

## 1 2.3 Resources

2 At the outset of the repository program, the DOE understood the importance of resources in the  
3 vicinity of a disposal system. Several of the siting criteria emphasized avoidance of resources  
4 that would impact the performance of the disposal system. In this regard, the DOE selected a  
5 site that (1) maximized the use of federal lands, (2) avoided known oil and gas trends, (3)  
6 minimized the impacts on potash deposits, and (4) avoided existing drill holes. While the DOE  
7 could not meet all these criteria totally, ~~this application shows~~ *it is shown* that the favorable  
8 characteristics of the location compensate for any increased risks due to the presence of  
9 resources. Consequently, the DOE has prepared this section to discuss resources that may exist  
10 at or beneath the WIPP site. The topic of resources is used to broadly define both economic  
11 (mineral and nonmineral) and cultural resources associated with the WIPP site. These resources  
12 are important because they (1) provide evidence of past uses of the area and (2) indicate potential  
13 future use of the area with the possibility that such use could lead to disruption of the closed  
14 repository. Because of the depth of the disposal horizon, it is believed that only the mineral  
15 resources are of significance in predicting the long-term performance of the disposal system.  
16 However, the nonmineral and cultural resources are presented for completeness because they are  
17 included in the FEP screening discussions in Chapter 6 and Appendix *PA, Attachment SCR*.  
18 Information needed to make screening decisions includes natural resource distributions,  
19 including potable groundwaters, the distribution of drillholes, mines, excavations, and other  
20 man-made features that exploit these resources, the distribution of drillholes and excavation used  
21 for disposal or injection purposes, activities that significantly alter the land surface, agricultural  
22 activities that may affect the disposal system, archaeological resources requiring deep excavation  
23 to exploit, and technological changes that may alter local demographics. This information is  
24 presented here or is referenced.

25 With respect to minerals or hydrocarbons, reserves are the portion of resources that are economic  
26 at today's market prices and with existing technology. For hydrocarbons, proved (proven)  
27 reserves are an estimated quantity that engineering and geologic data analysis demonstrates, with  
28 reasonable certainty, is recoverable in the future from discovered oil and gas pools. Probable  
29 resources (extensions) consist of oil and gas in pools that have been discovered but not yet  
30 developed by drilling. Their presence and distribution can generally be surmised with a high  
31 degree of confidence. Probable resources (new pools) consist of oil and gas surmised to exist in  
32 undiscovered pools within existing fields. (Definitions are from NMBMMR 1995, V-2 and  
33 V-3.)

34 Mineral resource discussions are focused principally on hydrocarbons and potassium salts, both  
35 of which have long histories of development in the region. Development of either resource  
36 potentially could be disruptive to the disposal system. The information regarding the mineral  
37 resources concentrates on the following factors:

- 38 • number, location, depth, and present state of development, including penetrations through  
39 the disposal horizon,
- 40 • type of resource,
- 41 • accessibility, quality, and demand, and

- 1       • mineral ownership in the area.

2       The specific impacts of resource development are discussed in Section 6.4.6.2.3, where scenarios  
3 related to mineral development are included for evaluation of disposal system performance. This  
4 discussion uses information presented in *CCA* Appendices DEL and MASS as indicated in the  
5 following text. The discussion of cultural and economic resources is focused on describing past  
6 and present land uses unrelated to the development of minerals. The archaeological record  
7 supports the observation that changes in land use are principally associated with climate and the  
8 availability of forage for wild and domestic animals. In no case does it appear that past or  
9 present land use has had an impact on the subsurface beyond the development of shallow  
10 groundwater wells to water livestock.

### 11   **2.3.1 Extractable Resources**

12       The geologic studies of the WIPP site included the investigation of potential natural resources to  
13 evaluate the impact of denying access to these resources and other consequences of their  
14 occurrence. Studies were completed in support of the FEIS to ensure knowledge of natural  
15 resources, and the impacts of denying access were included in the decision-making process for  
16 WIPP. Of the natural resources expected to occur beneath the site, five are of practical concern:  
17 the two potassium salts sylvite and langbeinite, which occur in the McNutt; and the three  
18 hydrocarbons, crude oil, natural gas, and distillate liquids associated with natural gas, all three of  
19 which occur elsewhere in strata below the Castile. Other mineral resources beneath the site are  
20 caliche, salt, gypsum, and lithium; enormous deposits of these minerals near the site and  
21 elsewhere in the country are more than adequate (and more economically attractive) to meet  
22 future requirements for these materials. In 1995, the NMBMMR performed a reevaluation of the  
23 mineral resources at and within 1.6 km (1 mi) around the WIPP site. The following discussion is  
24 based in part on information from NMBMMR (1995).

#### 25   2.3.1.1 Potash Resources at the WIPP Site

26       Throughout the Carlsbad Potash District, commercial quantities of potassium salts are restricted  
27 to the middle portion of the Salado, locally called the McNutt. A total of 11 zones (or distinct  
28 ore layers) have been recognized in the McNutt. Horizon Number 1 is at the base, and Number  
29 11 is at the top. The 11th ore zone is not mined.

30       The USGS uses three standard grades—low, lease, and high—to quantify the potash resources at  
31 the site. The USGS assumes that the lease and high grades comprise reserves because some  
32 lease-grade ore is mined in the Carlsbad Potash District. Most of the potash that is mined,  
33 however, is better typified as high-grade. Even the high-grade resources may not be reserves,  
34 however, if properties such as high clay content make processing uneconomical. The analysis in  
35 the *NMBMMR* (1995) ~~NMBMMR report~~ distinguishes between lease-grade ore and  
36 economically mineable ore.

37       The *NMBMMR* (1995) study contains a comprehensive summary of all previous potash resource  
38 evaluations. ~~Griswold~~ (*NMBMMR* (1995, Chapter VII)) used 40 existing boreholes drilled on  
39 and around the WIPP site to perform a reevaluation of potash resources. He selected holes that  
40 were drilled using brine so that the dissolution of potassium salts was inhibited. The conclusion

1 reached by Griswold is that only the 4th and 10th ore zones contain economic potash reserves.  
2 The quantities are summarized in Table 2-711.

3 **Table 2-711. Current Estimates of Potash Resources at the WIPP Site**

Mining Unit	Product	Recoverable Ore (10 <sup>6</sup> tons)	
		Within the WIPP site	One-Mile Strip Adjacent to the WIPP site
4th Ore Zone	Langbeinite	40.5 at 6.99%*	126.0 at 7.30%
10th Ore Zone	Sylvite	52.3 at 13.99%	105.0 at 14.96%

Source: NMBMMR 1995, Chapter VII.

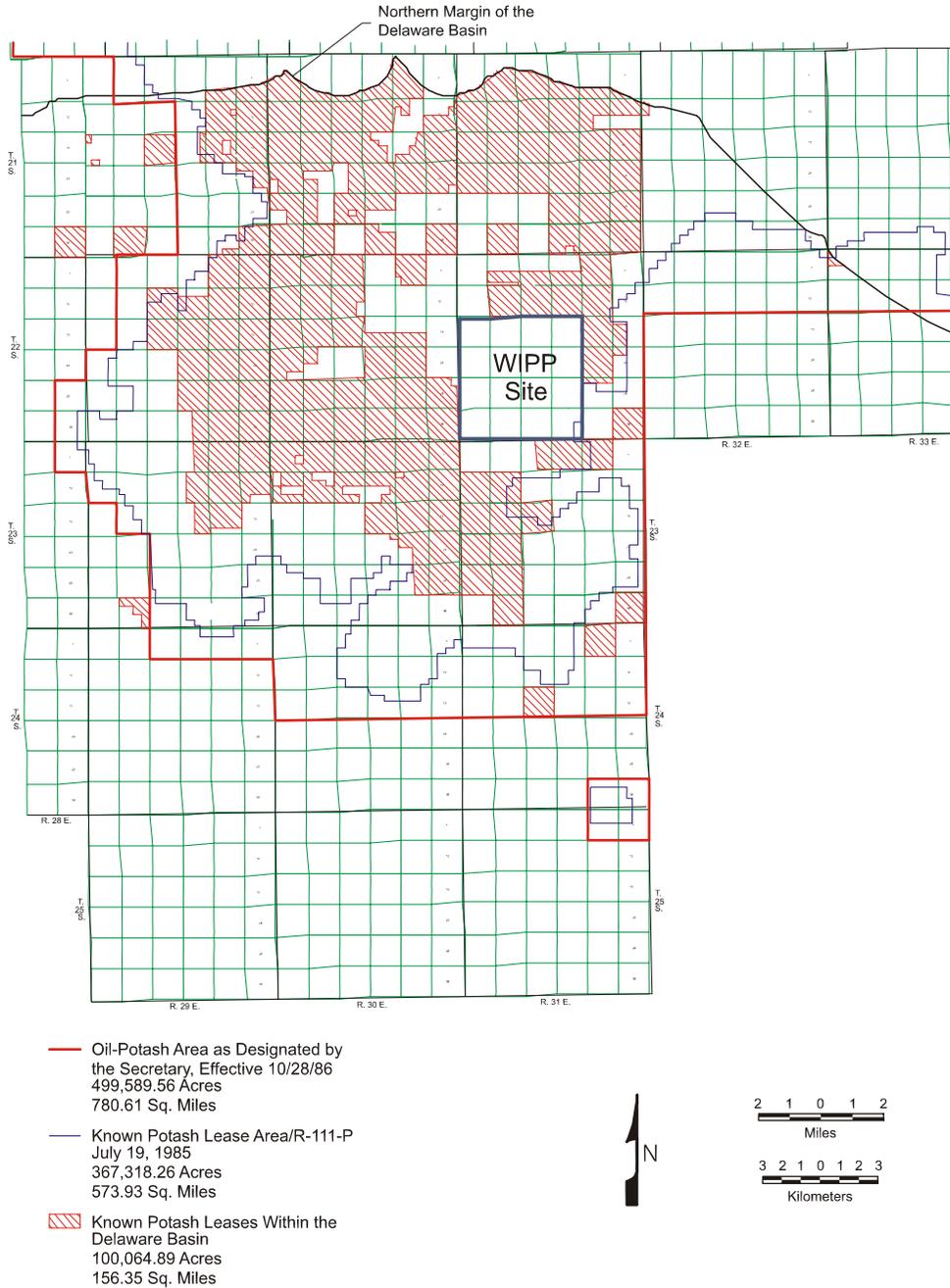
\* For example, read as 40.5 × 106 tons of ore at a grade of 6.99 percent or higher.

