permian	Muddy sandstone and shale red beds	232 to 383 (760 to 1255)	151 (495)

Sources: (BLM, 2003; TTU, 2000; DOE 1997b)

Table 3.3-2 Measured Permeabilities Near the NEF Site

Page 1 of 1

Permeability Direction	Sediment Type	Permeability, cm/s (ft/s)
Vertical	Clays	1.00×10^{-9} to 1.76×10^{-8} (3.28×10^{-11} to 5.77×10^{-10})
Horizontal	Clays	1.63×10^{-9} to 1.10×10^{-8} (5.35×10^{-11} to 3.61×10^{-10})
Vertical	Siltstones and sandstones within 18 to 27 m (56 to 90 ft) depth	2.58×10^{-8} to 1.93×10^{-6} (8.46×10^{-10} to 6.33×10^{-8})
Horizontal	Siltstones and sandstones within 18 to 27 m (56 to 90 ft) depth	Average: 6.53×10^{-7} (2.14×10^{-8})
Vertical	Siltstone at 63 m (208 ft) depth	2.06×10^{-8} (6.76×10^{-10})

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1931	8	16	-104.60	30.70	6.00	UTIG
1949	5	23	-105.20	34.60	4.50	NMTH
1955	1	27	-104.50	30.60	3.30	UTIG
1962	1	3	-103.75	34.85	2.90	NMTR
1962	3	6	-104.80	31.20	3.50	UTIG
1963	12	19	-104.27	34.82	3.40	NMTR
1964	2	11	-103.94	34.23	2.10	NMTR
1964	3	3	-103.60	34.84	2.90	NMTR
1964	6	19	-105.77	32.95	1.90	NMTR
1964	8	14	-102.94	31.97	1.90	NMTR
1964	9	7	-102.92	31.94	1.60	NMTR
1964	11	8	-103.10	31.90	3.00	UTIG
1964	11	21	-103.10	31.90	3.10	UTIG
1964	11	27	-102.97	31.89	1.90	NMTR
1965	1	21	-102.85	32.02	1.30	NMTR
1965	2	3	-103.10	31.90	3.30	UTIG
1965	8	30	-103.00	31.90	3.50	UTIG
1966	8	14	-103.00	31.90	3.40	UTIG
1966	9	17	-103.98	34.89	2.70	NMTR
1966	10	6	-104.12	35.13	2.90	NMTR
1966	11	26	-105.44	30.95	3.50	NMTR
1968	3	23	-105.91	32.67	2.60	NMTR
1968	5	2	-105.24	33.10	2.60	NMTR
1969	6	1	-105.21	34.20	1.90	NMTR
1969	6	8	-105.19	34.15	2.60	NMTR
1971	7	30	-103.00	31.72	3.00	ANSS
1971	7	31	-103.06	31.70	3.40	ANSS
1971	9	24	-103.20	31.60	3.20	UTIG
1972	7	26	-104.01	32.57	3.10	NMTR
1973	3	17	-102.36	31.59	2.50	NMTR
1973	8	2	-105.56	31.04	3.60	NMTR
1973	8	4	-103.22	35.11	3.00	NMTR
1974	7	31	-104.19	33.11	0.00	NMTR
1974	10	2	-100.86	31.87	0.00	NMTR
1974	10	27	-104.83	30.63	0.00	NMTR
1974	11	12	-102.67	32.14	0.00	NMTR
1974	11	21	-102.75	32.07	0.00	NMTR

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1974	11	22	-101.26	32.94	0.00	NMTR
1974	11	22	-105.21	33.78	0.00	NMTR
1974	11	28	-103.94	32.58	0.00	NMTR
1974	11	28	-104.14	32.31	3.90	ANSS
1974	12	30	-103.10	30.90	3.70	UTIG
1975	1	30	-103.08	30.95	2.10	NMTR
1975	2	2	-103.19	35.05	3.00	NMTR
1975	4	8	-101.69	32.18	0.00	NMTR
1975	7	25	-102.62	29.82	0.00	NMTR
1975	8	1	-104.60	30.49	0.00	NMTR
1975	8	1	-104.00	31.40	3.00	UTIG
1975	8	3	-104.45	30.71	0.00	NMTR
1975	10	10	-105.02	33.36	0.00	NMTR
1975	12	12	-102.31	31.61	3.00	NMTR
1976	1	10	-102.76	31.79	0.00	NMTR
1976	1	15	-102.32	30.98	0.00	NMTR
1976	1	19	-103.09	31.90	3.50	UTIG
1976	1	21	-102.29	30.95	0.00	NMTR
1976	1	22	-103.07	31.90	2.80	ANSS
1976	1	25	-103.08	31.90	3.90	ANSS
1976	1	28	-100.89	31.99	0.00	NMTR
1976	2	4	-103.53	31.68	0.00	NMTR
1976	2	14	-102.47	31.63	0.00	NMTR
1976	3	5	-102.25	31.66	0.00	NMTR
1976	3	15	-102.58	32.50	0.00	NMTR
1976	3	18	-102.96	32.33	0.00	NMTR
1976	3	20	-104.94	31.27	0.00	NMTR
1976	3	20	-103.06	32.22	0.00	NMTR
1976	3	27	-103.07	32.22	0.00	NMTR
1976	4	3	-103.10	31.24	0.00	NMTR
1976	4	12	-103.00	32.27	0.00	NMTR
1976	4	21	-102.89	32.25	0.00	NMTR
1976	4	30	-103.09	31.98	0.00	NMTR
1976	4	30	-103.11	31.92	0.00	NMTR
1976	5	1	-103.06	32.37	0.00	NMTR
1976	5	3	-105.66	32.41	0.00	NMTR
1976	5	3	-103.20	32.03	0.00	NMTR
1976	5	3	-103.03	32.03	0.00	NMTR
1976	5	4	-103.23	31.86	0.00	NMTR
1976	5	6	-103.18	31.97	0.00	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1976	5	6	-103.16	31.87	0.00	NMTR
1976	5	11	-102.92	32.29	0.00	NMTR
1976	5	21	-105.59	32.49	0.00	NMTR
1976	6	14	-102.49	31.52	0.00	NMTR
1976	6	15	-102.34	31.56	0.00	NMTR
1976	6	15	-102.37	31.60	0.00	NMTR
1976	7	28	-102.29	33.02	0.00	NMTR
1976	8	5	-101.73	30.87	0.00	NMTR
1976	8	5	-103.00	31.60	3.00	UTIG
1976	8	6	-102.59	31.78	2.10	NMTR
1976	8	10	-102.03	31.77	0.00	NMTR
1976	8	10	-102.06	31.79	0.00	NMTR
1976	8	25	-101.94	31.55	0.00	NMTR
1976	8	26	-102.01	31.84	0.00	NMTR
1976	8	30	-101.98	31.57	0.00	NMTR
1976	8	31	-102.18	31.46	0.00	NMTR
1976	9	3	-103.48	31.55	2.00	NMTR
1976	9	5	-102.74	32.23	0.00	NMTR
1976	9	17	-103.06	32.24	0.00	NMTR
1976	9	17	-102.50	31.40	3.10	UTIG
1976	9	19	-104.57	30.47	0.00	NMTR
1976	10	22	-102.16	31.55	0.00	NMTR
1976	10	23	-102.38	31.62	0.00	NMTR
1976	10	25	-102.53	31.84	0.00	NMTR
1976	10	26	-103.28	31.33	2.40	NMTR
1976	11	3	-102.27	30.92	0.00	NMTR
1976	12	12	-102.46	31.57	2.80	NMTR
1976	12	12	-102.49	31.61	1.90	NMTR
1976	12	15	-102.22	31.59	1.40	NMTR
1976	12	18	-103.02	31.62	1.80	NMTR
1976	12	19	-102.45	31.87	2.20	NMTR
1976	12	19	-103.14	32.25	1.80	NMTR
1976	12	19	-103.08	32.27	2.70	NMTR
1977	1	29	-104.59	30.58	0.00	NMTR
1977	2	4	-104.70	30.59	0.00	NMTR
1977	2	18	-103.05	32.24	0.00	NMTR
1977	3	5	-102.66	31.16	0.00	NMTR
1977	3	14	-101.01	33.04	0.00	NMTR
1977	3	20	-103.10	32.21	0.00	NMTR
1977	3	29	-103.28	31.60	0.00	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site
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YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1977	4	3	-103.17	31.49	1.90	NMTR
1977	4	3	-103.20	31.47	0.00	NMTR
1977	4	4	-103.36	31.00	0.00	NMTR
1977	4	7	-103.05	32.19	0.00	NMTR
1977	4	7	-102.70	31.32	0.00	NMTR
1977	4	7	-102.94	31.35	0.00	NMTR
1977	4	12	-102.55	31.28	0.00	NMTR
1977	4	17	-102.35	31.50	0.00	NMTR
1977	4	18	-103.25	31.60	0.00	NMTR
1977	4	22	-103.02	32.18	0.00	NMTR
1977	4	25	-102.81	32.07	0.00	NMTR
1977	4	26	-103.08	31.90	3.30	ANSS
1977	4	28	-102.52	31.83	0.00	NMTR
1977	4	28	-101.99	31.87	0.00	NMTR
1977	4	29	-102.65	31.77	0.00	NMTR
1977	6	7	-100.75	33.06	4.00	ANSS
1977	6	8	-100.83	32.83	0.00	NMTR
1977	6	8	-100.82	32.92	0.00	NMTR
1977	6	8	-101.04	32.87	0.00	NMTR
1977	6	17	-100.95	32.90	2.70	NMTR
1977	6	28	-103.30	31.54	2.30	NMTR
1977	7	1	-103.34	31.50	2.00	NMTR
1977	7	11	-102.62	31.80	0.00	NMTR
1977	7	11	-102.68	31.79	0.00	NMTR
1977	7	12	-102.64	31.77	0.00	NMTR
1977	7	18	-102.70	31.78	0.00	NMTR
1977	7	22	-102.72	31.80	0.00	NMTR
1977	7	22	-102.70	31.80	3.00	UTIG
1977	7	24	-102.70	31.79	0.00	NMTR
1977	8	20	-103.33	31.60	1.90	NMTR
1977	8	21	-104.91	30.54	0.00	NMTR
1977	10	13	-100.81	32.91	2.20	NMTR
1977	10	17	-102.46	31.57	1.80	NMTR
1977	11	14	-104.96	31.52	0.00	NMTR
1977	11	27	-101.14	33.02	0.00	NMTR
1977	11	28	-100.84	32.95	3.50	ANSS
1977	12	16	-102.40	31.52	0.00	NMTR
1977	12.	21	-102.41	31.52	0.00	NMTR
1977	12	31	-102.46	31.60	2.10	NMTR
1978	1	2	-102.53	31.60	2.20	NMTR

