DOE/WIPP-17-2308

Delaware Basin Monitoring Annual Report

September 2017

United States Department of Energy
Waste Isolation Pilot Plant

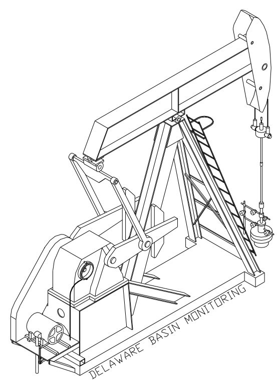
Carlsbad Field Office
Carlsbad, New Mexico

This document has been submitted as required to:

Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831
(865) 576-8401

Additional information about this document may be obtained by calling 1-800-336-9477. Copies may be obtained by contacting the National Technical Information Service, US Department of Commerce, 5285 Port Royal Road, Springfield, VA 22101.

Delaware Basin Monitoring Annual Report



September 2017

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Prepared for
the Department of Energy by
Nuclear Waste Partnership LLC, Regulatory Environmental Services
Delaware Basin Drilling Surveillance Program

This page intentionally left blank.

Table of Contents

List of Figures

List of Tables

1.0 Delaware Basin Drilling Surveillance Program

The Delaware Basin Drilling Surveillance Program (DBDSP) is designed to monitor drilling activities in the vicinity of the Waste Isolation Pilot Plant (WIPP) site. This program is based on Environmental Protection Agency (EPA) criteria in Title 40 Code of Federal Regulations (CFR) Part 194.33. The EPA Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes are codified in 40 CFR Part 191 (EPA 1993). Subpart B of 40 CFR Part 191 addresses the environmental standards for the disposal of radioactive waste. The standards require the Department of Energy (DOE) to demonstrate the expected long-term performance of the disposal system using a probabilistic risk assessment or performance assessment (PA). The results of the PA must show the expected long-term repository performance will not result in the release of radioactive material above EPA limits. The PA includes the consideration of inadvertent human intrusion into the repository.

In 40 CFR Part 194 (EPA 1996), the EPA defined the geographical area, for the evaluation of the historical rate of drilling for resources as the Delaware Basin. This same area is used for monitoring mining, drilling, and drilling-related activities. The definition of the Delaware Basin in 40 CFR § 194.2 is:

> "Delaware Basin means those surface and subsurface features which lie inside the boundary formed to the north, east and west of the [WIPP] disposal system, by the innermost edge of the Capitan Reef, and formed, to the south, by a straight line drawn from the southeastern point of the Davis Mountains to the most southwestern point of the Glass Mountains."

The Delaware Basin, depicted in Figure 1, includes all or part of Brewster, Culberson, Jeff Davis, Loving, Pecos, Reeves, Ward, and Winkler counties in west Texas, and portions of Eddy and Lea counties in southeastern New Mexico.

The DOE continues to provide surveillance of mining and drilling activities in the Delaware Basin in accordance with the criteria established in 40 CFR Part 194. This will continue until the DOE and the EPA mutually agree no further benefit can be gained from continued surveillance. The results of the ongoing surveillance will be used to determine if a substantial and detrimental deviation has occurred that would affect the long-term performance of the disposal system.

The *Delaware Basin Drilling Surveillance Plan* (WP 02-PC.02; NWP 2017) places specific emphasis on the nine-township area surrounding the WIPP site, which includes townships 21 through 23 south and ranges 30 through 32 east in southeastern New Mexico. The DBDSP provides data to build on the information presented in the Compliance Certification Application (CCA), Appendix DEL (DOE 1996), the Compliance Recertification Application-2004 (CRA-2004), Appendix DATA (DOE 2004), the CRA-2009, Appendix DATA (DOE 2009), and the CRA-2014, Appendix DATA-2014 (DOE 2014).

2.0 2017 Updates

The 40 CFR §194.33 standards for a PA requires the consideration of disturbed case scenarios that include intrusions into the repository by inadvertent and intermittent drilling for resources. The DBDSP collects the drilling-related data to be used for future PA calculations. The probability of these intrusions is based on a future drilling rate, based on consideration of the record of drilling events in the Delaware Basin for the most recent 100-year period. The DOE models several types of human intrusion scenarios in the PA. These include both single borehole intrusion events and combinations of multiple borehole intrusions.