4 Within the Carlsbad Known Potash Leasing Area, exploration holes have been drilled to evaluate  
5 the grade of the various ore zones. These are included in the drillhole database in *CCA*  
6 Appendix DEL. None of the economically minable reserves identified by the NMBMMR lies  
7 directly above the waste panels. The known potash leases within the Delaware Basin are shown  
8 in Figure 2-3744 and are detailed in *CCA* Appendix DEL, Figure DEL-8. From information in  
9 this figure and other data which is provided in *CCA* Appendix MASS, Attachment 15-5, DOE  
10 evaluates the extent of future mining outside the land withdrawal area. The extent of possible  
11 future mining within the controlled area is shown in Figure 2-3845. The DOE also addresses this  
12 subject with respect to *PA* in Section 6.4.6.2.3.

13 *The EPA concluded that neither the DOE's nor the Department of Interior's (DOI) estimate*  
14 *shows the area above the WIPP waste panels as containing mineable reserves. The DOE*  
15 *provided supplemental information in a letter dated May 14, 1997, indicating that potash*  
16 *solution mining and brine extraction do not need to be considered for the PA, based on low*  
17 *consequence to the containment capability of the repository (Docket A-93-02, Item II-I-31).*  
18 *The EPA reviewed the supplemental data and concurred with the DOE's conclusion. To*  
19 *obtain further discussion on this topic, CARD 32-Section 32.B, CARD 33-Section 33A, and*  
20 *CARD 32-Section 32 F (Docket A-93-02, item III-B-2) may be referenced. Additional*  
21 *information is found in FEPs screening discussions for solution mining for potash and*  
22 *solution mining for other resources (FEPs H58 and H59) in Appendix PA, Attachment SCR.*

### 23 2.3.1.2 Hydrocarbon Resources at the WIPP Site

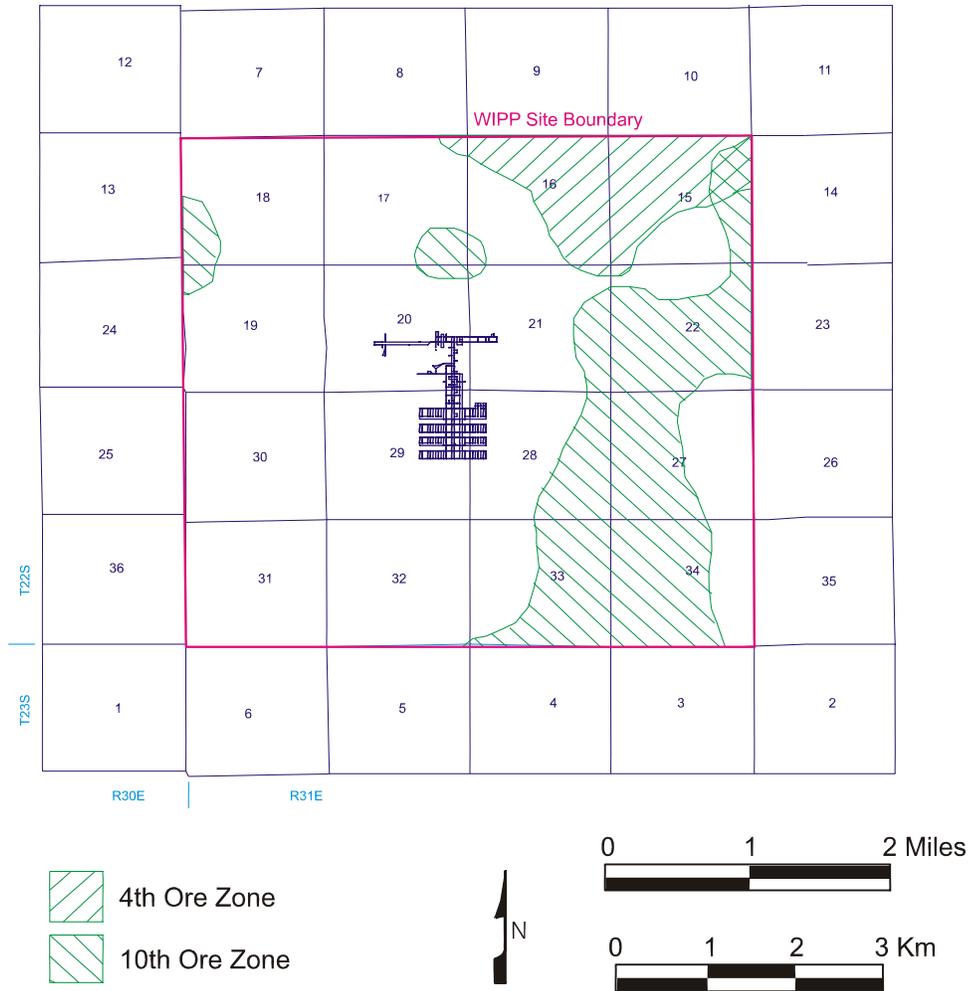
24 In 1974, Foster of the NMBMMR conducted a hydrocarbon resource study in southeastern New  
25 Mexico under contract to the ORNL. The study included an area of 3,914 km<sup>2</sup> (1,512 mi<sup>2</sup>). At  
26 the time of that study, the proposed repository site was about 8 km (5 mi) northeast of the current  
27 site. The 1974 NMBMMR evaluation included a more detailed study of a four-township area  
28 centered on the old site; the present site is in the southwest quadrant of that area. The 1974  
29 NMBMMR hydrocarbon resources study (Foster 1974) is presented in more detail in the FEIS  
30 (DOE 1980, Section 9.2.3.5). The reader is referred to the FEIS or the original study for  
31 additional information.



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**Figure 2-3744. Known Potash Leases Within the Delaware Basin**



CCA-077-2

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 2 **Figure 2-3845. Extent of Economically Mineable Reserves Inside the Site Boundary (Based**  
 3 **on NMBMMR Report)**

4 The resource evaluation was based both on the known reserves of crude oil and natural gas in the  
 5 region and on the probability of discovering new reservoirs in areas where past unsuccessful  
 6 drilling was either too widely spread or too shallow to have allowed discovery. Potentially  
 7 productive zones were considered in the evaluation; therefore, the findings may be used for  
 8 estimating the total hydrocarbon resources at the site. A fundamental assumption in the study  
 9 was that the WIPP area has the same potential for containing hydrocarbons as the

10 larger region studied for which exploration data are available. Whether such resources actually  
 11 exist can be satisfactorily established only by drilling at spacings close enough to give a high  
 12 probability of discovery.

13 The NMBMMR 1995 mineral resource reevaluation contains a comprehensive summary of all  
 14 previous evaluations. Broadhead et al. (NMBMMR (1995, Chapter XI) provided a reassessment

1 of hydrocarbon resources within the WIPP site boundary and within the first mile adjacent to the  
 2 boundary. Calculations were made for resources that are extensions of known, currently  
 3 productive oil and gas resources that are thought to extend beneath the study area with  
 4 reasonable certainty (called probable resources in the report). Qualitative estimates are also  
 5 made concerning the likelihood that oil and gas may be present in undiscovered pools and fields  
 6 in the area (referred to as possible resources). Possible resources were not quantified in the  
 7 study. The results of the study are shown in Tables 2-8<sup>12</sup> and 2-9<sup>13</sup>.

8 **Table 2-8<sup>12</sup>. In-Place Oil within Study Area**

Formation	Within WIPP Site (10 <sup>6</sup> bbl <sup>a</sup> )	1-Mile Strip Adjacent to the WIPP Site (10 <sup>6</sup> bbl)	Total (10 <sup>6</sup> bbl)
Delaware	10.33	20.8	31.13
Bone Spring	0.44	0.8	1.25
Strawn	0.4	0.4	0.8
Atoka	1.1	0.1	0.2
<b>Total</b>	<b>12.3</b>	<b>22.9</b>	<b>35.3</b>

Source: NMBMMR (1995, Chapter XI)  
 a bbl = barrel = 42 gallons

9 **Table 2-9<sup>13</sup>. In-Place Gas within Study Area**

Formation	Gas Reserves (Mcf) <sup>a</sup>	
	Within WIPP Site	1-Mile Strip Adjacent to the WIPP
Delaware	18176	32873
Bone Springs	956	1749
Strawn	9600	9875
Atoka	123336	94410
Morrow	32000	28780

Source: NMBMMR (1995, Chapter XI)  
 a Mcf = thousand cubic feet

10 The DOE has compiled statistics on the historical development of hydrocarbon resources in the  
 11 Delaware Basin and has included them in CCA Appendix DEL. For these purposes, the  
 12 Delaware Basin is described as the surface and subsurface features that lie inside the boundary  
 13 formed to the north, east, and west by the innermost edge of the Capitan Reef and formed to the  
 14 south by a straight line drawn from the southeastern point of the Davis Mountains to the  
 15 southwestern point of the Glass Mountains (see Figure 2-39<sup>46</sup>).

16 Several important modeling parameters result from the study of hydrocarbon resources and the  
 17 history of their exploitation. These include parameters related to the number of human  
 18 intrusions, the size of boreholes, the operational histories of such holes, the plugging of these

1 holes, and the use of such holes for other purposes, such as liquid disposal. Each of these topics  
2 is discussed in detail in *CCA Appendix DEL* and Appendix *PA, Attachment MASS, Section*  
3 *MASS.16* (Section Appendix MASS.16) and is addressed in Sections 6.4.7 and 6.4.12. The  
4 distribution of existing boreholes is shown in Figure DEL-4 (*CCA Appendix DEL*) for the entire  
5 Delaware Basin and Figure 2-47 DEL-6 for the vicinity of the WIPP site. In addition, *CCA*  
6 Appendix DEL includes an assessment of current drilling and plugging practices in the Delaware  
7 Basin. *CCA Appendix DEL* also discusses the regulatory constraints placed on the use of wells  
8 for injection.

### 9 2.3.1.3 Other Resources

10 While the focus of studies at the WIPP has been on potash and hydrocarbon, other resources are  
11 known to occur within the Delaware Basin and are considered in the screening. For example,  
12 sulfur is produced in the vicinity of Orla, Texas. Sulfur wells are included in *CCA Appendix*  
13 *DEL*; however, no sulfur resources have been identified in the vicinity of the WIPP; therefore,  
14 there are no projected impacts. Another resource that is extensively produced is groundwater.  
15 Potable water occurs in numerous places within the Delaware Basin. Several communities rely  
16 solely on groundwater sources for drinking water. *CCA Appendix DEL* includes a distribution of  
17 groundwater wells in the Delaware Basin. All such wells in the vicinity of the WIPP are  
18 shallow, generally no deeper than the Culebra. An evaluation of underground sources of  
19 drinking water in the vicinity of the disposal system is presented in *CCA Appendix USDW*.  
20 Figure USDW-4 shows the distribution of groundwater wells in the vicinity of the disposal  
21 system. Sand, gravel, and caliche are produced in numerous areas within the Delaware Basin. In  
22 all cases, these are surface quarries that are generally shallow (*10s* of feet). No impact to the  
23 disposal system is expected from these activities.