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1978	1	12	-102.30	31.49	0.00	NMTR
1978	1	15	-101.70	31.36	0.00	NMTR
1978	1	18	-103.23	31.61	0.00	NMTR
1978	1	19	-103.71	32.56	0.00	NMTR
1978	2	5	-102.60	31.89	0.00	NMTR
1978	2	5	-104.55	31.41	0.00	NMTR
1978	2	18	-104.69	31.21	2.30	NMTR
1978	3	2	-103.06	32.82	1.50	NMTR
1978	3	2	-102.38	31.58	3.30	NMTR
1978	3	2	-102.61	31.59	2.10	NMTR
1978	3	2	-102.56	31.55	3.50	UTIG
1978	3	19	-102.49	31.47	1.60	NMTR
1978	6	16	-100.80	33.00	3.40	UTIG
1978	6	16	-100.77	33.03	5.30	ANSS
1978	6	29	-102.42	31.08	3.20	NMTR
1978	7	5	-102.20	31.61	0.00	NMTR
1978	7	18	-104.36	30.36	0.00	NMTR
1978	7	21	-102.77	31.34	0.00	NMTR
1978	8	14	-102.18	31.58	2.20	NMTR
1978	9	29	-102.42	31.52	0.00	NMTR
1978	9	30	-102.17	31.36	0.00	NMTR
1978	10	2	-102.43	31.53	0.00	NMTR
1978	10	2	-102.19	31.51	0.00	NMTR
1978	10	2	-102.36	31.48	0.00	NMTR
1978	10	3	-102.99	31.90	0.00	NMTR
1978	10	6	-102.36	31.55	0.00	NMTR
1979	4	28	-104.72	30.47	0.00	NMTR
1979	7	17	-103.73	32.65	2.00	NMTR
1979	8	3	-100.81	32.87	2.40	NMTR
1980	1	21	-105.00	34.20	1.30	NMTR
1980	3	21	-102.34	31.57	1.60	NMTR
1981	8	13	-102.70	31.90	2.20	NMTR
1981	9	16	-105.23	33.72	1.80	NMTR
1982	1	4	-102.49	31.18	3.90	ANSS
1982	4	26	-100.84	33.02	2.80	ANSS
1982	5	1	-103.04	32.33	2.10	NMTR
1982	10	17	-102.71	30.90	2.00	NMTR
1982	10	26	-103.59	33.67	1.50	NMTR
1982	10	26	-103.61	33.63	1.50	NMTR
1982	11	25	-100.78	32.89	2.30	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1982	11	28	-100.84	33.00	3.30	ANSS
1983	1	9	-104.19	30.65	1.90	NMTR
1983	1	12	-105.19	34.32	1.50	NMTR
1983	1	29	-102.08	31.75	2.20	NMTR
1983	3	3	-104.35	29.96	2.80	NMTR
1983	6	5	-105.35	32.52	1.30	NMTR
1983	6	21	-103.58	33.63	1.60	NMTR
1983	7	21	-105.14	30.97	1.60	NMTR
1983	8	4	-105.14	32.57	1.30	NMTR
1983	8	19	-102.23	31.31	1.80	NMTR
1983	8	22	-105.08	34.06	1.30	NMTR
1983	8	23	-105.52	31.17	2.10	NMTR
1983	8	26	-102.53	33.62	1.60	NMTR
1983	8	29	-100.62	31.80	2.60	NMTR
1983	9	15	-104.43	34.92	3.10	NMTR
1983	9	29	-104.45	34.89	2.70	NMTR
1983	9	30	-103.97	30.57	1.70	NMTR
1983	12	1	-101.99	31.86	1.40	NMTR
1983	12	3	-103.32	30.97	2.10	NMTR
1983	12	26	-102.88	30.77	1.70	NMTR
1984	1	2	-102.12	31.81	1.80	NMTR
1984	1	3	-102.69	31.21	1.70	NMTR
1984	1	3	-103.04	30.76	2.00	NMTR
1984	1	16	-102.20	31.56	1.40	NMTR
1984	3	2	-104.84	30.81	1.90	NMTR
1984	3	23	-100.78	32.45	1.50	NMTR
1984	5	21	-102.59	31.14	1.30	NMTR
1984	5	21	-102.23	35.07	3.10	ANSS
1984	6	27	-102.48	31.22	2.00	NMTR
1984	7	17	-105.77	32.85	1.30	NMTR
1984	8	18	-103.56	30.78	1.80	NMTR
1984	8	24	-104.48	30.67	1.30	NMTR
1984	8	26	-104.27	30.38	2.10	NMTR
1984	9	11	-100.70	31.99	3.20	ANSS
1984	9	19	-100.69	32.03	3.00	ANSS
1984	9	27	-103.42	32.59	1.60	NMTR
1984	10	4	-102.70	33.58	1.30	NMTR
1984	10	4	-102.24	31.65	1.30	NMTR
1984	10	11	-100.56	31.95	2.40	NMTR
1984	10	27	-104.56	30.62	1.70	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site
Page 7 of 14

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1984	11	27	-105.41	33.57	1.60	NMTR
1984	12	4	-101.93	30.10	2.30	NMTR
1984	12	4	-103.21	32.64	2.10	NMTR
1984	12	4	-103.56	32.27	2.90	ANSS
1984	12	12	-105.61	33.36	1.50	NMTR
1985	2	21	-100.75	32.88	1.40	NMTR
1985	2	21	-100.81	32.72	1.50	NMTR
1985	3	9	-105.12	33.97	1.30	NMTR
1985	5	3	-104.95	31.04	1.90	NMTR
1985	6	1	-102.83	31.06	1.50	NMTR
1985	6	2	-102.28	31.18	1.60	NMTR
1985	6	12	-103.90	34.64	1.60	NMTR
1985	8	2	-104.34	32.48	1.40	NMTR
1985	9	5	-103.77	33.66	1.80	NMTR
1985	9	18	-103.42	30.90	2.00	NMTR
1985	10	21	-101.88	32.04	1.30	NMTR
1985	11	13	-103.08	32.10	1.80	NMTR
1985	11	28	-101.99	31.61	1.80	NMTR
1985	12	5	-102.94	32.42	1.60	NMTR
1986	1	25	-100.73	32.06	2.90	ANSS
1986	1	30	-104.01	33.54	1.90	NMTR
1986	1	30	-100.69	32.07	3.30	ANSS
1986	2	7	-105.44	32.54	1.40	NMTR
1986	2	14	-100.76	31.53	2.60	NMTR
1986	3	1	-102.57	31.16	1.70	NMTR
1986	3	11	-105.08	32.11	2.00	NMTR
1986	3	21	-105.64	33.43	1.60	NMTR
1986	5	28	-105.12	31.76	1.60	NMTR
1986	6	12	-102.22	31.77	1.80	NMTR
1986	6	27	-102.01	32.06	2.20	NMTR
1986	7	9	-102.48	31.55	1.60	NMTR
1986	7	20	-105.00	33.47	1.50	NMTR
1986	8	2	-103.79	33.68	1.70	NMTR
1986	8	6	-103.03	33.86	2.40	NMTR
1986	8	14	-104.66	32.53	1.30	NMTR
1986	8	15	-103.43	33.14	1.70	NMTR
1986	8	29	-102.41	31.31	1.40	NMTR
1986	9	18	-102.37	31.51	1.80	NMTR
1986	10	18	-102.69	30.07	1.60	NMTR
1986	10	25	-102.13	31.60	1.70	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1986	11	3	-104.64	31.09	2.00	NMTR
1986	11	6	-104.58	32.55	1.60	NMTR
1986	11	17	-100.73	33.08	2.00	NMTR
1986	11	24	-102.16	31.68	2.00	NMTR
1986	12	6	-102.16	31.59	2.40	NMTR
1986	12	6	-102.23	31.47	2.10	NMTR
1986	12	6	-102.17	31.65	1.70	NMTR
1986	12	6	-102.09	31.72	2.20	NMTR
1986	12	15	-103.19	35.07	1.50	NMTR
1986	12	15	-102.02	31.76	1.50	NMTR
1987	1	25	-104.86	31.74	1.70	NMTR
1987	2	9	-103.45	30.69	2.30	NMTR
1987	2	9	-101.96	31.86	1.60	NMTR
1987	2	12	-101.94	31.66	1.60	NMTR
1987	2	17	-104.52	30.60	2.10	NMTR
1987	3	2	-105.08	30.78	1.80	NMTR
1987	3	3	-105.44	31.17	1.50	NMTR
1987	3	10	-105.66	31.13	1.50	NMTR
1987	3	26	-103.28	30.96	2.60	NMTR
1987	3	31	-104.95	31.52	2.80	NMTR
1987	4	23	-105.02	32.03	1.60	NMTR
1987	4	25	-105.22	33.97	1.90	NMTR
1987	4	29	-105.92	32.67	2.30	NMTR
1987	7	5	-104.77	30.85	2.00	NMTR
1987	7	23	-103.03	35.29	1.90	NMTR
1987	7	30	-103.87	34.54	1.50	NMTR
1987	8	4	-102.12	31.87	1.70	NMTR
1987	9	11	-103.62	33.61	2.00	NMTR
1987	9	21	-103.74	33.68	1.80	NMTR
1987	10	1	-105.16	30.47	1.60	NMTR
1987	10	1	-103.76	33.66	1.50	NMTR
1987	10	9	-104.59	31.07	1.40	NMTR
1987	10	31	-105.31	32.86	1.30	NMTR
1987	11	3	-103.71	33.70	1.30	NMTR
1987	11	17	-101.97	32.06	1.60	NMTR
1987	12	6	-102.76	31.83	1.60	NMTR
1987	12	20	-103.07	32.29	2.20	NMTR
1987	12	28	-102.25	31.47	2.10	NMTR
1987	12	29	-102.11	31.58	1.50	NMTR
1988	1	26	-102.42	31.24	2.30	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1988	2	14	-102.06	31.78	1.40	NMTR
1988	2	21	-103.02	30.45	1.40	NMTR
1988	2	27	-103.75	33.67	1.80	NMTR
1988	3	9	-102.44	31.24	1.70	NMTR
1988	3	15	-105.52	31.72	1.30	NMTR
1988	3	17	-102.20	31.66	1.60	NMTR
1988	4	5	-102.33	31.44	2.10	NMTR
1988	4	6	-102.09	31.94	1.30	NMTR
1988	5	3	-104.39	30.52	1.30	NMTR
1988	5	10	-105.20	30.96	1.40	NMTR
1988	5	27	-102.12	31.78	1.30	NMTR
1988	5	27	-102.02	32.06	1.30	NMTR
1988	7	4	-100.74	33.74	2.00	NMTR
1988	7	11	-103.25	35.28	1.90	NMTR
1988	7	20	-102.43	29.77	2.20	NMTR
1988	7	25	-104.91	31.98	1.50	NMTR
1988	7	26	-105.14	30.94	1.50	NMTR
1988	8	23	-102.02	32.26	1.50	NMTR
1988	9	15	-103.32	31.68	1.50	NMTR
1988	9	19	-102.45	32.46	2.00	NMTR
1988	10	2	-103.79	33.63	1.30	NMTR
1988	11	10	-102.40	31.55	1.90	NMTR
1989	1	9	-102.59	31.44	1.80	NMTR
1989	1	9	-102.12	31.78	1.30	NMTR
1989	1	20	-101.97	32.08	1.90	NMTR
1989	2	21	-103.39	35.29	2.30	NMTR
1989	3	19	-103.55	31.19	1.50	NMTR
1989	3	21	-102.33	31.42	1.50	NMTR
1989	3	30	-102.86	33.24	1.40	NMTR
1989	6	5	-102.09	32.10	2.10	NMTR
1989	6	23	-102.23	31.59	1.60	NMTR
1989	6	28	-105.08	30.93	2.30	NMTR
1989	7	13	-105.27	33.53	1.50	NMTR
1989	7	24	-100.93	32.92	1.60	NMTR
1989	7	25	-101.76	30.90	2.10	NMTR
1989	8	8	-102.70	31.30	2.30	NMTR
1989	8	16	-101.96	31.70	1.60	NMTR
1989	9	5	-102.50	34.25	2.50	NMTR
1989	11	2	-100.94	33.02	2.00	NMTR
1989	11	16	-103.12	35.11	2.60	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1989	12	7	-103.67	34.58	1.40	NMTR
1989	12	28	-101.06	31.70	2.10	NMTR
1989	12	28	-100.96	32.04	1.70	NMTR
1990	1	16	-105.32	31.74	1.80	NMTR
1990	3	4	-103.92	30.53	1.70	NMTR
1990	3	30	-100.53	32.96	2.30	NMTR
1990	3	30	-100.56	32.99	2.20	NMTR
1990	4	6	-103.36	31.51	1.90	NMTR
1990	5	10	-102.37	31.14	2.20	NMTR
1990	5	10	-101.96	32.13	1.60	NMTR
1990	5	16	-102.04	31.86	2.40	NMTR
1990	5	22	-102.09	30.24	2.20	NMTR
1990	6	22	-100.76	32.58	2.20	NMTR
1990	7	3	-102.22	31.44	1.50	NMTR
1990	7	13	-101.81	34.86	2.70	NMTR
1990	8	3	-100.69	32.21	3.40	NMTR
1990	8	9	-102.67	31.21	1.90	NMTR
1990	8	14	-102.26	31.39	1.80	NMTR
1990	8	25	-102.01	31.91	1.80	NMTR
1990	10	8	-105.12	30.94	1.30	NMTR
1990	12	20	-103.14	35.27	2.50	NMTR
1991	1	1	-105.27	32.44	1.60	NMTR
1991	1	29	-103.04	32.89	1.40	NMTR
1991	2	3	-104.49	32.81	1.30	NMTR
1991	2	3	-103.96	35.00	2.10	NMTR
1991	3	10	-103.97	30.47	2.10	NMTR
1991	3	10	-103.33	33.58	2.00	NMTR
1991	4	8	-103.13	34.98	2.10	NMTR
1991	5	16	-103.75	33.67	2.00	NMTR
1991	6	4	-102.31	32.05	2.00	NMTR
1991	7	16	-101.12	33.09	2.10	NMTR
1991	8	1	-104.02	34.59	2.70	NMTR
1991	8	7	-104.81	31.62	1.80	NMTR
1991	8	17	-100.99	32.09	2.00	NMTR
1991	9	22	-101.30	31.32	2.10	NMTR
1991	9	28	-103.77	33.63	1.70	NMTR
1991	9	30	-100.73	31.85	2.20	NMTR
1991	10	5	-105.41	31.38	2.20	NMTR
1992	1	2	-103.19	32.30	5.00	NMTR
1992	1	2	-103.19	32.30	1.80	NMTR