Two different types of boreholes are considered in the PA: (1) those that penetrate a pressurized brine reservoir in the underlying Castile Formation and (2) those that do not. While the presence of pressurized brine under the repository is speculative, it cannot be completely ruled out based on available information. The primary consequence of contacting pressurized brine is the introduction of an additional source of brine beyond that which is assumed to be released into the repository from the Salado Formation. The human intrusion scenario models are based on extensive field data sets collected by the DOE. The data have been continuously collected from the time of the 1996 submittal of the CCA and include specific wells drilled during the last year in the New Mexico portion of the Delaware Basin, specifically the nine-township area immediately surrounding the WIPP site. Data provided in this report covers the period from September 1, 2016 to August 31, 2017. These data are summarized in the following sections.

2.1 Miscellaneous Drilling Information

The EPA provided criteria in 40 CFR §194.33(c) to address the consideration of drilling in the PA. These criteria led to the formulation of conceptual models that incorporate the effects of this activity. The conceptual models use parameter values as documented in CCA, Appendix DEL (DOE 1996), such as:

- Drill collar diameter and length
- Casing diameters
- Drill pipe diameter
- Speed of drill string rotation through the Salado Formation
- Penetration rate through the Salado Formation
- Instances of air drilling
- Types of drilling fluids
- Amounts of drilling fluids
- Borehole depths
- Borehole diameters
- Borehole plugs
- Fraction of each borehole that is plugged
- Instances of encountering pressurized brine in the Castile Formation

The DBDSP data set includes the final borehole depth for wells drilled in the Delaware Basin. Borehole depths range from 19 feet to 25,201 feet. The 19-foot hole is an exhaust shaft monitoring well located on the WIPP site, and the 25,201-foot hole is a gas well located in the

Texas portion of the Delaware Basin. Borehole depths in the immediate vicinity of the WIPP site typically range from 7,750 feet to 9,000 feet for oil wells and 13,000 feet to 16,000 feet for gas wells.

The diameter of each well bore is more difficult to ascertain. The DBDSP data set includes the casing size and depth for each section of the hole drilled in the last year within the nine-township area (Table 1). Drill bit size is not a reportable element, although hole sizes are reported on Sundry notices (miscellaneous forms) maintained by the New Mexico Oil Conservation Division (NMOCD). The casing size or hole size is used to determine the diameter of the bit used to drill that particular section of the well. In previous years, the most common bit sizes were 17 1/2 inches for the surface section, 12 1/4 inches for the intermediate section, and 7 7/8 inches for the production section of the hole. This year the common pattern was observed for the surface and intermediate sections, however, 8 3/4, and 8 1/2 inches were observed for the production section. Table 2 shows the documented bit sizes used in drilling wells within the nine-township area during the last year. The typical hole and casing sizes, for a three-string well in the vicinity of the WIPP site, are shown in Figure 2.

2.1.1 Drilling Techniques

The drilling techniques reported since the CCA, Appendix DEL are still being implemented by area drillers. There were 154 hydrocarbon wells spudded, not necessarily completed, in the New Mexico portion of the Delaware Basin from September 1, 2016 through August 31, 2017. This number is derived from the Delaware Basin Well Tracking Application (DBWTA), a Microsoft® SQL server application maintained by the DBDSP. In reality, the number of new wells is higher; but paperwork on some of the wells has not yet been filed with the NMOCD or will be filed after this report is issued. Therefore, those wells are not included in the count listed above.

Rotary drilling rigs were used to drill the 154 wells. Some have been completed as oil wells, others as gas wells, still others as salt water disposal wells. The 154 wells were conventionally drilled utilizing mud as a medium for circulation. Two of these wells were in the nine-township area. The depths of the completed wells in the nine-township area are 14,396 feet and 20,650 feet. Outside of the nine-township area the depths of the completed wells range from 1,982 feet to 21,282 feet.

A technique used by operators to increase production is to drill a well horizontally after a target depth for lateral kick-off point is reached, which allows for more of the wellbore area to be in the production zone. The CCA, Appendix DEL reported that this technique was not often used in this area because of the increased costs due to the additional drilling time needed; however this is no longer the case. The DBDSP monitors directional and horizontally drilled wells only in the nine-township area. All of the six new wells spudded during the last year in the nine-township area had horizontally drilled components.