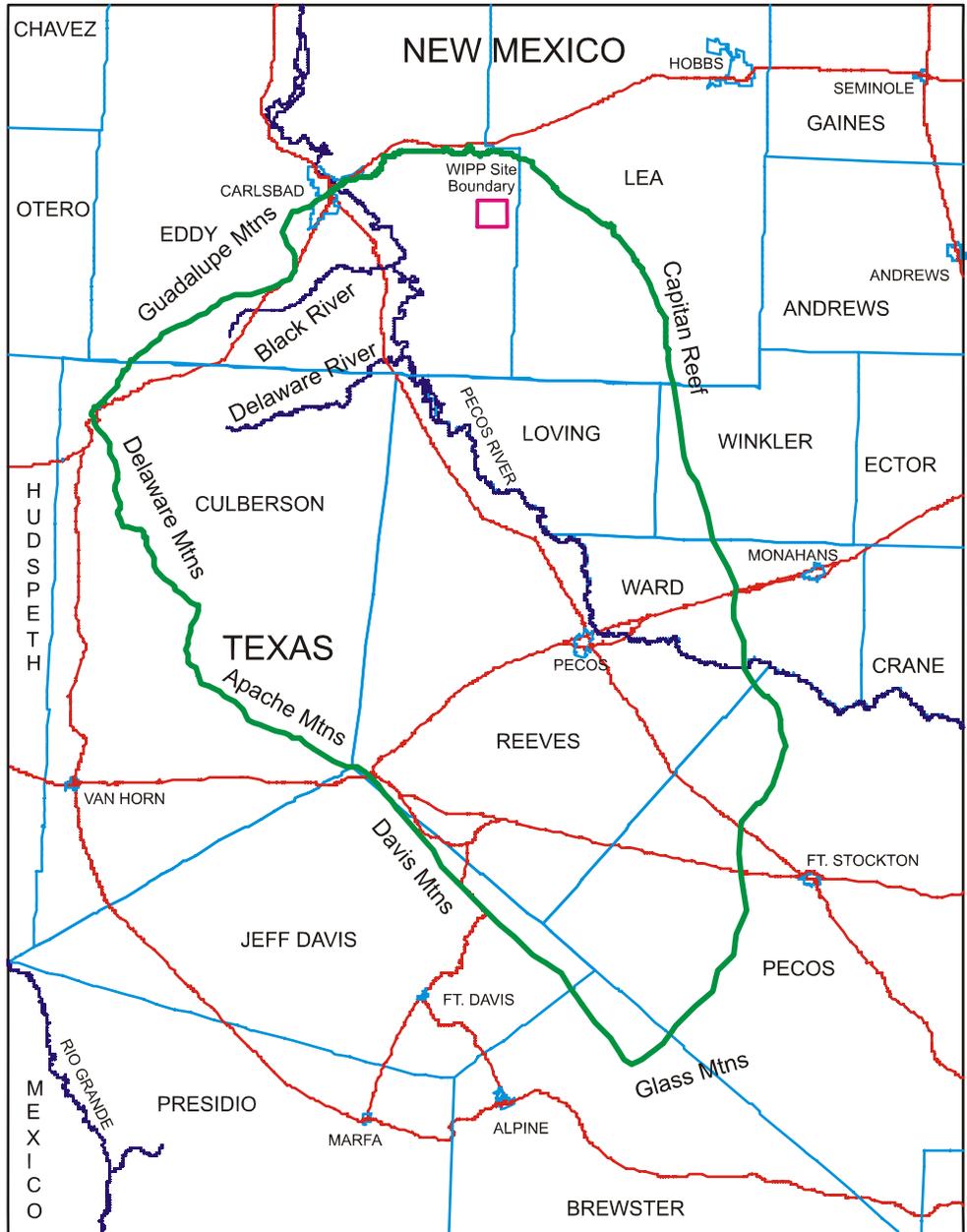
### 24 2.3.2 *Cultural and Economic Resources*

25 The demographics, land use, and history and archaeology of the WIPP site and its environs are  
26 characterized in the sections that follow.

#### 27 2.3.2.1 Demographics

28 The WIPP facility is located 42 km (26 mi) east of Carlsbad in Eddy County in southeastern  
29 New Mexico and includes an area of 10,240 ac (approximately 41 km<sup>2</sup>) (16 mi<sup>2</sup>). The facility is  
30 located in a sparsely populated area with fewer than 30 permanent residents living within a 16-  
31 km (10-mi) radius of the facility. The area surrounding the facility is used primarily for grazing,  
32 potash mining, and hydrocarbon production. No resource development that would affect WIPP  
33 facility operations or the long-term integrity of the facility is allowed within the 10,240 ac that  
34 have been set aside for the WIPP project.

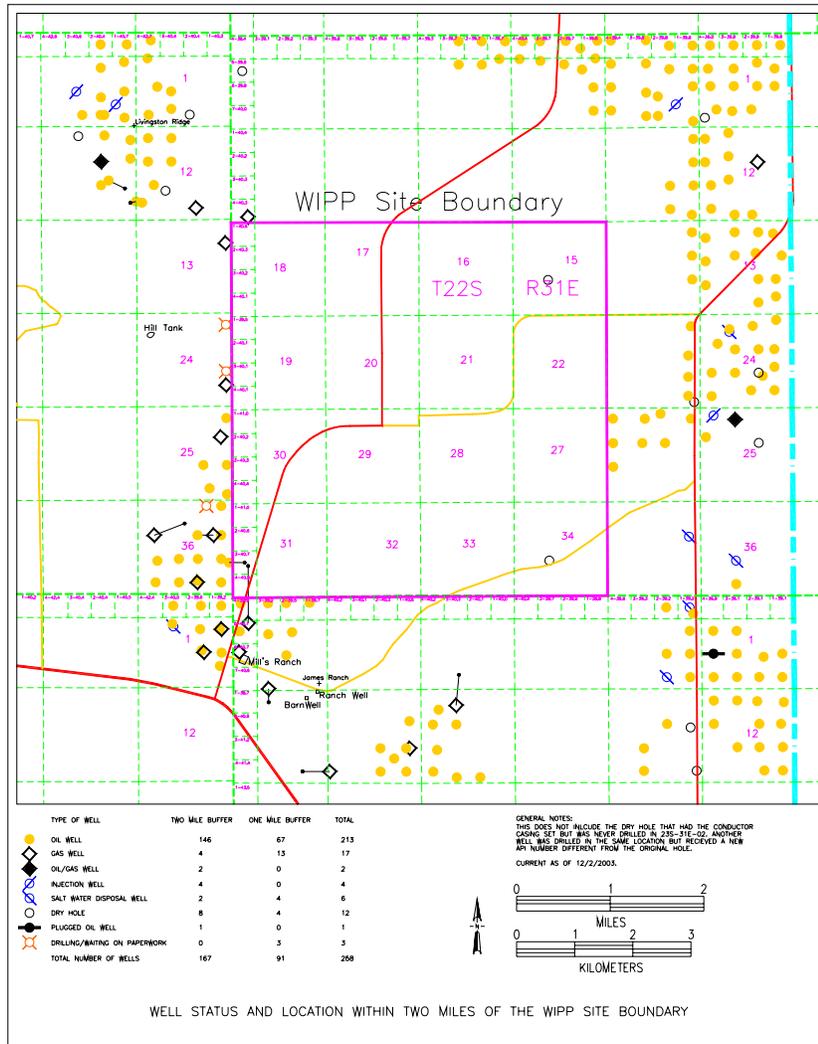
35 The permanent residence nearest to the WIPP site boundary is the J.C. Mills Ranch, which is  
36 2 km (1.2 mi) to the south. The community nearest to the WIPP site is the town of Loving, New  
37 Mexico, 29 km (18 mi) west-southwest of the site center. The population of Loving decreased  
38 from 1,355 in 1980 to *increased from* 1,243 in 1990 *to* 1,326 in 2000. The nearest population  
39 center is the city of Carlsbad, New Mexico, 42 km (26 mi) west of the site. The population of



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**Figure 2-3946. Delaware Basin Boundary**



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2 **Figure 2-47. Distribution of Existing Petroleum Industry Boreholes Within Two Miles of the**  
3 **WIPP Site**

4 Carlsbad has ~~decreased~~ **increased** from 25,496 in 1980 to 24,896 in 1990 **to 26,870 in 2000**.  
5 Hobbs, New Mexico, 58 km (36 mi) to the east of the site, had a 1980 population of 29,153 and a  
6 1990 population decrease from of 29,115 **in 1990 to 28,657 in 2000**. Eunice, New Mexico,  
7 64 km (40 mi) east of the site, had a 1980 population of 2,970 and a 1990 population of 2,731  
8 **decrease to 2,562 in 2000**. Jal, New Mexico, 72 km (45 mi) southeast of the site, had a  
9 population of 2,575 in 1980 and of 2,153 in 1990 **decrease to 1,996 in 2000**.

10 The WIPP site is located in Eddy County near the border of **f** Lea County, New Mexico. The  
11 Eddy County population increased from 47,855 in 1980 to 48,605 in 1990 **to 51,658 in 2000**.  
12 The Lea County population decreased from 55,993 in 1980 to 55,765 in 1990 **to 55,511 in 2000**.  
13 Population figures are taken from the 1980 and 1990 census (U.S. Department of Commerce,  
14 1980, 1990) **and the 2000 census (U.S. Census Bureau, 2000)**.

1 2.3.2.2 Land Use

2 At present, land within 16 km (10 mi) of the site is used for potash mining operations, active oil  
3 and gas wells, activities associated with hydrocarbon production, and grazing.

4 The WIPP Land Withdrawal Act (LWA) (U.S. Congress 1992) withdrew certain public lands  
5 from the jurisdiction of the Bureau of Land Management (BLM). The law provides for the  
6 transfer of the WIPP site lands from the U.S. Department of the Interior (DOI) to the DOE and  
7 effectively withdraws the lands, subject to existing rights, from entry, sale, or disposition;  
8 appropriation under mining laws; *or* operation of the mineral and geothermal leasing laws. The  
9 LWA directed the Secretary of Energy to produce a management plan to provide for grazing,  
10 hunting and trapping, wildlife habitat, mining, and the disposal of salt and tailings.