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1992	1	2	-103.19	32.30	1.50	NMTR
1992	1	2	-103.19	32.30	2.40	NMTR
1992	1	2	-103.19	32.30	1.80	NMTR
1992	1	3	-103.19	32.30	1.90	NMTR
1992	1	4	-103.19	32.30	1.50	NMTR
1992	1	7	-103.19	32.30	2.40	NMTR
1992	1	9	-103.19	32.30	2.80	NMTR
1992	1	11	-103.19	32.30	2.00	NMTR
1992	1	23	-102.29	31.84	1.90	NMTR
1992	2	2	-102.86	32.17	1.90	NMTR
1992	3	15	-104.12	34.92	1.70	NMTR
1992	3	28	-105.39	33.45	1.80	NMTR
1992	4	3	-103.03	32.26	2.10	NMTR
1992	4	6	-102.61	31.86	1.70	NMTR
1992	4	7	-102.29	31.56	1.60	NMTR
1992	4	7	-102.29	31.56	2.30	NMTR
1992	4	7	-102.29	31.56	1.70	NMTR
1992	4	8	-104.86	32.41	1.60	NMTR
1992	4	30	-104.31	30.66	1.70	NMTR
1992	5	9	-104.34	30.49	1.60	NMTR
1992	5	15	-103.08	32.28	1.60	NMTR
1992	5	16	-102.34	31.75	1.70	NMTR
1992	6	14	-103.10	32.30	2.30	NMTR
1992	6	20	-102.42	31.43	1.60	NMTR
1992	6	20	-102.42	31.43	1.50	NMTR
1992	6	29	-102.47	31.42	1.40	NMTR
1992	6	29	-102.47	31.42	1.40	NMTR
1992	6	29	-102.47	31.42	2.00	NMTR
1992	7	5	-102.39	31.88	1.50	NMTR
1992	7	5	-102.39	31.88	1.30	NMTR
1992	7	21	-103.13	32.28	1.90	NMTR
1992	8	12	-102.41	31.39	1.50	NMTR
1992	8	18	-102.45	31.46	1.90	NMTR
1992	8	19	-100.92	33.11	2.20	NMTR
1992	8	26	-102.71	32.17	3.00	ANSS
1992	8	28	-100.98	32.38	1.70	NMTR
1992	9	4	-102.26	31.42	1.90	NMTR
1992	9	15	-103.02	32.16	2.20	NMTR
1992	10	8	-102.81	32.25	1.60	NMTR
1992	10	10	-102.41	31.71	1.60	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1992	10	27	-101.93	34.12	1.30	NMTR
1992	11	22	-103.16	32.29	1.70	NMTR
1992	11	27	-102.49	31.44	1.30	NMTR
1992	12	2	-102.35	31.42	2.40	NMTR
1992	12	3	-103.74	33.66	1.90	NMTR
1992	12	5	-102.51	31.87	1.40	NMTR
1993	1	4	-105.27	31.06	1.30	NMTR
1993	1	28	-102.58	31.85	1.80	NMTR
1993	1	31	-104.64	30.60	1.50	NMTR
1993	2	11	-105.23	31.12	2.00	NMTR
1993	2	28	-102.43	31.21	1.30	NMTR
1993	2	28	-102.41	31.22	1.50	NMTR
1993	3	8	-103.33	30.87	1.60	NMTR
1993	3	21	-102.37	31.43	1.50	NMTR
1993	4	23	-102.47	31.21	1.70	NMTR
1993	5	5	-105.16	32.29	2.10	NMTR
1993	5	16	-105.06	30.44	2.20	NMTR
1993	5	17	-102.33	31.42	2.30	NMTR
1993	5	23	-102.42	31.42	1.60	NMTR
1993	5	28	-103.12	32.75	2.50	NMTR
1993	6	17	-102.56	31.80	1.70	NMTR
1993	6	23	-102.44	31.51	1.40	NMTR
1993	6	23	-102.54	31.43	2.50	NMTR
1993	6	23	-102.52	31.43	2.80	NMTR
1993	6	23	-102.52	31.43	2.10	NMTR
1993	6	23	-102.54	29.66	1.90	NMTR
1993	6	23	-102.51	31.35	2.80	ANSS
1993	6	24	-102.45	31.48	2.10	NMTR
1993	7	3	-102.43	31.44	1.50	NMTR
1993	7	3	-102.34	31.50	2.20	NMTR
1993	7	3	-102.38	31.54	1.60	NMTR
1993	8	13	-102.52	31.89	1.30	NMTR
1993	8	29	-102.91	32.35	2.50	NMTR
1993	9	5	-100.96	32.28	2.00	NMTR
1993	9	6	-100.91	32.48	1.80	NMTR
1993	9	11	-103.76	34.72	1.50	NMTR
1993	9	26	-103.52	35.08	1.50	NMTR
1993	9	30	-103.80	33.64	1.90	NMTR
1993	10	3	-103.84	33.61	1.70	NMTR
1993	11	6	-102.19	31.75	1.50	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1993	11	24	-104.74	32.34	1.30	NMTR
1993	11	25	-102.10	34.27	2.60	NMTR
1993	11	25	-104.38	30.49	1.30	NMTR
1993	12	2	-102.34	31.27	1.30	NMTR
1993	12	3	-102.23	31.68	1.60	NMTR
1993	12	10	-102.29	31.74	1.60	NMTR
1993	12	18	-103.41	30.21	1.80	NMTR
1993	12	22	-105.68	33.33	3.20	ANSS
1994	1	6	-105.09	31.95	2.40	NMTR
1994	1	7	-102.32	31.24	1.70	NMTR
1994	3	15	-103.56	30.11	2.00	NMTR
1994	4	21	-103.12	32.31	1.40	NMTR
1994	4	25	-104.62	30.60	1.90	NMTR
1994	5	23	-102.64	32.11	1.60	NMTR
1994	6	30	-102.33	31.36	1.30	NMTR
1994	8	22	-102.21	33.34	1.60	NMTR
1994	8	30	-102.32	31.38	1.40	NMTR
1994	8	30	-102.32	31.34	1.50	NMTR
1994	8	30	-102.30	31.42	1.30	NMTR
1994	9	24	-102.36	31.43	2.00	NMTR
1994	11	24	-100.80	32.39	2.70	NMTR
1995	1	1	-102.45	31.77	1.40	NMTR
1995	1	4	-102.38	31.48	1.30	NMTR
1995	2	1	-104.09	34.51	1.80	NMTR
1995	3	19	-104.21	35.00	3.30	ANSS
1995	4	14	-103.35	30.28	5.70	UTIG
1995	4	18	-102.27	31.44	1.90	NMTR
1995	4	18	-105.34	31.10	1.60	NMTR
1995	4	21	-103.35	30.30	2.90	ANSS
1995	5	11	-105.20	32.71	2.40	NMTR
1995	5	15	-102.42	31.40	1.80	NMTR
1995	5	27	-102.34	31.34	2.30	NMTR
1995	5	30	-105.21	32.71	2.10	NMTR
1995	7	11	-105.06	30.87	1.80	NMTR
1995	7	17	-104.94	31.15	1.40	NMTR
1995	8	1	-105.27	33.14	1.30	NMTR
1995	8	2	-103.36	30.31	1.80	NMTR
1995	8	12	-103.07	30.79	1.90	NMTR
1995	8	14	-102.96	30.41	1.50	NMTR
1995	10	19	-104.84	32.05	2.00	NMTR

Table 3.3-3 Earthquakes Within a 322-Kilometer (200-Mile) Radius of the NEF Site
Page 14 of 14

YEAR	MONTH	DAY	LONGITUDE	LATITUDE	MAGNITUDE	DATA SOURCE[1]
1995	10	25	-103.42	30.35	2.20	NMTR
1995	11	12	-103.35	30.30	3.60	ANSS
1995	12	3	-104.90	31.93	1.50	NMTR
1995	12	4	-104.90	31.93	1.40	NMTR
1995	12	4	-104.90	31.93	1.30	NMTR
1996	3	15	-105.69	33.59	2.90	ANSS
1998	4	15	-103.30	30.19	3.60	ANSS
1999	3	1	-104.66	32.57	2.90	ANSS
1999	3	14	-104.63	32.59	4.00	ANSS
1999	3	17	-104.67	32.58	3.50	ANSS
1999	5	30	-104.66	32.58	3.90	ANSS
1999	8	9	-104.59	32.57	2.90	ANSS
2000	2	2	-104.63	32.58	2.70	ANSS
2000	2	26	-103.61	30.24	2.80	ANSS
2001	6	2	-103.14	32.33	3.30	ANSS
2001	11	22	-102.63	31.79	3.10	ANSS
2002	9	17	-104.63	32.58	3.50	ANSS
2002	9	17	-104.63	32.58	3.30	ANSS
2003	6	21	-104.51	32.67	3.60	ANSS

[1]Data Sources:

UTIG, University of Texas Institute for Geophysics (UTIG, 2002)
NMTH, New Mexico Tech Historical Catalog (NMIMT, 2002)
ANSS, Advanced National Seismic System (USGS, 2003a)
NMTR, New Mexico Tech Regional Catalog, Exclusive of Socorro, New Mexico Events (NMIMT, 2002)

Table 3.3-4 Earthquakes of Magnitude 4.0 and Greater Within 322 Kilometers (200 Miles) of the NEF Site