11 Between 1978 and 1988, DOE acquired all active potash and hydrocarbon leases within the  
12 WIPP site boundary. These were acquired either through outright purchase or through  
13 condemnation. In one condemnation proceeding, the court awarded DOE the surface and top  
14 1.82 km (6,000 ft) of Section 31 and allowed the leaseholder to retain the subsurface below 1.82  
15 km (6,000 ft). This was allowed because analysis showed that wells developed within this lease  
16 below the 1.82-km (6,000-ft) limit would be too far away from the waste panels to be of  
17 consequence to the WIPP (see, for example, Brausch et al. 1982). This is corroborated by the  
18 results of *PA* discussed in Section 6.2.5.1; and Appendix *PA, Attachment SCR, FEP 56 SCR*  
19 (*Section SCR.3.3.1*). Consequently, as the result of the DOE's acquisition activities, there are no  
20 producing hydrocarbon wells within the volumetric boundary defined by the land withdrawal  
21 (T22S, R31E, S15-22, 27-34). Two active wells were drilled to tap the oil and gas resources on  
22 the leases beneath Section 31. The James Ranch #13, drilled in 1982, is a gas well, and the  
23 James Ranch #27, drilled in 2000, is an oil well. Both wells are located on surface leases outside  
24 the WIPP site boundary. Both wells enter Section 31 below a depth of 1.82 km (6,000 ft)  
25 beneath ground level. Except for the leases in Section 31, the LWA prohibits all drilling into the  
26 controlled area unless such drilling is in support of the WIPP.

27 Grazing leases have been issued for all land sections immediately surrounding the WIPP facility.  
28 Grazing within the WIPP site lands occurs within the authorization of the Taylor Grazing Act of  
29 1934, the Federal Land Policy and Management Act (FLPMA), the Public Rangelands  
30 Improvement Act of 1978, and the Bankhead-Jones Farm Tenant Act of 1973.

31 The responsibilities of DOE include supervision of ancillary activities associated with grazing  
32 (for example, wildlife access to livestock water development), tracking of water developments,  
33 inside WIPP lands to ensure that they are configured according to the regulatory requirements,  
34 and ongoing coordination with respective allottees. Administration of grazing rights is in  
35 cooperation with the BLM according to the memorandum of understanding (MOU) and the  
36 coinciding Statement of Work through guidance established in the East Roswell Grazing  
37 Environmental Impact Statement. The WIPP site is composed of two grazing allotments  
38 administered by the BLM: the Livingston Ridge (No. 77027), and the Antelope Ridge  
39 (No. 77032) (*see Figure 7-2*).

1    2.3.2.3    History and Archaeology

2    From about 10,000 B.C. to the late 1800s, the WIPP site and surrounding region were inhabited  
3    by nomadic aboriginal hunters and gatherers who subsisted on various wild plants and animals.  
4    From about A.D. 600 onward, as trade networks were established with Puebloan peoples to the  
5    west, domesticated plant foods and materials were acquired in exchange for dried meat, hides,  
6    and other products from the Pecos Valley and Plains. In the late 1500s, the Spanish  
7    Conquistadors encountered Jumano and Apachean peoples in the region who practiced hunting  
8    and gathering and engaged in trade with Puebloans. After the Jumanos abandoned the southern  
9    Plains region, the Comanches became the major population of the area. Neighboring populations  
10   with whom the Comanches maintained relationships ranging from mutual trade to open warfare  
11   included the Lipan, or Southern Plains Apache, several Puebloan Groups, Spaniards, and the  
12   Mescalero Apaches.

13   The best documented indigenous culture in the WIPP region is that of the Mescalero Apaches,  
14   who lived west of the Pecos. The lifestyle of the Mescalero Apaches represents a transition  
15   between the full sedentism of the Pueblos and the nomadic hunting and gathering of the  
16   Jumanos. In 1763, the San Saba expedition encountered and camped with a group of Mescaleros  
17   in Los Medaños. Expedition records indicate the presence of both Lipan and Mescalero Apaches  
18   in the region.

19   A peace accord reached between the Comanches and the Spaniards in 1786 resulted in two  
20   historically important economic developments: (1) organized buffalo hunting by Hispanic and  
21   Puebloan ciboleros, and (2) renewal and expansion of the earlier extensive trade networks by  
22   Comancheros. These events placed eastern New Mexico in a position to receive a wide array of  
23   both physical and ideological input from the Plains culture area to the east and north and from  
24   Spanish-dominated regions to the west and south. Comanchero trade began to mesh with the  
25   Southwest American trade influence in the early nineteenth century. However, by the late 1860s,  
26   the importance of Comanchero trade was cut short by Texan influence.

27   The first cattle trail in the area was established along the Pecos River in 1866 by Charles  
28   Goodnight and Oliver Loving. By 1868, Texan John Chisum dominated much of the area by  
29   controlling key springs along the river. Overgrazing, drought, and dropping beef prices led to  
30   the demise of open-range cattle ranching by the late 1880s.

31   Following the demise of open-range livestock production, ranching developed using fenced  
32   grazing areas and production of hay crops for winter use. Herd grazing patterns were influenced  
33   by the availability of water supplies as well as by the storage of summer grasses for winter  
34   feeding.

35   The town of Carlsbad was founded as Eddy in 1889 as a health spa. In addition to ranching, the  
36   twentieth century brought the development of the potash, oil, and gas industries that have  
37   increased the population eightfold in the last 50 years.

38   Although technological change has altered some of the aspects, ranching remains an important  
39   economic activity in the WIPP region. This relationship between people and the land is still an  
40   important issue in the area. Ranch-related sites dating to the 1940s and 1950s are common in

1 parts of the WIPP area. These will be considered historical properties within the next several  
2 years, and thus will be treated as such under current law.

3 The National Historic Preservation Act (NHPA) (16 USC Part 470 et seq.) was enacted to protect  
4 the nation's cultural resources in conjunction with the states, local governments, Indian tribes,  
5 and private organizations and individuals. The policy of the federal government includes:  
6 (1) providing leadership in preserving the prehistoric and historic resources of the nation,  
7 (2) administering federally owned, administered, or controlled prehistoric resources for the  
8 benefit of present and future generations, (3) contributing to the preservation of nonfederally  
9 owned prehistoric and historic resources, and (4) assisting state and local governments and the  
10 national trust for historic preservation in expanding and accelerating their historic preservation  
11 programs and activities. The act also established the National Register of Historic Places  
12 (National Register). At the state level, the State Historic Preservation Officer (SHPO)  
13 coordinates the state's participation in implementing the NHPA. The NHPA has been amended  
14 by two acts: the Archeological and Historic Preservation Act (16 USC Part 469 et seq.), and the  
15 Archeological Resource Protection Act (16 USC Part 470aa et seq.).

16 To protect and preserve cultural resources found within the WIPP site boundary, the WIPP  
17 submitted a mitigation plan to the New Mexico SHPO describing the steps to either avoid or  
18 excavate archaeological sites. A site was defined as a place used and occupied by prehistoric  
19 people. In May 1980, the SHPO made a determination of "no adverse effect from WIPP facility  
20 activities" on cultural resources. The Advisory Council on Historic Preservation concurred that  
21 the WIPP Mitigation Plan is appropriate to protect cultural resources.

22 Known historical sites (more than 50 years old) in southeastern New Mexico consist primarily of  
23 early twentieth century homesteads that failed, or isolated features from late nineteenth century  
24 and early twentieth century cattle or sheep ranching, *or* military activities. To date, no Spanish  
25 or Mexican sites have been identified. Historic components are rare but are occasionally noted  
26 in the WIPP area. These include features and debris related to ranching.

27 Since 1976, cultural resource investigations have recorded 98 archaeological sites and numerous  
28 isolated artifacts within the 41-km<sup>2</sup> (16-mi<sup>2</sup>) area enclosed by the WIPP site. In the central 10.4-  
29 km<sup>2</sup> (4-mi<sup>2</sup>) area, 33 sites were determined to be eligible for inclusion on the National Register  
30 as archaeological districts. Investigations since 1980 have recorded an additional 14 individual  
31 sites outside the central 10.4-km<sup>2</sup> (4-mi<sup>2</sup>) area that are considered eligible for inclusion on the  
32 National Register. The following major cultural resource investigations to date are broken out in  
33 the list that follows. Additional information can be found in the bibliography *of CCA Chapter 2*.

34 **1977.** The first survey of the area was conducted for SNL by Nielson of the Agency for  
35 Conservation Archaeology (ACA). This survey resulted in the location of 33 sites and 64  
36 isolated artifacts.

37 **1979.** MacLennan and Schermer of ACA conducted another survey to determine access roads  
38 and a railroad right-of-way for Bechtel, Inc. The survey encountered two sites and 12 isolated  
39 artifacts.

1 **1980.** Schermer conducted another survey to relocate the sites originally recorded by Nielson.  
2 This survey redescribed 28 of the original 33 sites.

3 **1981.** Hicks (1981a, 1981b) directed the excavation of nine sites in the WIPP core area.

4 **1982.** Bradley (Lord and Reynolds 1985) recorded one site and four isolated artifacts in an  
5 archaeological survey for a proposed water pipeline.

6 **1985.** Lord and Reynolds (**1985**) examined three sites within the WIPP core area that consisted  
7 of two plant-collecting and processing sites and one base camp used between 1000 B.C. and  
8 A.D. 1400. The artifacts recovered from the excavations are in the Laboratory of Anthropology  
9 at the Museum of New Mexico in Santa Fe.

10 **1987.** Mariah Associates, Inc.; identified 40 sites and 75 isolates in an inventory of 2,460 ac in  
11 15 quarter-section units surrounding the WIPP site. In this investigation, 19 of the sites were  
12 located within the WIPP site's boundary. Sites encountered in this investigation tended to lack  
13 evident or intact features. Of the 40 new sites defined, 14 were considered eligible for inclusion  
14 in the National Register, 24 were identified as having insufficient data to determine eligibility,  
15 and 2 were determined to be ineligible for inclusion. The eligible and potentially eligible sites  
16 have been mapped and are avoided by DOE in its current activities at the WIPP site.

17 **1988–1992.** Several archaeological clearance reports have been prepared for seismic testing  
18 lines on public lands in Eddy County, New Mexico.

19 All archaeological sites are surface or near-surface sites, and no reasons exist (either geological  
20 or archeological) to suspect that deep drilling would uncover or investigate archaeological sites.