No.	Year	Month	Day	Longitude	Latitude	Magnitude	Data Source[1]	Distance km (mi) to NEF Site
507	1931	8	16	-104.6000	30.7000	6.0	UTIG	237 (147)
547	1949	5	23	-105.2000	34.6000	4.5	NMTH	314 (195)
559	1977	6	7	-100.7490	33.0580	4.0	ANSS	229 (142)
562	1978	6	16	-100.7660	33.0300	5.3	ANSS	225 (140)
382	1992	1	2	-103.1863	32.3025	5.0	NMTR	16 (10)
541	1995	4	14	-103.3500	30.2800	5.7	UTIG	238 (148)
602	1999	3	14	-104.6300	32.5910	4.0	ANSS	146 (91)

[1]Data Sources:

UTIG, University of Texas Institute for Geophysics (UTIG, 2002)
NMTH, New Mexico Tech Historical Catalog (NMIMT, 2002)
ANSS, Advanced National Seismic System (USGS, 2003a)
NMTR, New Mexico Tech Regional Catalog, Exclusive of Socorro, New Mexico Events (NMIMT, 2002)

Table 3.3-5 Earthquake Data Sources for New Mexico and West Texas

Page 1 of 1

Data Source	Time Span	Number of Events Within a 322-Kilometer (200-Mile) Radius
New Mexico Tech, Regional Catalog (NMIMT, 2002)	1962 - 1995	504
New Mexico Tech, Historical Catalog (NMIMT, 2002)	1869 - 1992	2
Univ. of Texas Institute of Geophysics (UTIG, 2002)	1931 - 1998	42
Advanced National Seismic System (USGS, 2003a)	1962 - 2003	64

Table 3.3-6 Modified Mercalli Intensity Scale

Intensity Value	Description
I	Not felt except by a very few under especially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration like passing of truck.
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing automobiles rocked noticeably.
V	Felt by nearly everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown in the air.

Table 3.3-7 Comparison of Parameters for the January 2, 1992, Eunice, New Mexico Earthquake

Page 1 of 1

Year	Month	Day	Longitude	Latitude	Magnitude	Data Source[1]
1992	1	2	-103.1863	32.3025	5.0	NMTR
1992	1	2	-102.97	32.36	4.6	UTIG
1992	1	2	-103.2	32.3	5.0	NMTH
1992	1	2	-103.101	32.336	5.0	ANSS

[1]Data Sources:

UTIG, University of Texas Institute for Geophysics (UTIG, 2002)
NMTH, New Mexico Tech Historical Catalog (NMIMT, 2002)
ANSS, Advanced National Seismic System (USGS, 2003a)
NMTR, New Mexico Tech Regional Catalog, Exclusive of Socorro, New Mexico Events (NMIMT, 2002)

FIGURES

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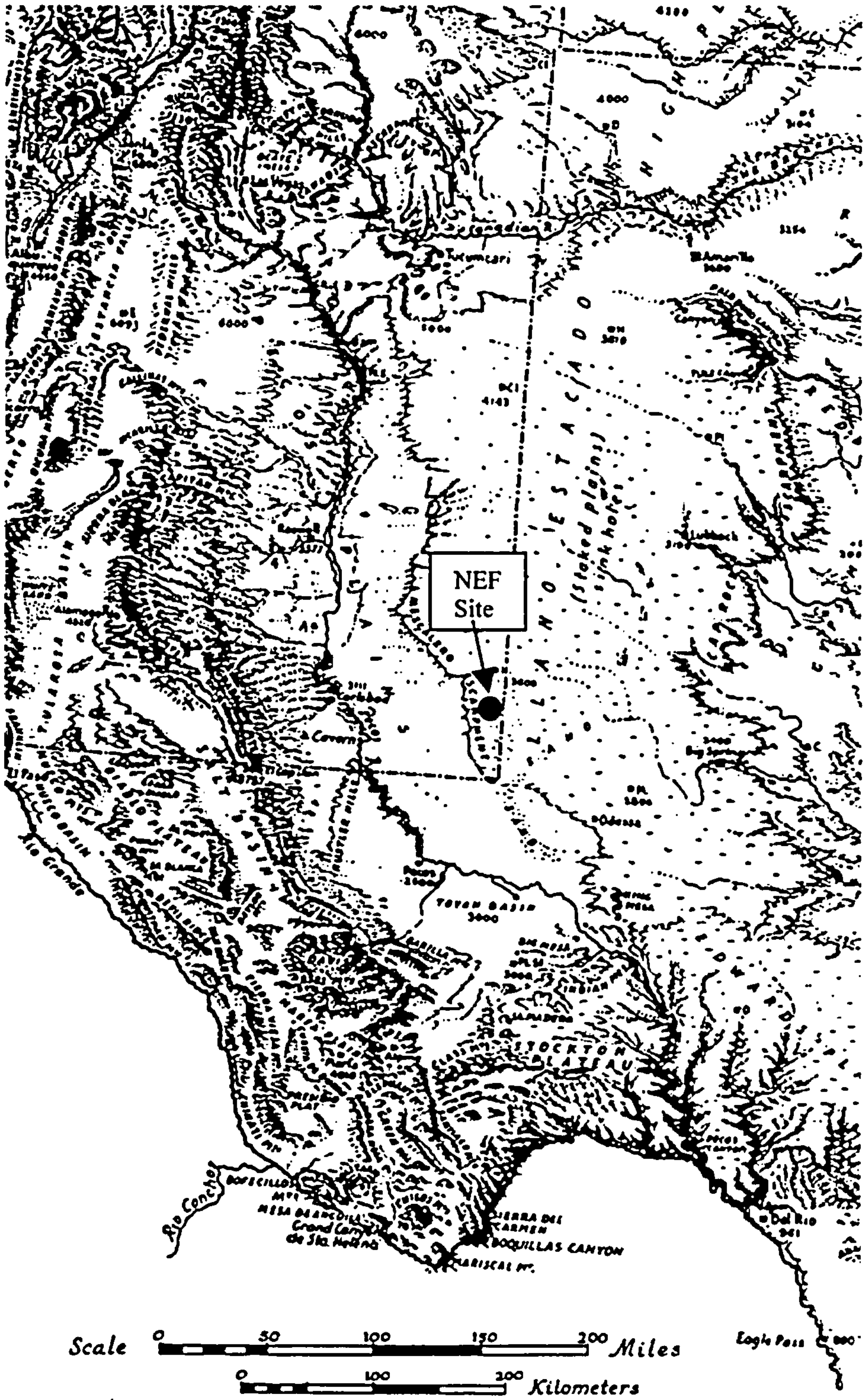

REFERENCE:
(RAISZ, 1957)

NORTH

REFERENCE NUMBER
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FIGURE 3.3-1
REGIONAL PHYSIOGRAPHY
ENVIRONMENTAL REPORT
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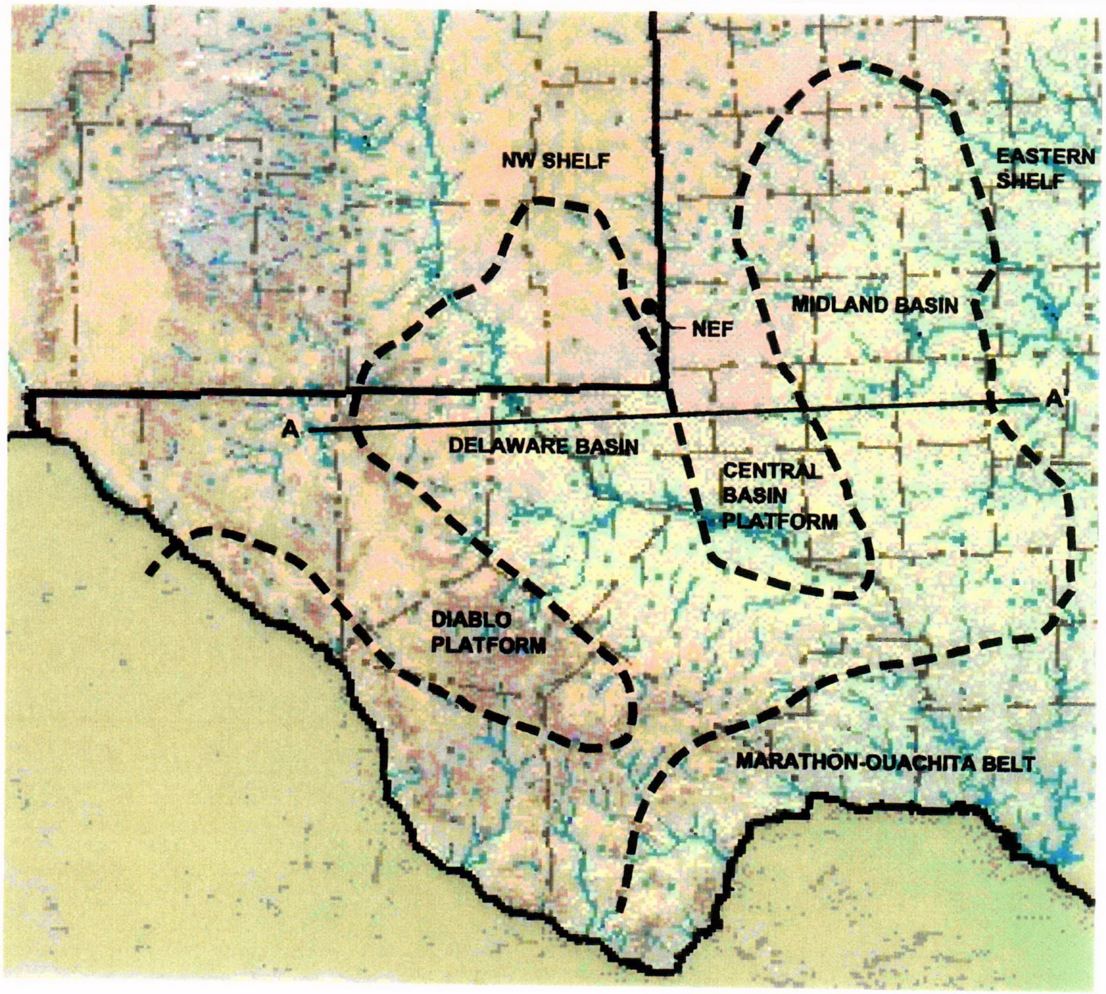

Permian Basin Geologic Profile

(Generalized from UTPB, 2003)