21 *No artifacts were encountered during cultural resource surveys performed from 1992 until*  
22 *present. The following list provides examples of WIPP projects that required cultural resource*  
23 *surveys. All investigations were performed and reported in accordance with requirements*  
24 *established by the New Mexico Office of Cultural Affairs (OCA) and administered by the*  
25 *SHPO.*

26 • *SPDV site investigation into status of a previously recorded site (#LA 33175) to determine*  
27 *potential impacts from nearby reclamation activity. Assessment included minor surface*  
28 *excavation.*

29 • *WIPP well bore C-2737. Cultural resource investigation for well pad and access road.*

30 • *WIPP well bores WQSP 1-6 and 6a. Individual cultural resource investigations conducted*  
31 *for construction of each respective well pad and access road.*

32 • *WIPP well bores SNL 1, 2, 3, 9 and 12. Cultural resource investigations conducted for*  
33 *construction of each respective well pad and access road.*

34 • *WIPP well bore WTS 4. Cultural resource investigation conducted in support of siting*  
35 *and constructing reserve pits for well drilling and development.*

- 1 • *North Salt Pile Expansion. Cultural resource investigation conducted in support of the*  
2 *expansion of the North Salt Pile, a project designed to mitigate surface water infiltration.*

3 All of the aforementioned archeological investigations received determinations of “No Adverse  
4 Affect” from the OCA and the SHPO. This determination serves as a clearance to proceed with  
5 work.

6 The Delaware Basin has been used in the past for an isolated nuclear test. This test, Project  
7 Gnome, took place in 1961 at a location approximately 13 km (8 mi) southwest of the WIPP.  
8 The primary objective of Project Gnome was to study the effects of an underground nuclear  
9 explosion in salt. The Gnome experiment involved the detonation of a 3.1-kiloton nuclear device  
10 at a depth of 361 m (1,200 ft) in the bedded salt of the Salado (Rawson et al. 1965). The  
11 explosion created a cavity of approximately 28,000 m<sup>3</sup> (1,000,000 ft<sup>3</sup>) and caused surface  
12 displacements over an area of about a 360-m (1,200-ft) radius. Fracturing and faulting caused  
13 measurable changes in rock permeability and porosity at distances up to approximately 100 m  
14 (330 ft) from the cavity. No earth tremors were reported at distances over 40 km (25 mi) from  
15 the explosion. Project Gnome was decommissioned in 1979.

## 16 **2.4 Background Environmental Conditions**

17 *Background environmental conditions at and near the WIPP site were characterized prior to*  
18 *the initiation of the operation of the facility and are described in CCA Section 2.4. Because*  
19 *background characterization focuses on environmental conditions existing prior to operations,*  
20 *it is not meaningful to redefine background environmental conditions after operations began.*  
21 *Accordingly, information presented in CCA Section 2.4 is not repeated and updated in this*  
22 *recertification application.*

23 ~~One of the criteria established for the selection of a repository site was that the impacts on the~~  
24 ~~ecology from constructions and operations be minimal. Consequently, as the DOE assessed the~~  
25 ~~geological and hydrological characteristics of the site, they also assessed the ecological~~  
26 ~~characteristics. The result was a demonstration, documented in the FEIS, that the ecological~~  
27 ~~impacts are minimal and within acceptable bounds. The FEIS concluded that adverse impacts on~~  
28 ~~the ecology were expected to be slight for the following reasons:~~

- 29 ~~1. No natural areas proposed for protection are present on or near the site,~~
- 30 ~~2. No endangered species of plants or animals are known to inhabit the site or the vicinity of~~  
31 ~~the site; nor are any critical habitats known to exist on or near the site,~~
- 32 ~~3. Water requirements for the site are low,~~
- 33 ~~4. The land contains soil types and vegetation associations that are common throughout the~~  
34 ~~region, and~~
- 35 ~~5. Access in the form of dirt roads is already available throughout the area; therefore,~~  
36 ~~recreational use of the area is not likely to increase significantly.~~

1 The results of the DOE's assessment of background environmental conditions are provided in  
2 this application as part of the complete description of the WIPP and its vicinity. Background  
3 environmental conditions form the baseline for determining if releases to the environment have  
4 occurred during the operational period or during any postoperational monitoring period (Wolfe et  
5 al. 1977). For this reason, the EPA considers these are important criteria for certification as  
6 stated in 40 CFR § 194.14(g). The DOE routinely collects environmental information at and  
7 around the WIPP site in accordance with the WIPP Environmental Monitoring Plan (see  
8 Appendix EMP). The EMP satisfies the criteria of 40 CFR § 194.14(g) in that it provides  
9 programmatic specifications for implementing and operating the WIPP environmental  
10 monitoring program. Appendix EMP includes a description of sampling locations, sampling  
11 frequencies, sample management practices, and where appropriate, analytical procedures.  
12 Specific field procedures are maintained at the WIPP site in a separate Environmental  
13 Monitoring Procedures Manual. Emphasis is placed on ecological conditions, water quality, and  
14 air quality and includes the following:

#### 15 *Ecological Conditions*

- 16 •—Vegetation
- 17 •—Mammals
- 18 •—Reptiles and amphibians
- 19 •—Birds
- 20 •—Arthropods
- 21 •—Aquatic ecology
- 22 •—Endangered species.

#### 23 *Quality of Environmental Media*

- 24 •—Surface water
- 25 •—Groundwater
- 26 •—Air.

#### 27 *2.4.1 Terrestrial and Aquatic Ecology*

28 The vegetation, mammals, reptiles and amphibians, birds, arthropods, aquatic ecology, and  
29 endangered species of the WIPP site and its environs are characterized in the sections that  
30 follow. Much of the information in this section was reported in the FEIS (DOE 1980). Where  
31 this information has been updated with more recent data, this update is noted.

1 2.4.1.1—Vegetation

2 The WIPP site is in an area characterized by stabilized sand dunes. The vegetation is dominated  
3 by shinnery oak, mesquite, sand sage, dune yucca, smallhead snakeweed, three-awn, and  
4 numerous species of forbs and perennial grasses. The dominant shrubs are deep-rooted species  
5 with extensive root systems. The shrubs not only stabilize the dune sand but serve as food,  
6 shelter, and nesting sites for many species of wildlife inhabiting the area.

7 The vegetation in the vicinity of the WIPP site is not a climax vegetation, at least in part because  
8 of past grazing management. The composition of the plant life at the site is heterogeneous  
9 because of variations in terrain and in the type and depth of soil. Shrubs are conspicuous  
10 members of all plant communities. The site lies within a region of transition between the  
11 northern extension of the Chihuahuan Desert (desert grassland) and the southern Great Plains  
12 (short grass prairie); it shares the floral characteristics of both.

13 Grazing, primarily by domestic livestock, and fire control are largely responsible for the shrub-  
14 dominated seral communities of much of southeastern New Mexico. A gradual retrogression  
15 from the tall- and mid-grass-dominated vegetation of 100 years ago has occurred throughout the  
16 region. The cessation of grazing would presumably not alter the domination by shrubs, but it  
17 would result in an increase in grasses. Experimental exclosures have been established to study  
18 site-specific patterns of succession in the absence of grazing, but long-term results are not yet  
19 available.

20 The semiarid climate makes water a limiting factor in the entire region. The amount and timing  
21 of rainfall greatly influence plant productivity and, therefore, the food supply for wildlife and  
22 livestock. The seeds of desert plants are often opportunistic: they may lie dormant through long  
23 periods of drought to germinate in the occasional year of favorable rainfall. Significant  
24 fluctuations in the abundance and distribution of plants and wildlife are typical of this region.  
25 Several examples of such fluctuations have been documented in the area within 8.3 km (5 mi) of  
26 the center of the WIPP site, which has been intensively studied.

27 Two introduced species of significance in the region are the Russian thistle, or tumbleweed, a  
28 common invader in disturbed areas, and the Tamarisk, or salt cedar, which has proliferated along  
29 drainage ways.

30 Several distinct biological zones occur on or near the site: the mesa, the central dunes complex,  
31 the creosote bush flats, the Livingston Ridge escarpment, and the Tobosa Flats in Nash Draw  
32 west of the ridge. A low, broad mesa named the Divide lies on the eastern edge of the study area  
33 and supports a typical desert grassland vegetation. The dominant shrub and subshrub are  
34 mesquite and snakeweed, respectively. The most abundant grasses are black grama, bush muhly,  
35 ring muhly, and fluffgrass. Cacti, especially varieties of prickly pear, are present.

36 Where the ground slopes down from the Divide to the central dune plains, the soil becomes deep  
37 and sandy. Shrubs like shinnery oak, mesquite, sand sagebrush, snakeweed, and dune yucca are  
38 dominant. In some places, all of these species are present; in others, one or more are either  
39 missing or very low in density. These differences appear to be caused by localized variations in  
40 the type and depth of soil. Thus, a number of closely related but distinct plant associations form

1 a patchwork complex, or mosaic, across the stabilized dunes in the central area. Hummocky,  
2 partially stabilized sand dunes occur, and large, active dunes are also present. The former consist  
3 of islands of vegetation, primarily mesquite, separated by expanses of bare sand. The mesquite-  
4 anchored soil is less susceptible to erosion, mainly by wind, than is the bare sand. The result is a  
5 series of valley-like depressions, or blowouts, between vegetated hummocks. Active dunes  
6 running east to west are found 16 km (10 mi) south and east of the site.

7 To the west and southwest, the soil changes again, becoming more dense and shallow (less than  
8 2.5 cm [10 in.] to caliche) than in the dune area. The composition of the plant life is radically  
9 altered, and creosote bushes become dominant. Toward Livingston Ridge to the west and  
10 northwest, creosote bushes gradually give way to an acacia-dominated association at the top of  
11 the escarpment. The western face of the ridge drops sharply to a valley floor (flats) that is  
12 densely populated with tobosa grass, which is rare elsewhere in the study area.

#### 13 2.4.1.2—Mammals

14 The most conspicuous wild mammals at the site are the black-tailed jack rabbit and the desert  
15 cottontail. Common small mammals found at the WIPP site include the Ord's kangaroo rat, the  
16 Plains pocket mouse, and the northern grasshopper mouse. Big game species, such as the mule  
17 deer and the pronghorn antelope, and carnivores, such as the coyote, are present in small  
18 numbers.

#### 19 2.4.1.3—Reptiles and Amphibians

20 Commonly observed reptiles in the study area are the side-blotched lizard, the western box turtle,  
21 the western whiptail lizard, and several species of snakes, including the bullsnake, the prairie  
22 rattlesnake, the western diamondback rattlesnake, the coachwhip, the western hognose, and the  
23 glossy snake. Of these, only the side-blotched lizard is found in all habitats. The others are  
24 mainly restricted to one or two associations within the central dunes area, although the western  
25 whiptail lizard and the western diamondback rattlesnake are found in areas dominated by  
26 creosote bush as well. The yellow mud turtle is found only in the limited number of aquatic  
27 habitats in the study area (that is, dirt stock ponds and metal stock tanks), but it is common in  
28 these locales.