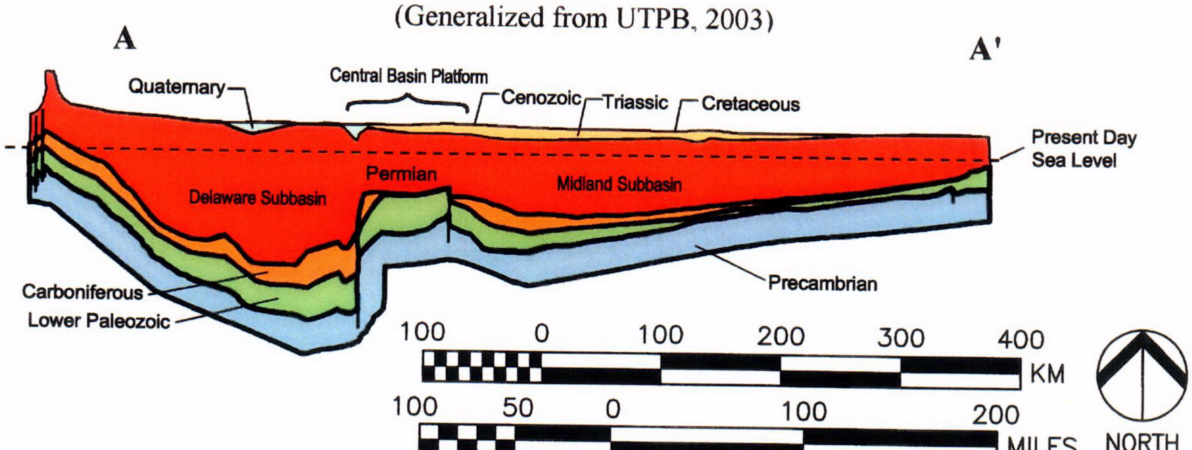

FIGURE 3.3-2

REGIONAL GEOLOGY OF THE PERMIAN BASIN

ENVIRONMENTAL REPORT

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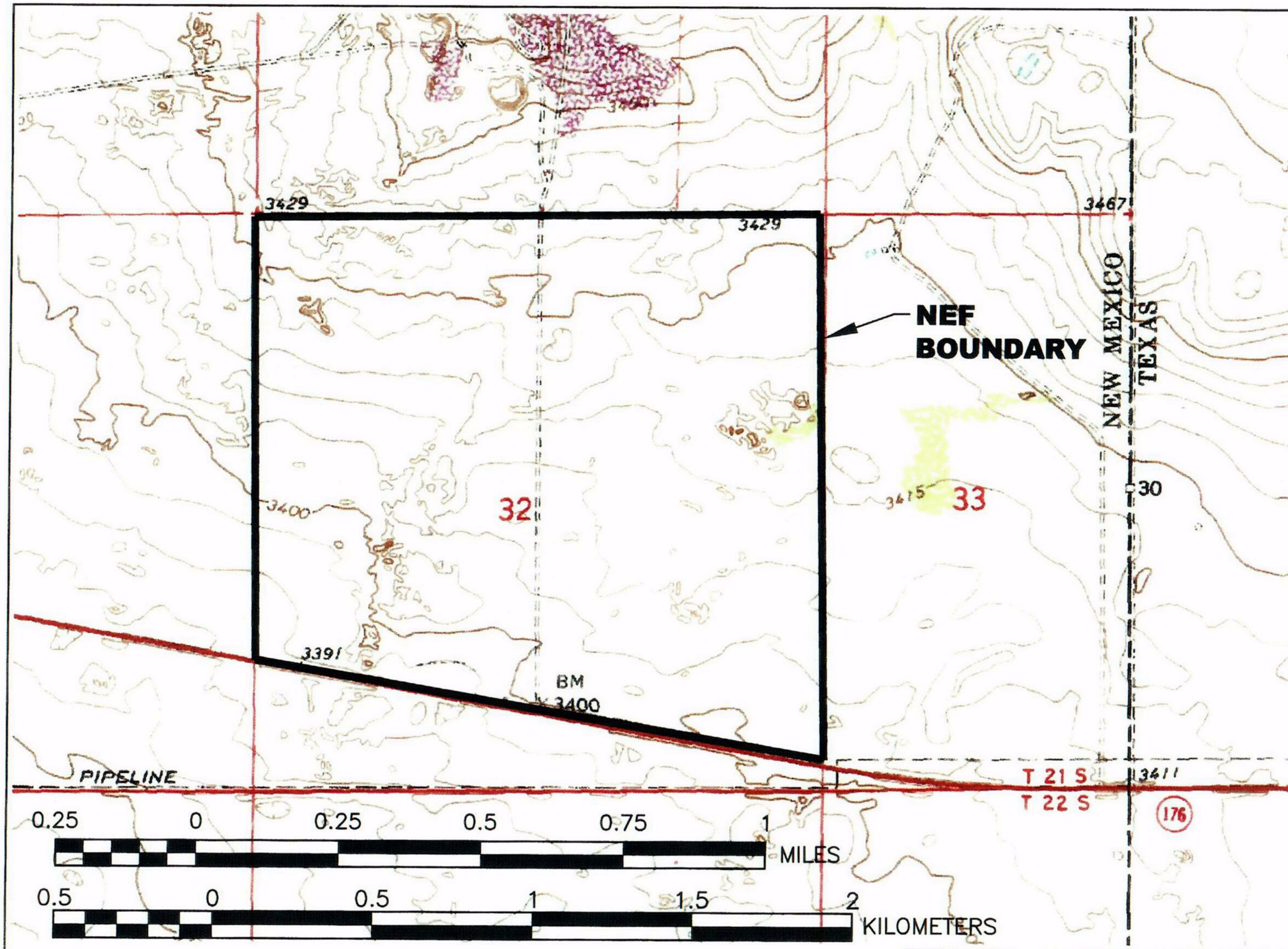
REFERENCE NUMBER

Section 3.3 Figures.dwg



FROM USGS EUNICE NE TEX–NM TOPOGRAPHIC QUADRANGLE, PHOTO–REVISED JULY, 1979

CONTOUR INTERVAL: 5 FEET

Modified from: http://mrdata.usgs.gov.

REFERENCE NUMBER
Figure 3.3–3.dwg

FIGURE 3.3-3
SITE TOPOGRAPHY

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LEGEND

ca CALICHE — *Partly indurated zone of calcium carbonate accumulation formed in upper layers of surficial deposits; 2 to 10 ft thick, commonly overlain by windblown sand. Much caliche shown on the map consists of tough, slabby surface layers underlain by calcium carbonate nodules that grade downward to fibers and veinlets. Especially well developed in Basin and Range and Great Plains parts of the state. Thick caliches (locally >20 ft) associated with undissected High Plains surfaces of the Great Plains commonly comprise an upper sequence of several carbonate-cemented zones interlayered with reddish loamy paleosol horizons over a basal caprock zone developed on Ogallala* (To) *sediments. Forms on various types of parent formations, indicated by subscripts. The extensive caliche along Rio Salado northwest of Socorro is partly a travertine deposit. Where buried by sand, the caliche is identified by subscript* ca. *A distinctive unit; boundaries are well defined where the caliche forms rimrock and approximate where exposed in deflation hollows. Where thick and well indurated, caliche is quarried for road metal and other aggregate, subject to minimal erosion*

al_2 FLOODPLAIN AND CHANNEL DEPOSITS ALONG GENERALLY DRY ARROYOS AND WASHES — *Includes deposits along some perennial mountain streams. Extent exaggerated to emphasize drainage patterns. Sandier than* al_1*, gradients 5 to 15 percent. Arroyos 10 ft deep common. Surface flat where deposit was formed by stream overflowing its banks; hummocky where built of coalescing fans at mouths of tributaries that crowd the main stream against its far bank, or V-shaped where alluvium grades laterally into fan sand washed from adjoining hillsides. Ephemeral perched water tables under some deposits. Width of deposits represented has been exaggerated but total area probably about right because small deposits had to be omitted*

fs SAND FACIES — *Sandy alluvium with subordinate amounts of fine gravel, silt, and clay. Forms at least four kinds of ground: 1) On short, steep fans sloping from the mountains of granitic or gneissic rock (e.g., parts of the Florida Mountains), this facies may form a smooth sandy layer a few feet thick covering gravel below; slopes 5 to 20 percent; washes 1 to 10 ft deep may expose underlying gravel. 2) On other short fans, sand facies may form arcuate belt at toe of fan with slopes averaging 10 percent, commonly reworked into coppice dunes 3 to 7 ft high* (sm)*. 3) Other belts of smooth sandy ground commonly slope 5 percent or less and consist of sand mounds approximately 1 ft high over caliche* (fs_2)*. 4) Gypsiferous sand* (fs_3)*, especially in the Jornada del Muerto, Tularosa Valley and east side of the Pecos Valley. Sand facies absent on the broad Las Palomas surface. Thin fan sand covering pediments is denoted by* fs *over subscript that identifies underlying formation. Boundary with residual sand, fan gravel, and fan silt is approximate*

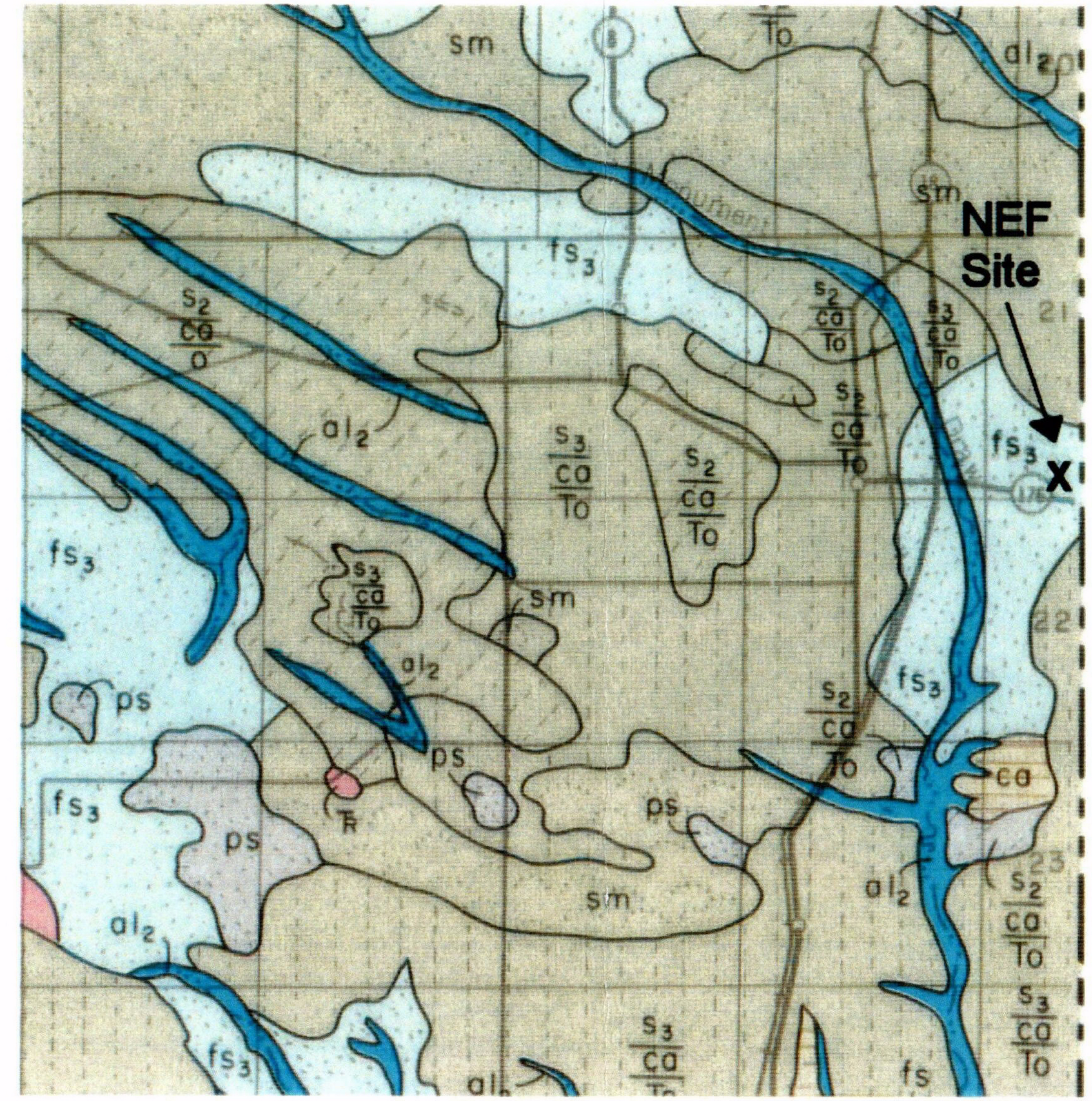
s_2/ca/To MODERATELY THICK SAND ON CALICHE ON OGALLALA FORMATION — *Sand 1 to 3 ft thick. Surface layers noncalcareous over reddish loam. Local sand mounds. Ground favored for farming. Boundaries approximate*

s_3/ca/To THICK SAND ON CALICHE ON OGALLALA FORMATION *Sand 3 to 5 ft thick. Local mounds. Brownish-red, fine sandy loam over reddish-brown, sandy clay loam; noncalcareous to depths of 3 ft; calcareous subsoil contains filaments of lime carbonate. Where farmed, ground is subject to wind erosion. Boundaries approximate*

sm LOOSE SAND IN MOUNDS *Coppice dunes, commonly 3 to 7 ft high and 25 to 50 ft in diameter; generally elongated north of east but a local exception lies east of Columbus where elongation is south of east. Age is Holocene. Boundaries fairly accurate*

ps SANDY LAKE OR PLAYA DEPOSITS — *Gypsiferous deposits labeled* ps_2

Ꞧ OTHER BEDROCK — *Colluvium or other cover amounts to less than half the area. Only extensive areas are shown; age and rock type keyed by symbol to State geologic map (e.g.,* Kd*, Cretaceous Dakota Sandstone,* Ꞧs *Triassic Santa Rosa Sandstone). Many small areas omitted; indicated boundaries are approximate.* Ꞧ – *Triassic, undifferentiated*