29 Amphibians are similarly restricted by the availability of aquatic habitat. Stock-watering ponds  
30 and tanks may be frequented by tiger salamanders and occasional frogs and toads. Fish are  
31 sometimes stocked in the ponds and tanks.

#### 32 2.4.1.4—Birds

33 Numerous birds inhabit the area either as transients or year-long residents. Loggerhead shrikes,  
34 pyrrhuloxias, and black-throated sparrows are examples of common residents. Migrating or  
35 breeding waterfowl species do not frequently occur in the area. Some raptors (for example,  
36 Harris hawks) are residents. The density of large avian predators' nests has been documented as  
37 among the highest recorded in the scientific literature.

## 1 2.3 Resources

2 At the outset of the repository program, the DOE understood the importance of resources in the  
3 vicinity of a disposal system. Several of the siting criteria emphasized avoidance of resources  
4 that would impact the performance of the disposal system. In this regard, the DOE selected a  
5 site that (1) maximized the use of federal lands, (2) avoided known oil and gas trends, (3)  
6 minimized the impacts on potash deposits, and (4) avoided existing drill holes. While the DOE  
7 could not meet all these criteria totally, ~~this application shows~~ *it is shown* that the favorable  
8 characteristics of the location compensate for any increased risks due to the presence of  
9 resources. Consequently, the DOE has prepared this section to discuss resources that may exist  
10 at or beneath the WIPP site. The topic of resources is used to broadly define both economic  
11 (mineral and nonmineral) and cultural resources associated with the WIPP site. These resources  
12 are important because they (1) provide evidence of past uses of the area and (2) indicate potential  
13 future use of the area with the possibility that such use could lead to disruption of the closed  
14 repository. Because of the depth of the disposal horizon, it is believed that only the mineral  
15 resources are of significance in predicting the long-term performance of the disposal system.  
16 However, the nonmineral and cultural resources are presented for completeness because they are  
17 included in the FEP screening discussions in Chapter 6 and Appendix *PA, Attachment SCR*.  
18 Information needed to make screening decisions includes natural resource distributions,  
19 including potable groundwaters, the distribution of drillholes, mines, excavations, and other  
20 man-made features that exploit these resources, the distribution of drillholes and excavation used  
21 for disposal or injection purposes, activities that significantly alter the land surface, agricultural  
22 activities that may affect the disposal system, archaeological resources requiring deep excavation  
23 to exploit, and technological changes that may alter local demographics. This information is  
24 presented here or is referenced.

25 With respect to minerals or hydrocarbons, reserves are the portion of resources that are economic  
26 at today's market prices and with existing technology. For hydrocarbons, proved (proven)  
27 reserves are an estimated quantity that engineering and geologic data analysis demonstrates, with  
28 reasonable certainty, is recoverable in the future from discovered oil and gas pools. Probable  
29 resources (extensions) consist of oil and gas in pools that have been discovered but not yet  
30 developed by drilling. Their presence and distribution can generally be surmised with a high  
31 degree of confidence. Probable resources (new pools) consist of oil and gas surmised to exist in  
32 undiscovered pools within existing fields. (Definitions are from NMBMMR 1995, V-2 and  
33 V-3.)

34 Mineral resource discussions are focused principally on hydrocarbons and potassium salts, both  
35 of which have long histories of development in the region. Development of either resource  
36 potentially could be disruptive to the disposal system. The information regarding the mineral  
37 resources concentrates on the following factors:

- 38 • number, location, depth, and present state of development, including penetrations through  
39 the disposal horizon,
- 40 • type of resource,
- 41 • accessibility, quality, and demand, and

- 1 • mineral ownership in the area.

2 The specific impacts of resource development are discussed in Section 6.4.6.2.3, where scenarios  
3 related to mineral development are included for evaluation of disposal system performance. This  
4 discussion uses information presented in *CCA* Appendices DEL and MASS as indicated in the  
5 following text. The discussion of cultural and economic resources is focused on describing past  
6 and present land uses unrelated to the development of minerals. The archaeological record  
7 supports the observation that changes in land use are principally associated with climate and the  
8 availability of forage for wild and domestic animals. In no case does it appear that past or  
9 present land use has had an impact on the subsurface beyond the development of shallow  
10 groundwater wells to water livestock.

### 11 **2.3.1 Extractable Resources**

12 The geologic studies of the WIPP site included the investigation of potential natural resources to  
13 evaluate the impact of denying access to these resources and other consequences of their  
14 occurrence. Studies were completed in support of the FEIS to ensure knowledge of natural  
15 resources, and the impacts of denying access were included in the decision-making process for  
16 WIPP. Of the natural resources expected to occur beneath the site, five are of practical concern:  
17 the two potassium salts sylvite and langbeinite, which occur in the McNutt; and the three  
18 hydrocarbons, crude oil, natural gas, and distillate liquids associated with natural gas, all three of  
19 which occur elsewhere in strata below the Castile. Other mineral resources beneath the site are  
20 caliche, salt, gypsum, and lithium; enormous deposits of these minerals near the site and  
21 elsewhere in the country are more than adequate (and more economically attractive) to meet  
22 future requirements for these materials. In 1995, the NMBMMR performed a reevaluation of the  
23 mineral resources at and within 1.6 km (1 mi) around the WIPP site. The following discussion is  
24 based in part on information from NMBMMR (1995).

#### 25 **2.3.1.1 Potash Resources at the WIPP Site**

26 Throughout the Carlsbad Potash District, commercial quantities of potassium salts are restricted  
27 to the middle portion of the Salado, locally called the McNutt. A total of 11 zones (or distinct  
28 ore layers) have been recognized in the McNutt. Horizon Number 1 is at the base, and Number  
29 11 is at the top. The 11th ore zone is not mined.

30 The USGS uses three standard grades—low, lease, and high—to quantify the potash resources at  
31 the site. The USGS assumes that the lease and high grades comprise reserves because some  
32 lease-grade ore is mined in the Carlsbad Potash District. Most of the potash that is mined,  
33 however, is better typified as high-grade. Even the high-grade resources may not be reserves,  
34 however, if properties such as high clay content make processing uneconomical. The analysis in  
35 the *NMBMMR* (1995) ~~NMBMMR report~~ distinguishes between lease-grade ore and  
36 economically mineable ore.

37 The *NMBMMR* (1995) study contains a comprehensive summary of all previous potash resource  
38 evaluations. ~~Griswold~~ (*NMBMMR* (1995, Chapter VII) used 40 existing boreholes drilled on  
39 and around the WIPP site to perform a reevaluation of potash resources. He selected holes that  
40 were drilled using brine so that the dissolution of potassium salts was inhibited. The conclusion

1 reached by Griswold is that only the 4th and 10th ore zones contain economic potash reserves.  
2 The quantities are summarized in Table 2-711.

3 **Table 2-711. Current Estimates of Potash Resources at the WIPP Site**

Mining Unit	Product	Recoverable Ore (10 <sup>6</sup> tons)	
		Within the WIPP site	One-Mile Strip Adjacent to the WIPP site
4th Ore Zone	Langbeinite	40.5 <i>at</i> 6.99%*	126.0 <i>at</i> 7.30%
10th Ore Zone	Sylvite	52.3 <i>at</i> 13.99%	105.0 <i>at</i> 14.96%

Source: NMBMMR 1995, Chapter VII.

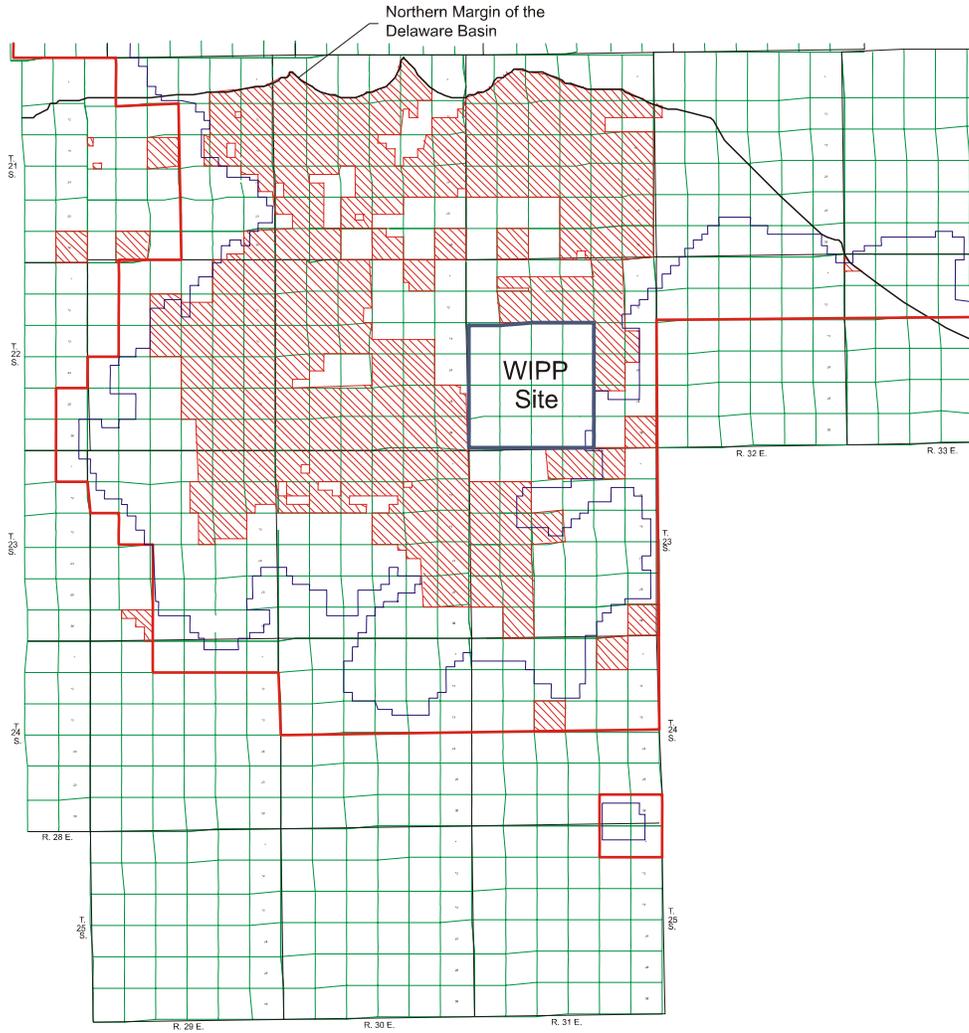
\* For example, read as 40.5 × 106 tons of ore at a grade of 6.99 percent or higher.