REFERENCE: (NMIMT, 1977)

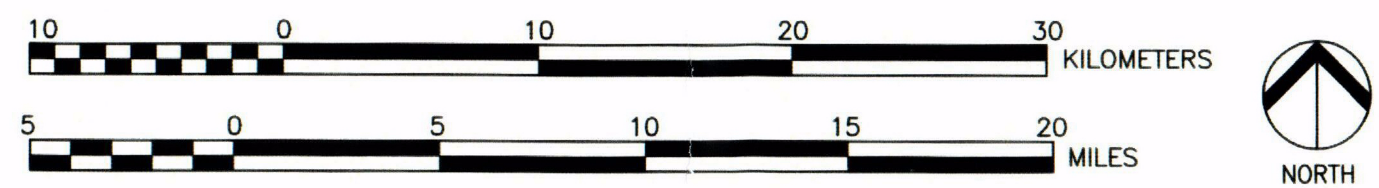


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Figure 3.3-4.dwg

FIGURE 3.3-4
SURFICIAL GEOLOGIC MAP OF THE NEF SITE AREA
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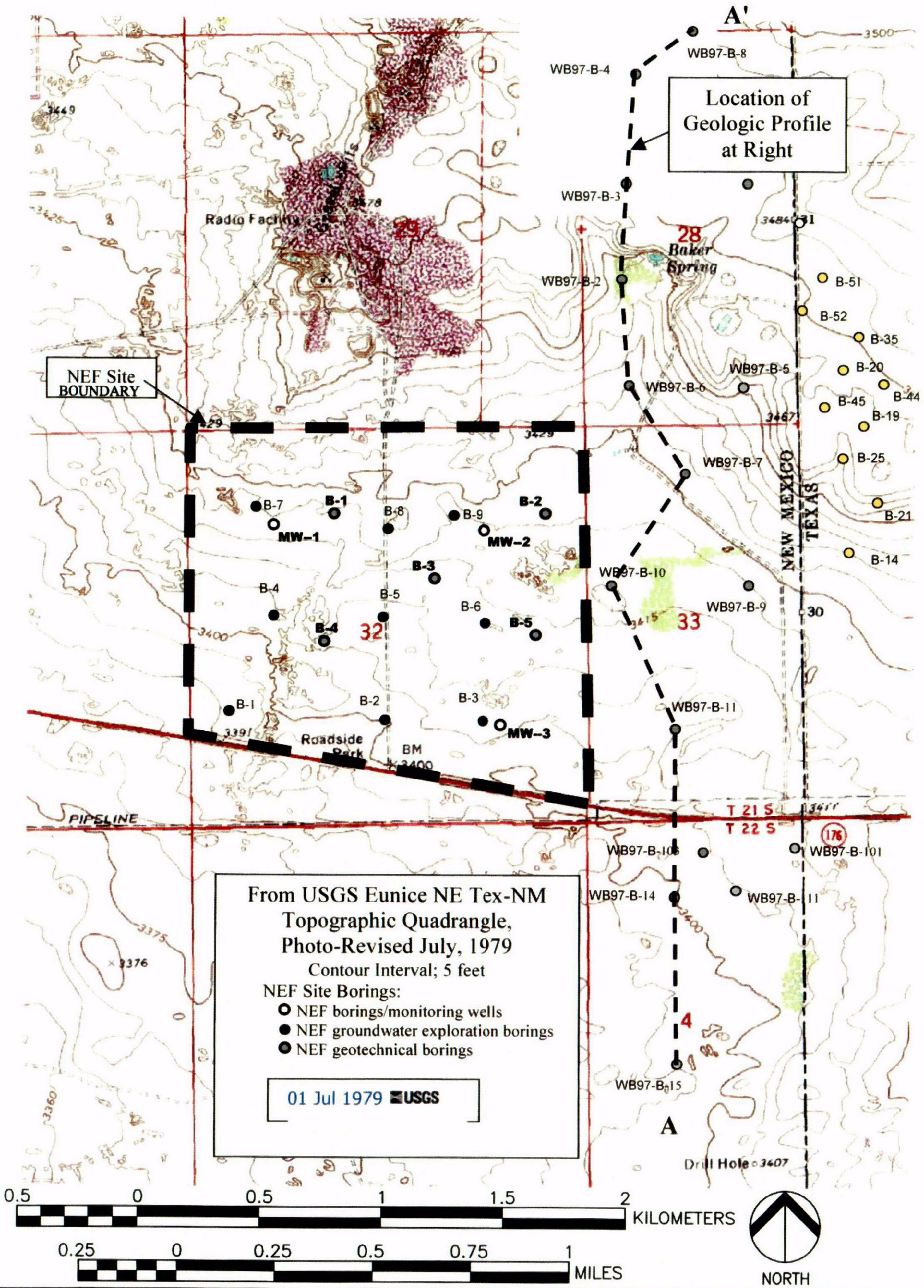

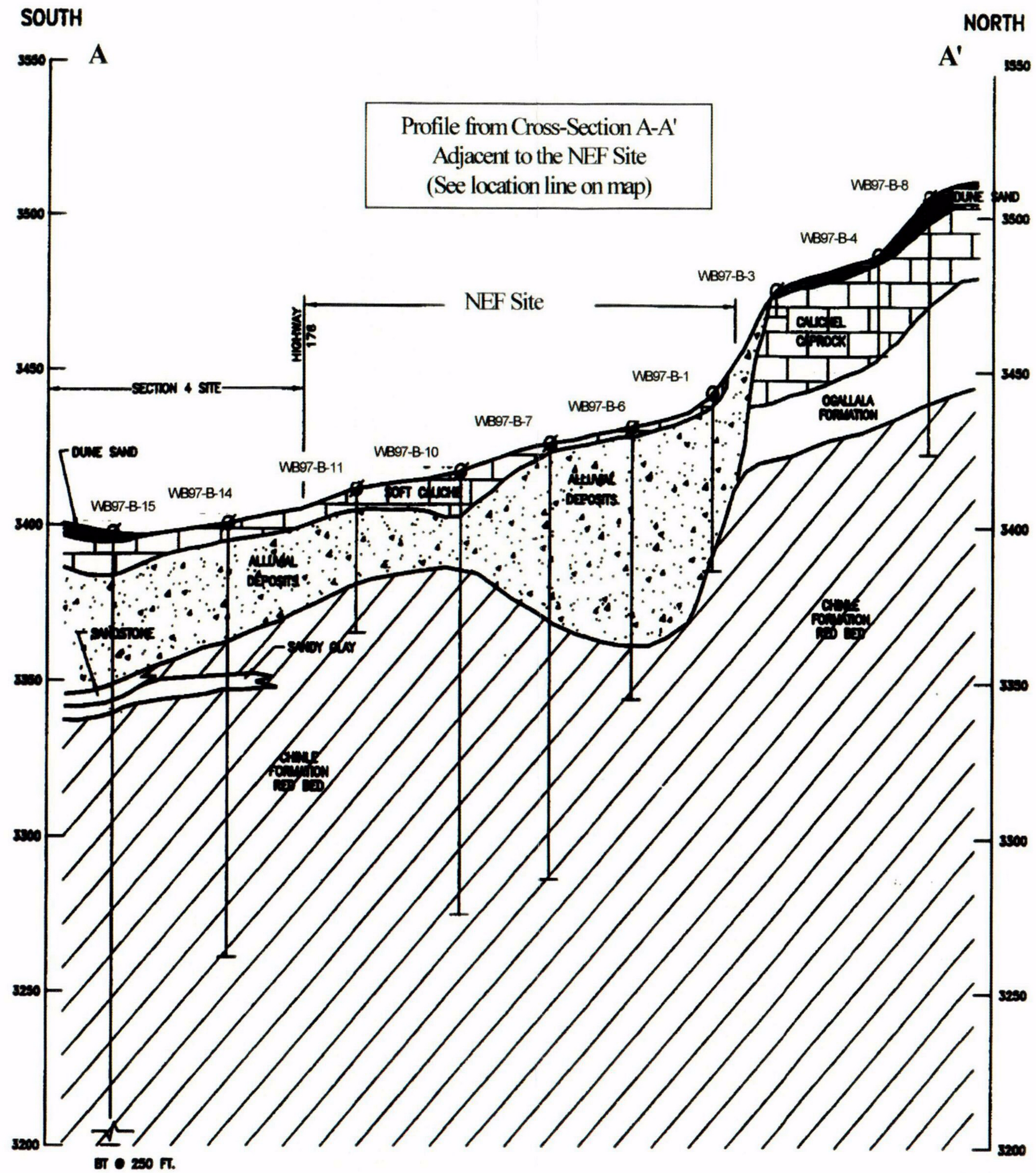

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Figure 3.3–5.dwg

FIGURE 3.3-5
SITE BORING PLAN AND PROFILE
ENVIRONMENTAL REPORT
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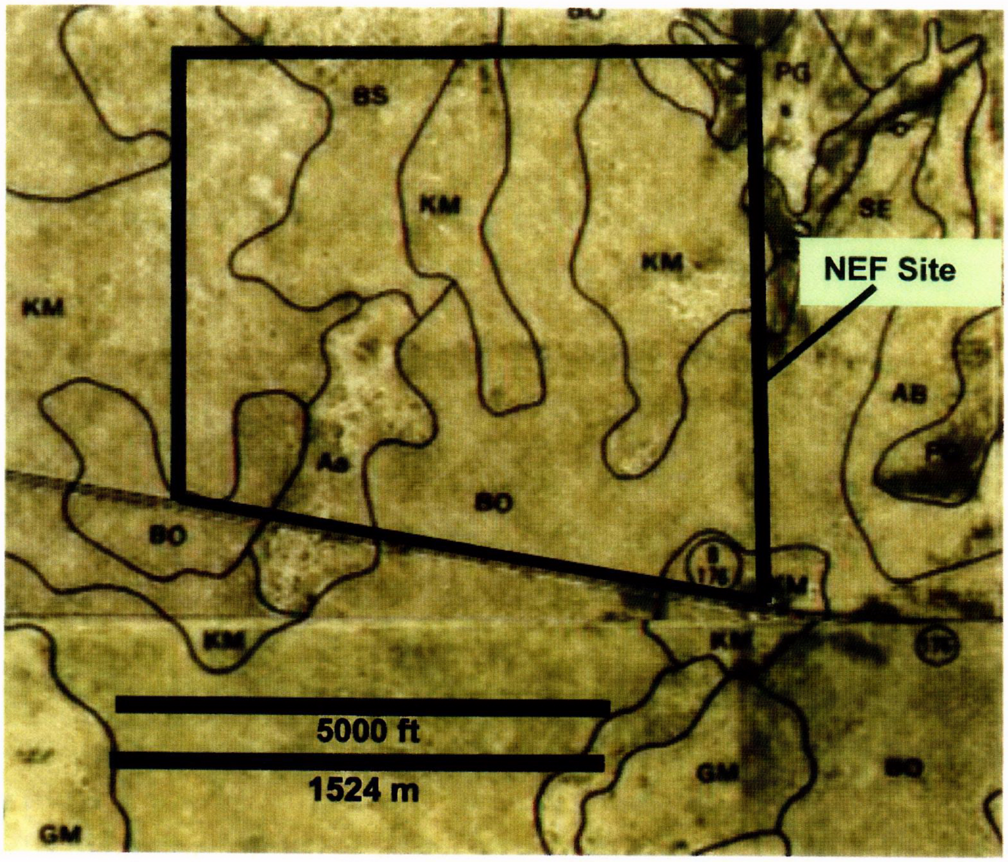