4 Within the Carlsbad Known Potash Leasing Area, exploration holes have been drilled to evaluate  
5 the grade of the various ore zones. These are included in the drillhole database in *CCA*  
6 Appendix DEL. None of the economically minable reserves identified by the NMBMMR lies  
7 directly above the waste panels. The known potash leases within the Delaware Basin are shown  
8 in Figure 2-3744 and are detailed in *CCA* Appendix DEL, Figure DEL-8. From information in  
9 this figure and other data which is provided in *CCA* Appendix MASS, Attachment 15-5, DOE  
10 evaluates the extent of future mining outside the land withdrawal area. The extent of possible  
11 future mining within the controlled area is shown in Figure 2-3845. The DOE also addresses this  
12 subject with respect to *PA* in Section 6.4.6.2.3.

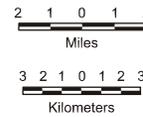
13 *The EPA concluded that neither the DOE's nor the Department of Interior's (DOI) estimate*  
14 *shows the area above the WIPP waste panels as containing mineable reserves. The DOE*  
15 *provided supplemental information in a letter dated May 14, 1997, indicating that potash*  
16 *solution mining and brine extraction do not need to be considered for the PA, based on low*  
17 *consequence to the containment capability of the repository (Docket A-93-02, Item II-I-31).*  
18 *The EPA reviewed the supplemental data and concurred with the DOE's conclusion. To*  
19 *obtain further discussion on this topic, CARD 32-Section 32.B, CARD 33-Section 33A, and*  
20 *CARD 32-Section 32 F (Docket A-93-02, item III-B-2) may be referenced. Additional*  
21 *information is found in FEPs screening discussions for solution mining for potash and*  
22 *solution mining for other resources (FEPs H58 and H59) in Appendix PA, Attachment SCR.*

### 23 2.3.1.2 Hydrocarbon Resources at the WIPP Site

24 In 1974, Foster of the NMBMMR conducted a hydrocarbon resource study in southeastern New  
25 Mexico under contract to the ORNL. The study included an area of 3,914 km<sup>2</sup> (1,512 mi<sup>2</sup>). At  
26 the time of that study, the proposed repository site was about 8 km (5 mi) northeast of the current  
27 site. The 1974 NMBMMR evaluation included a more detailed study of a four-township area  
28 centered on the old site; the present site is in the southwest quadrant of that area. The 1974  
29 NMBMMR hydrocarbon resources study (Foster 1974) is presented in more detail in the FEIS  
30 (DOE 1980, Section 9.2.3.5). The reader is referred to the FEIS or the original study for  
31 additional information.



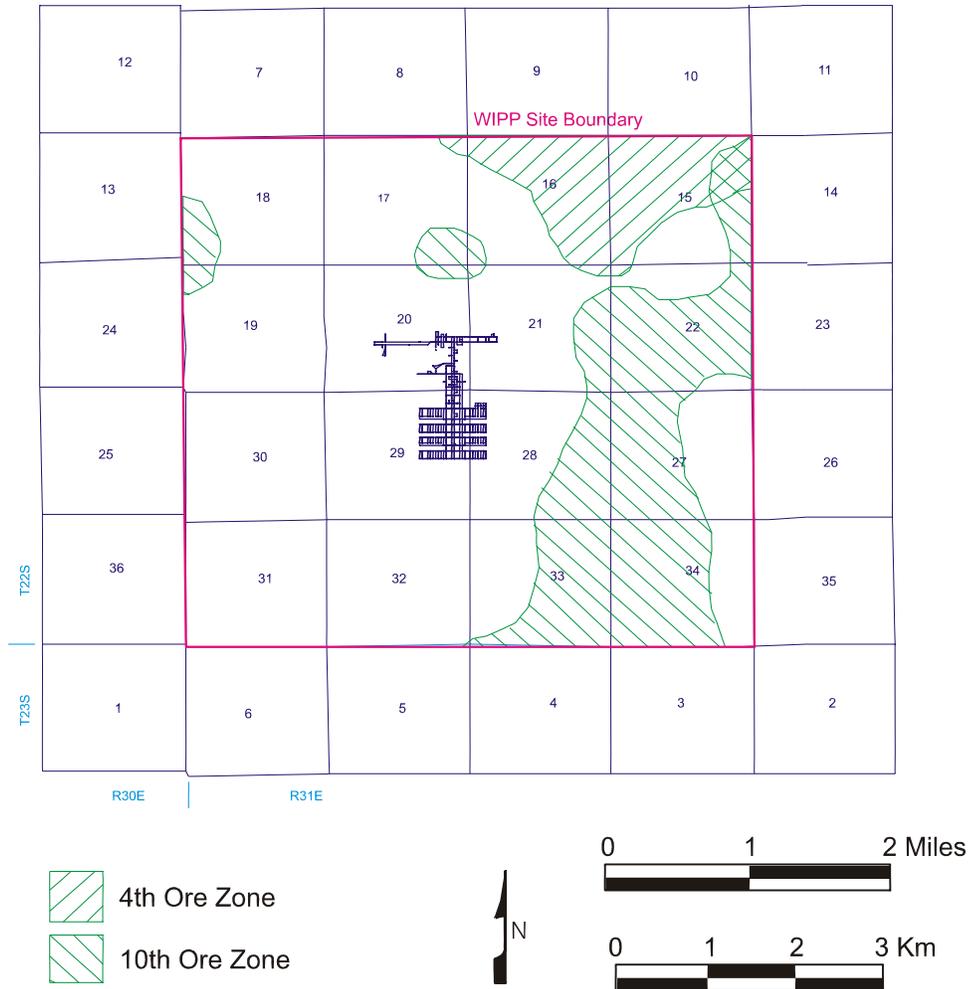
- Oil-Potash Area as Designated by the Secretary, Effective 10/28/86  
499,589.56 Acres  
780.61 Sq. Miles
- Known Potash Lease Area/R-111-P  
July 19, 1985  
367,318.26 Acres  
573.93 Sq. Miles
- ▨ Known Potash Leases Within the Delaware Basin  
100,064.89 Acres  
156.35 Sq. Miles



CCA-074-2

1  
2

**Figure 2-3744. Known Potash Leases Within the Delaware Basin**



CCA-077-2

1  
 2 **Figure 2-3845. Extent of Economically Mineable Reserves Inside the Site Boundary (Based**  
 3 **on NMBMMR Report)**

4 The resource evaluation was based both on the known reserves of crude oil and natural gas in the  
 5 region and on the probability of discovering new reservoirs in areas where past unsuccessful  
 6 drilling was either too widely spread or too shallow to have allowed discovery. Potentially  
 7 productive zones were considered in the evaluation; therefore, the findings may be used for  
 8 estimating the total hydrocarbon resources at the site. A fundamental assumption in the study  
 9 was that the WIPP area has the same potential for containing hydrocarbons as the

10 larger region studied for which exploration data are available. Whether such resources actually  
 11 exist can be satisfactorily established only by drilling at spacings close enough to give a high  
 12 probability of discovery.

13 The NMBMMR 1995 mineral resource reevaluation contains a comprehensive summary of all  
 14 previous evaluations. Broadhead et al. (NMBMMR (1995, Chapter XI) provided a reassessment

1 of hydrocarbon resources within the WIPP site boundary and within the first mile adjacent to the  
 2 boundary. Calculations were made for resources that are extensions of known, currently  
 3 productive oil and gas resources that are thought to extend beneath the study area with  
 4 reasonable certainty (called probable resources in the report). Qualitative estimates are also  
 5 made concerning the likelihood that oil and gas may be present in undiscovered pools and fields  
 6 in the area (referred to as possible resources). Possible resources were not quantified in the  
 7 study. The results of the study are shown in Tables 2-8<sup>12</sup> and 2-9<sup>13</sup>.

8 **Table 2-8<sup>12</sup>. In-Place Oil within Study Area**

Formation	Within WIPP Site (10 <sup>6</sup> bbl <sup>a</sup> )	1-Mile Strip Adjacent to the WIPP Site (10 <sup>6</sup> bbl)	Total (10 <sup>6</sup> bbl)
Delaware	10.33	20.8	31.13
Bone Spring	0.44	0.8	1.25
Strawn	0.4	0.4	0.8
Atoka	1.1	0.1	0.2
<b>Total</b>	<b>12.3</b>	<b>22.9</b>	<b>35.3</b>

Source: NMBMMR (1995, Chapter XI)  
 a bbl = barrel = 42 gallons

9 **Table 2-9<sup>13</sup>. In-Place Gas within Study Area**

Formation	Gas Reserves (Mcf) <sup>a</sup>	
	Within WIPP Site	1-Mile Strip Adjacent to the WIPP
Delaware	18176	32873
Bone Springs	956	1749
Strawn	9600	9875
Atoka	123336	94410
Morrow	32000	28780

Source: NMBMMR (1995, Chapter XI)  
 a Mcf = thousand cubic feet

10 The DOE has compiled statistics on the historical development of hydrocarbon resources in the  
 11 Delaware Basin and has included them in CCA Appendix DEL. For these purposes, the  
 12 Delaware Basin is described as the surface and subsurface features that lie inside the boundary  
 13 formed to the north, east, and west by the innermost edge of the Capitan Reef and formed to the  
 14 south by a straight line drawn from the southeastern point of the Davis Mountains to the  
 15 southwestern point of the Glass Mountains (see Figure 2-39<sup>46</sup>).

16 Several important modeling parameters result from the study of hydrocarbon resources and the  
 17 history of their exploitation. These include parameters related to the number of human  
 18 intrusions, the size of boreholes, the operational histories of such holes, the plugging of these

1 holes, and the use of such holes for other purposes, such as liquid disposal. Each of these topics  
2 is discussed in detail in *CCA Appendix DEL* and Appendix *PA, Attachment MASS, Section*  
3 *MASS.16* (Section Appendix MASS.16) and is addressed in Sections 6.4.7 and 6.4.12. The  
4 distribution of existing boreholes is shown in Figure DEL-4 (*CCA Appendix DEL*) for the entire  
5 Delaware Basin and Figure 2-47 DEL-6 for the vicinity of the WIPP site. In addition, *CCA*  
6 Appendix DEL includes an assessment of current drilling and plugging practices in the Delaware  
7 Basin. *CCA Appendix DEL* also discusses the regulatory constraints placed on the use of wells  
8 for injection.