USDA SOIL DESIGNATION	SOIL NAME/DESCRIPTION	UNIFIED SOIL CLASSIFICATION DESIGNATION(S)
Aa	ACTIVE (SAND) DUNE LAND.	SP
BO	BROWNFIELD-SPRINGER ASSOCIATION: MOSTLY FINE SAND WITH LOAM FINE SAND; LEVEL TO UNDULATING TOPOGRAPHY; MODERATELY RAPID PERMEABLILITY AND SLOW RUNOFF.	SM
BS	BROWNFIELD-SPRINGER ASSOCIATION: MOSTLY FINE SAND WITH LOAM FINE SAND; DUNES AND HUMMOCKS FOR CONCAVE AND CONVEX ROLLING TERRAIN; DRAINAGE SIMILAR TO BO.	SM
KM	KERMIT SOILS AND DUNE LAND: EXCESSIVELY-DRAINED NON-CALCAREOUS SOILS; HUMMOCKY AND UNDULATING TOPOGRAPHY DUE TO EOLIAN PROCESSES.	SP-SM OR SM
MU	MIXED ALLUVIAL LANDS: UNCONSOLIDATED, STRATIFIED ALLUVIUM WITH VARIED TEXTURES OCCURRING INTERMITTENTLY IN DRAINAGE-WAYS A FEW FEET IN THICKNESS; MODERATE TO RAPID PERMEABILITY WITH SLOW RUNOFF.	VARIABLE
PG	PORTALES AND GOMEZ FINE SANDY LOAMS: LIGHT CLAY LOAM, WELL-DRAINED.	VARIABLE

SOURCE: (USDA, 1974)

NORTH

REFERENCE NUMBER
MSWord Figures.dwg

FIGURE 3.3-6
SITE SOILS MAP PER USDA DATA
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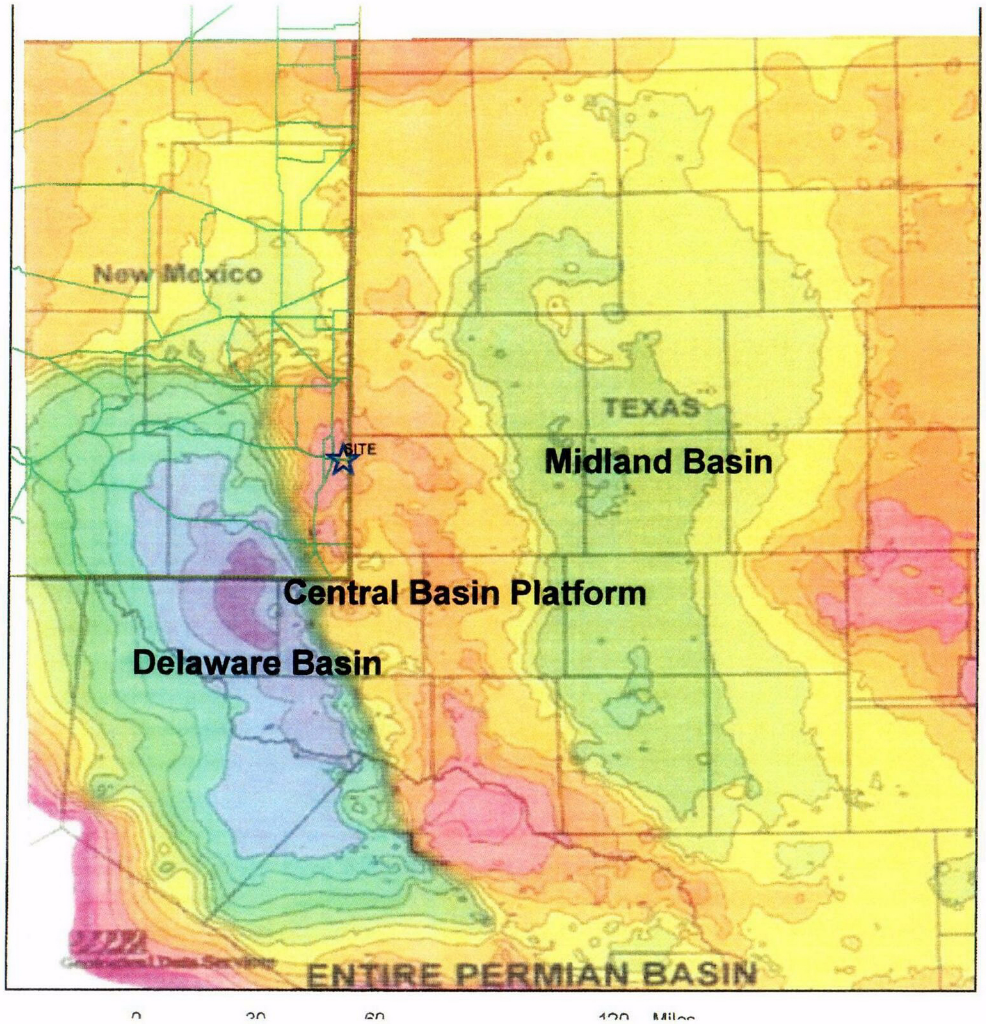
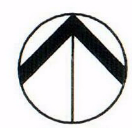
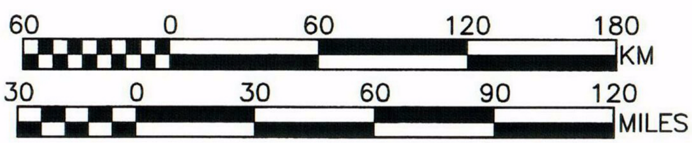


LEGEND

☆ NEF SITE

REFERENCE: (TALLEY, 1997)





REFERENCE NUMBER
Section 3.3 Figures.dwg

FIGURE 3.3-7

TECTONIC SUBDIVISIONS OF THE PERMIAN BASIN
ENVIRONMENTAL REPORT

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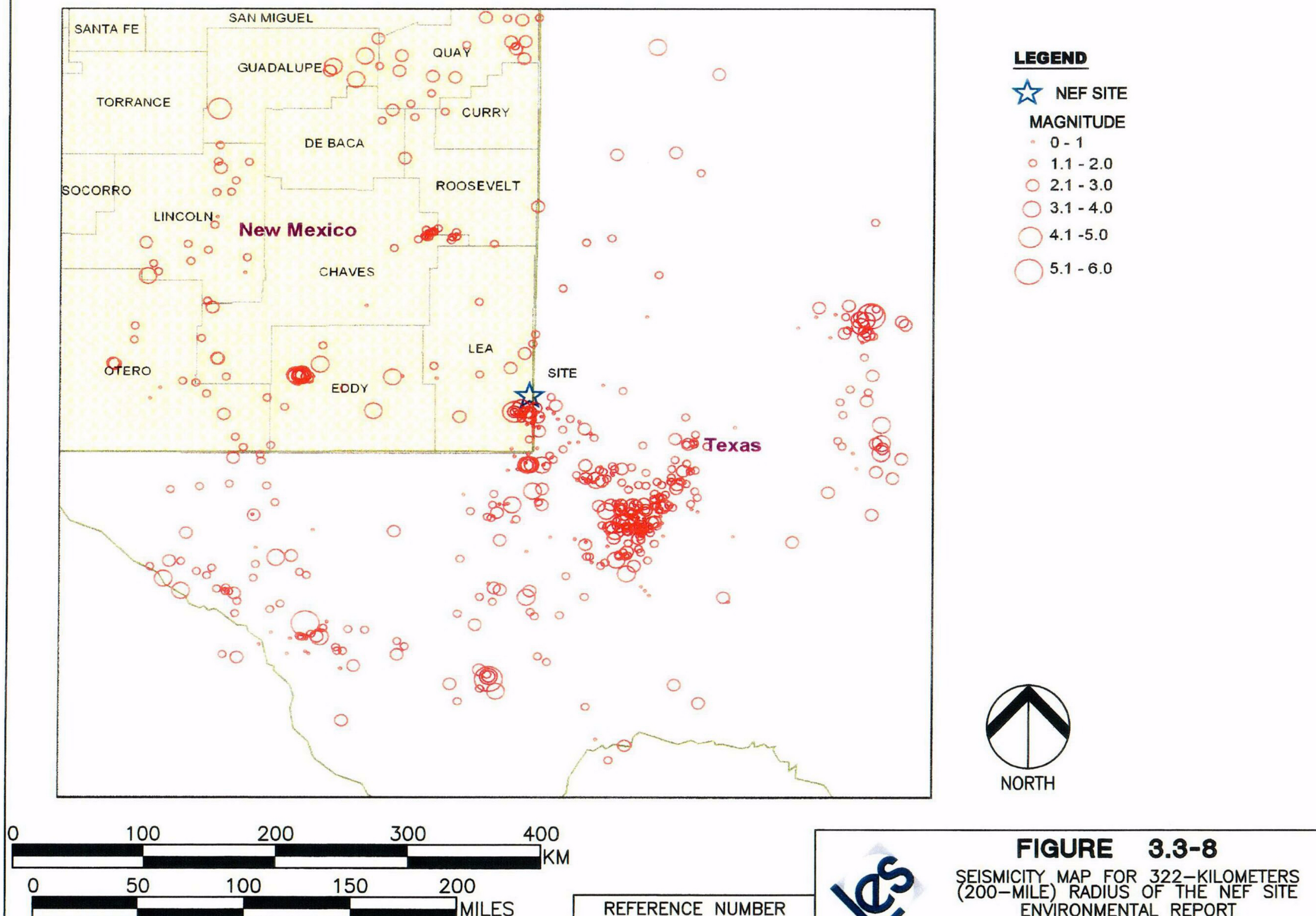