### 9 2.3.1.3 Other Resources

10 While the focus of studies at the WIPP has been on potash and hydrocarbon, other resources are  
11 known to occur within the Delaware Basin and are considered in the screening. For example,  
12 sulfur is produced in the vicinity of Orla, Texas. Sulfur wells are included in *CCA Appendix*  
13 *DEL*; however, no sulfur resources have been identified in the vicinity of the WIPP; therefore,  
14 there are no projected impacts. Another resource that is extensively produced is groundwater.  
15 Potable water occurs in numerous places within the Delaware Basin. Several communities rely  
16 solely on groundwater sources for drinking water. *CCA Appendix DEL* includes a distribution of  
17 groundwater wells in the Delaware Basin. All such wells in the vicinity of the WIPP are  
18 shallow, generally no deeper than the Culebra. An evaluation of underground sources of  
19 drinking water in the vicinity of the disposal system is presented in *CCA Appendix USDW*.  
20 Figure USDW-4 shows the distribution of groundwater wells in the vicinity of the disposal  
21 system. Sand, gravel, and caliche are produced in numerous areas within the Delaware Basin. In  
22 all cases, these are surface quarries that are generally shallow (*10s* of feet). No impact to the  
23 disposal system is expected from these activities.

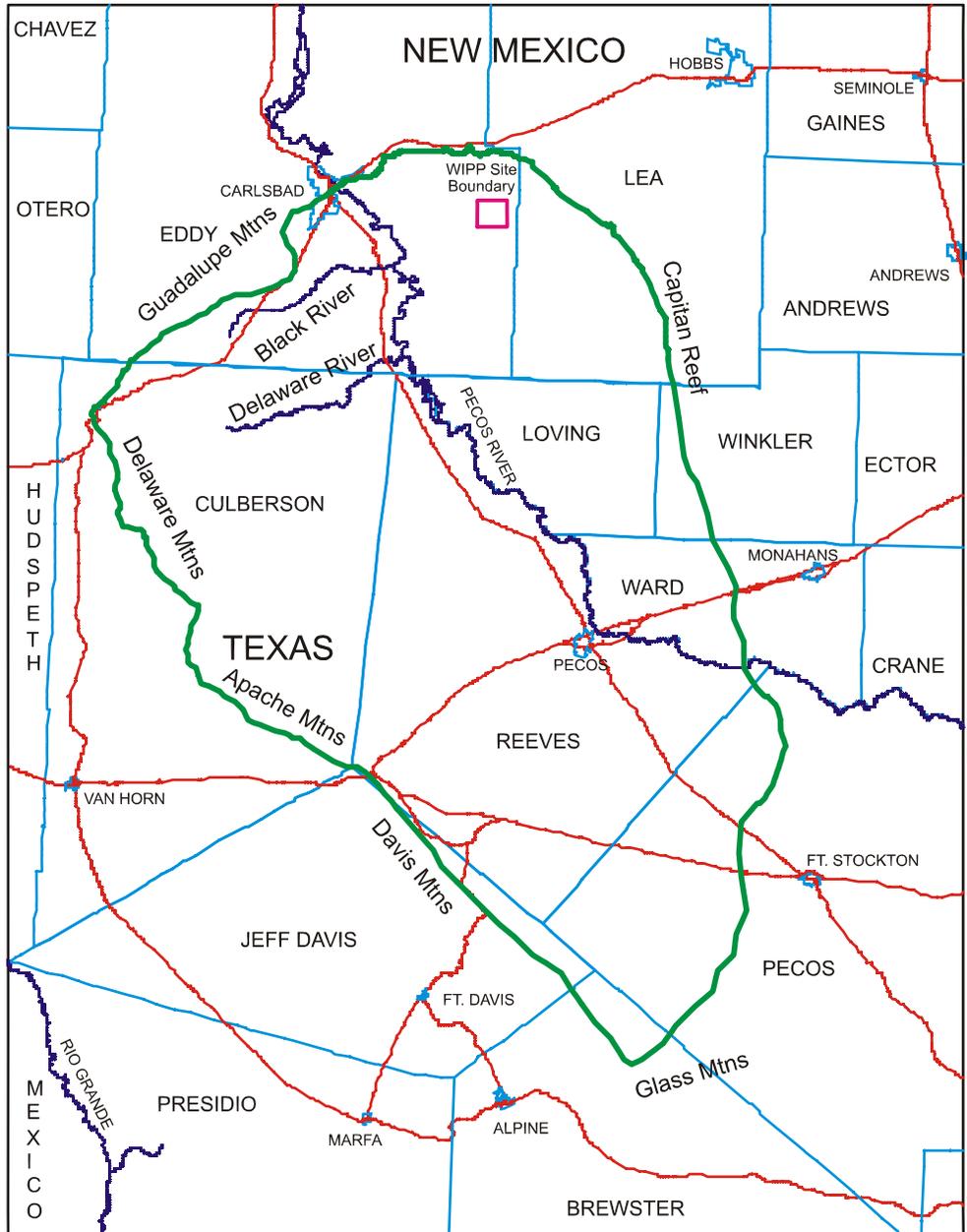
### 24 2.3.2 *Cultural and Economic Resources*

25 The demographics, land use, and history and archaeology of the WIPP site and its environs are  
26 characterized in the sections that follow.

#### 27 2.3.2.1 Demographics

28 The WIPP facility is located 42 km (26 mi) east of Carlsbad in Eddy County in southeastern  
29 New Mexico and includes an area of 10,240 ac (approximately 41 km<sup>2</sup>) (16 mi<sup>2</sup>). The facility is  
30 located in a sparsely populated area with fewer than 30 permanent residents living within a 16-  
31 km (10-mi) radius of the facility. The area surrounding the facility is used primarily for grazing,  
32 potash mining, and hydrocarbon production. No resource development that would affect WIPP  
33 facility operations or the long-term integrity of the facility is allowed within the 10,240 ac that  
34 have been set aside for the WIPP project.

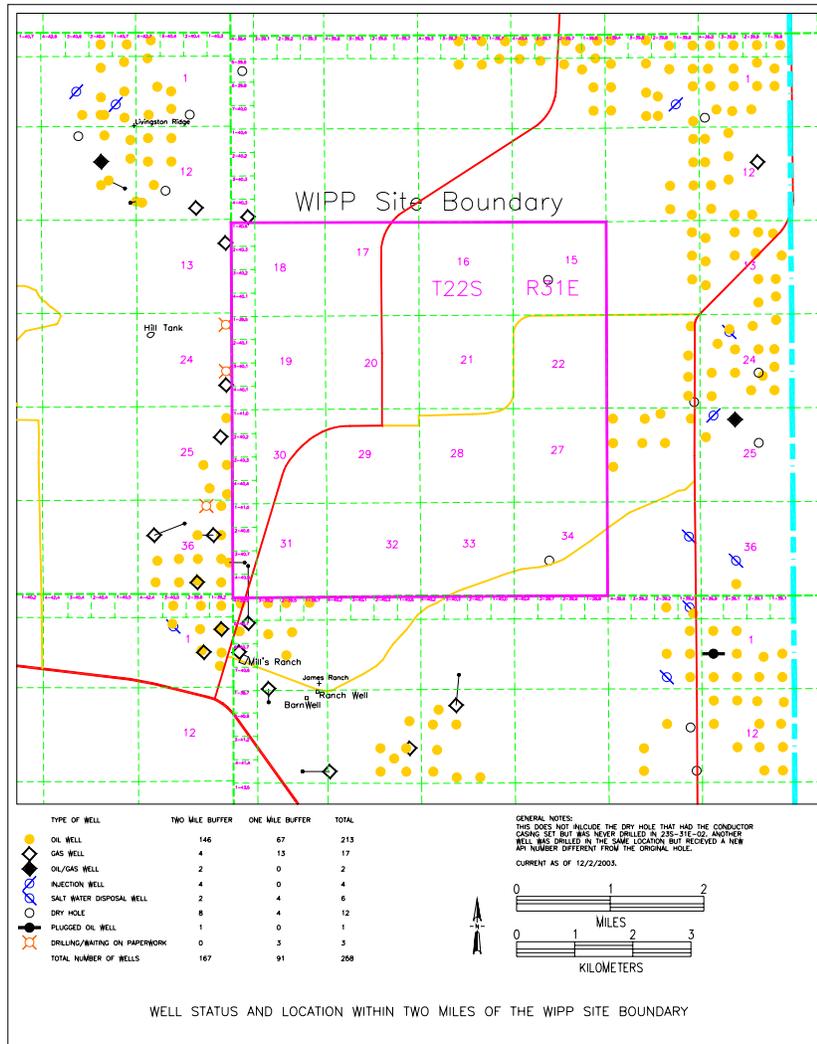
35 The permanent residence nearest to the WIPP site boundary is the J.C. Mills Ranch, which is  
36 2 km (1.2 mi) to the south. The community nearest to the WIPP site is the town of Loving, New  
37 Mexico, 29 km (18 mi) west-southwest of the site center. The population of Loving decreased  
38 from 1,355 in 1980 to *increased from* 1,243 in 1990 *to* 1,326 in 2000. The nearest population  
39 center is the city of Carlsbad, New Mexico, 42 km (26 mi) west of the site. The population of



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**Figure 2-3946. Delaware Basin Boundary**



1  
2 **Figure 2-47. Distribution of Existing Petroleum Industry Boreholes Within Two Miles of the**  
3 **WIPP Site**

4 Carlsbad has ~~decreased~~ **increased** from 25,496 in 1980 to 24,896 in 1990 **to 26,870 in 2000**.  
5 Hobbs, New Mexico, 58 km (36 mi) to the east of the site, had a 1980 population of 29,153 and a  
6 1990 population decrease from of 29,115 **in 1990 to 28,657 in 2000**. Eunice, New Mexico,  
7 64 km (40 mi) east of the site, had a 1980 population of 2,970 and a 1990 population of 2,731  
8 **decrease to 2,562 in 2000**. Jal, New Mexico, 72 km (45 mi) southeast of the site, had a  
9 population of 2,575 in 1980 and of 2,153 in 1990 **decrease to 1,996 in 2000**.

10 The WIPP site is located in Eddy County near the border of **f** Lea County, New Mexico. The  
11 Eddy County population increased from 47,855 in 1980 to 48,605 in 1990 **to 51,658 in 2000**.  
12 The Lea County population decreased from 55,993 in 1980 to 55,765 in 1990 **to 55,511 in 2000**.  
13 Population figures are taken from the 1980 and 1990 census (U.S. Department of Commerce,  
14 1980, 1990) **and the 2000 census (U.S. Census Bureau, 2000)**.