REFERENCE NUMBER
Section 3.3 Figures.dwg

FIGURE 3.3-8

SEISMICITY MAP FOR 322-KILOMETERS (200-MILE) RADIUS OF THE NEF SITE
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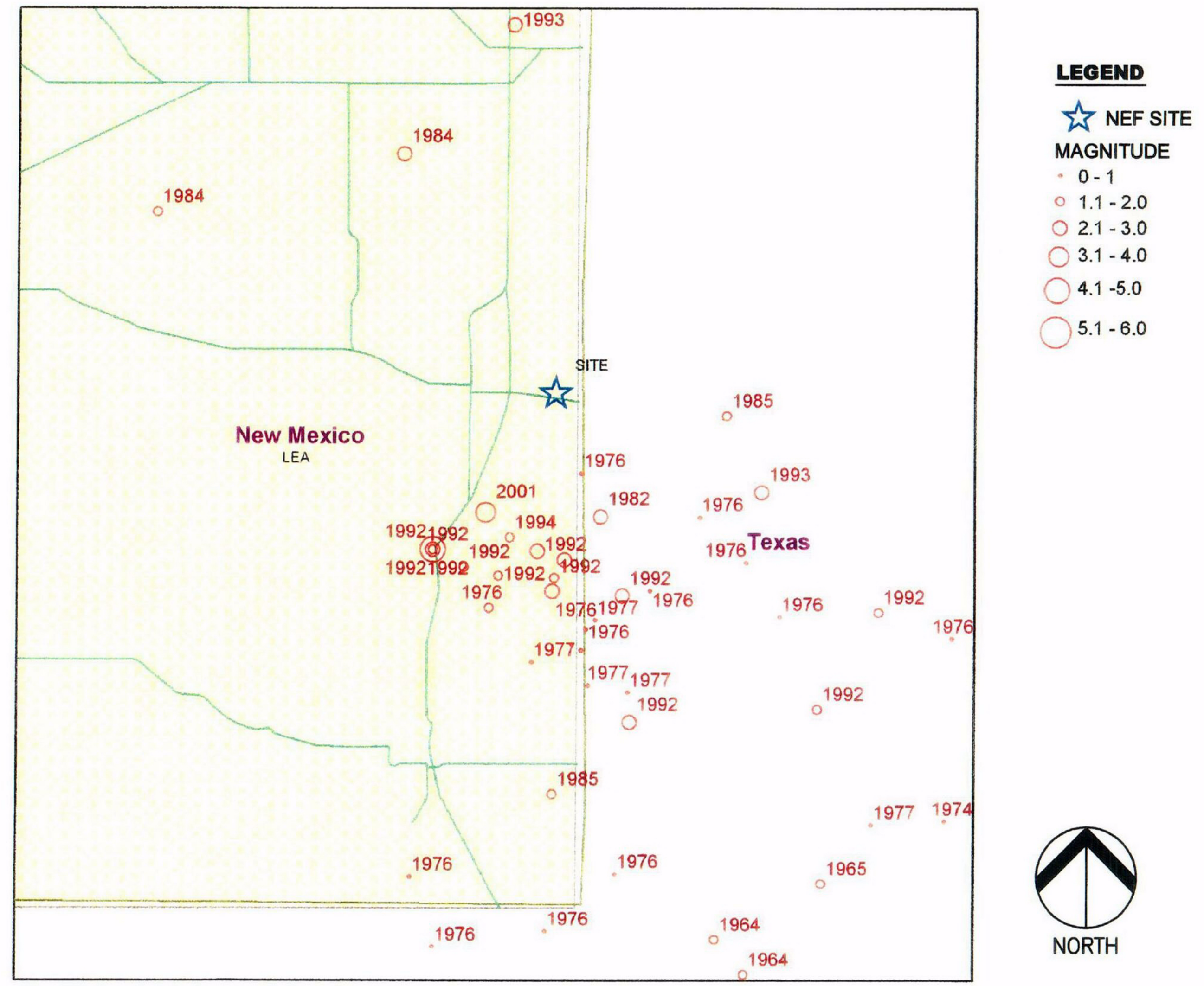

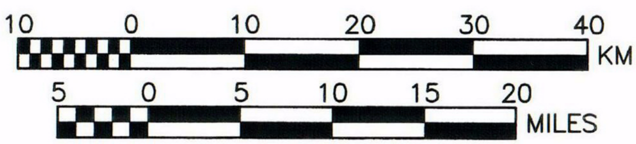

REFERENCE NUMBER
Section 3.3 Figures1.dwg

FIGURE 3.3-9

SEISMICITY IN THE IMMEDIATE VICINITY OF THE NEF SITE
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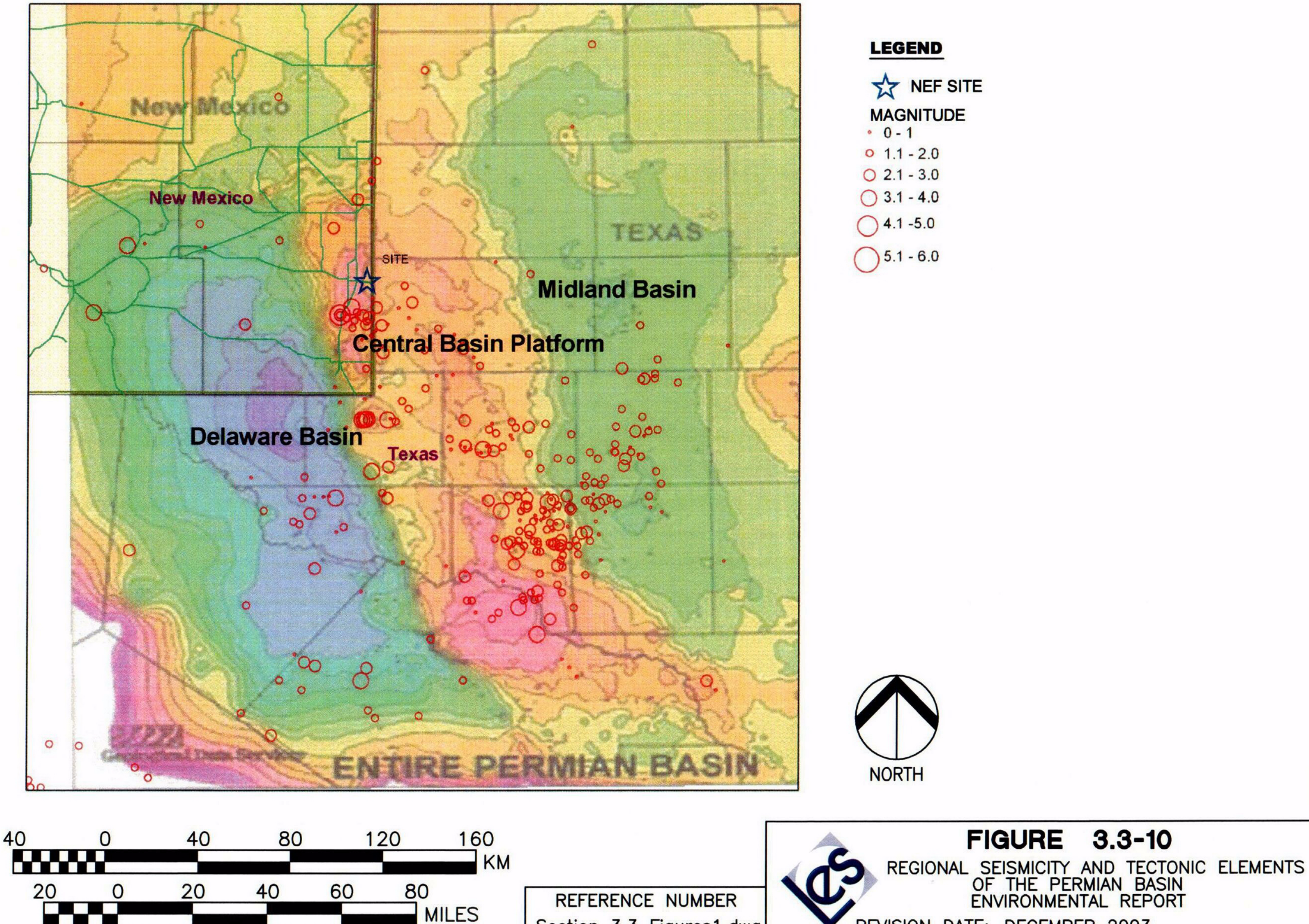

REFERENCE NUMBER
Section 3.3 Figures1.dwg

FIGURE 3.3-10

REGIONAL SEISMICITY AND TECTONIC ELEMENTS OF THE PERMIAN BASIN
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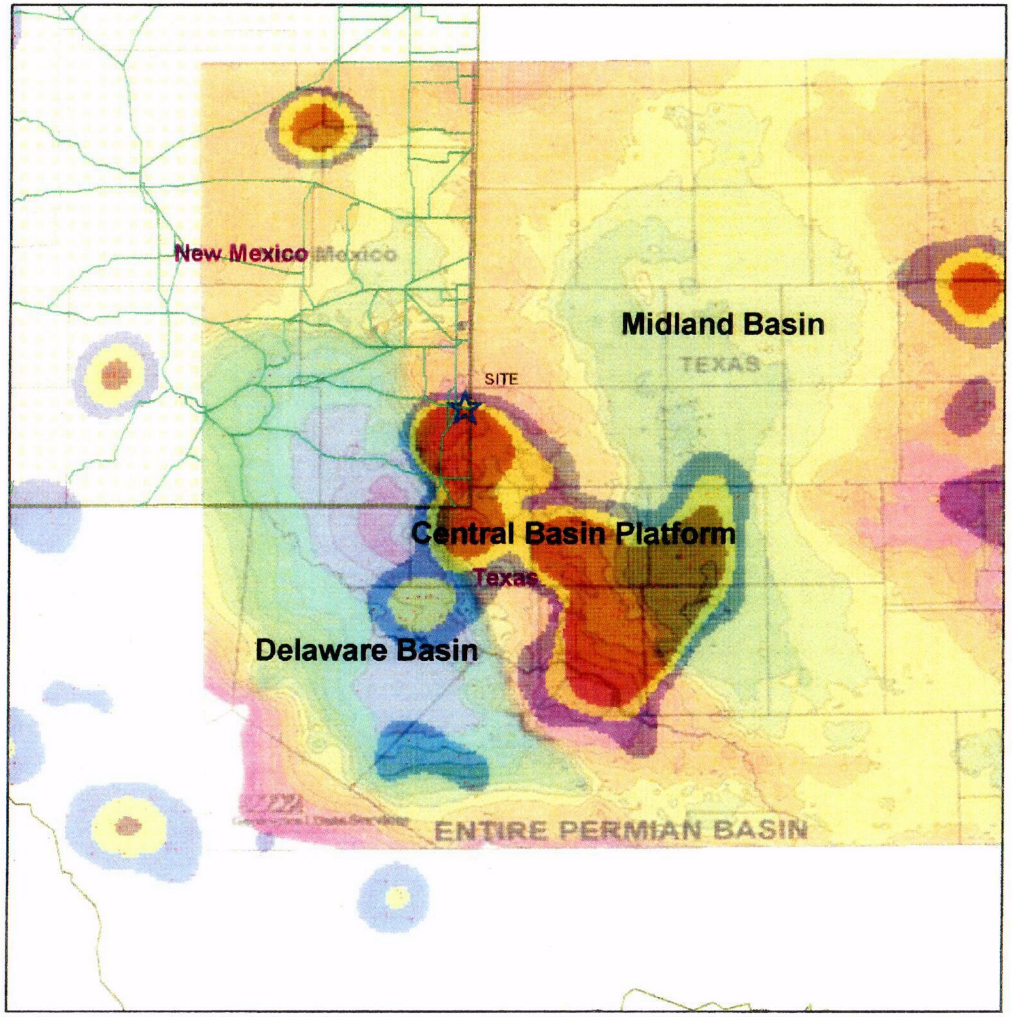

LEGEND

NEF SITE

epicenters

EARTHQUAKE DENSITY

- 0 - 40
- 40 - 86
- 86 - 133
- 133 - 705

NORTH

60 0 60 120 180 240 KM

30 0 30 60 90 120 150 MILES

REFERENCE NUMBER

Section 3.3 Figures1.dwg

FIGURE 3.3-11

EARTHQUAKE FREQUENCY CONTOURS AND TECTONIC ELEMENTS OF THE PERMIAN BASIN

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