2.1.2 Drilling Fluids

Employing a rotary rig for drilling involves the use of drilling fluids. Drilling fluid, commonly known as mud, is the liquid circulated through the wellbore during rotary drilling and workover operations. In addition to its function of bringing cuttings to the surface, drilling mud cools and lubricates the bit and drill stem, protects against blowouts by holding back subsurface pressures, and deposits a mud cake on the wall of the borehole to prevent loss of fluids into the formation.

Typically, a driller will use fresh water and additives to drill the surface section of the borehole, which ends at the top of the Salado Formation. A change in drilling practices would necessitate a change in the application of drilling fluids. Within the Known Potash Leasing Area (KPLA) of southeastern New Mexico, drillers are required under NMOCD Order R-111-P to use saturated brine to drill through the salt formation, which is usually called the intermediate section. The purpose of the requirement is to keep the salt from washing out and making the hole larger than necessary. Once this section has been drilled and cased, the driller again changes to fresh water and additives to finish drilling the hole to depth.

2.1.3 Air Drilling

A method of hydrocarbon drilling not emphasized in CCA, Appendix DEL is air drilling. As defined by the oil industry, air drilling is a method of rotary drilling using compressed air as the circulation medium. The conventional method of removing cuttings from the wellbore is to use a flow of water or drilling mud. In some cases, compressed air removes the cuttings with equal or greater efficiency. The rate of penetration is usually increased considerably when air drilling is used; however, a fundamental problem in air drilling is the penetration of formations containing water, since the entry of water into the system reduces the ability of the air to remove cuttings. Air drilling occurrences are tracked by the DBDSP in the New Mexico portion of the Delaware Basin only.

Stakeholders noted the air drilling scenario was not included by the DOE in the CCA and raised the following issues: (1) air drilling technology is currently successfully used in the Delaware Basin, (2) air drilling is thought to be a viable drilling technology under the hydrological and geological conditions at the WIPP site, and (3) air drilling could result in releases of radionuclides that are substantially greater than those considered by the DOE in the CCA. Considerable research on air drilling in the Delaware Basin has determined that, although air drilling is a common method of drilling wells, it is not practiced in the vicinity of the WIPP site because (1) it is against NMOCD Order R-111-P regulations to drill with anything but saturated brine through the salt formation in the KPLA; (2) it is not economical to drill with air when a driller has to use saturated brine for the intermediate section; and (3) if water is encountered prior to or after drilling the salt formation, the driller would have to convert to a conventional system of drilling.

DOE provided additional information to EPA Air Docket No. A-93-02, IV-G-7 (Kirkes 1998). In this information, the following was provided:

> “The well record search has continued and now includes information from the entire New Mexico portion of the Delaware Basin. Within the nine-townships surrounding the WIPP, the records showed no evidence of air drilling. One possible exception to this may be the Lincoln Federal #1. This well is said to have been air drilled due to a loss of circulation at a depth of 1290 feet, but this

> has not been verified. The records associated with the Lincoln Federal #1 do not contain any evidence of air drilling. Rather, this information is based on verbal communications with the operating and drilling companies involved with the well. Nonetheless, the Lincoln Federal #1 may have been drilled with air, although it was not a systematic use of the technology. Air drilling at this well was used from 2984' to 4725' merely as a mitigative attempt to continue drilling to the next casing transition depth. After this casing transition, mud drilling was used for the remainder of the hole.
>
> The area of the expanded search contains 3,756 boreholes. Of these, 407 well files were unavailable for viewing (in process); therefore, 3,349 well files constitute the database. Among these wells, 11 instances of air drilling were found in which any portion of the borehole was drilled with air. Only 7 of these were drilled through the Salado Formation at the depth of the repository. This results in a frequency of 7/3349, or 0.0021. This value is conservative in that it includes the Lincoln Federal #1, and four other wells which were proposed to be drilled with air, but no subsequent verification of actual drilling exists in the records."

In the CCA Final Rule (FR Vol. 63 No. 95) the EPA ruled air drilling did not have to be considered for PA; however, the DBDSP will continue to monitor for instances of air drilling (EPA 1998a).

During the summer of 1999, another search of these same records was conducted as a follow-up to the original research. This search of the records was used as a quality assurance check of the original search. The database consisted of 3,810 boreholes with only 12 records unavailable for viewing. This search added five more wells with indications of some portion of the borehole being drilled with air. None were located in the nine-township area or were air drilled through the Salado Formation. Of the five wells added to the count, one (the Sheep Draw "28" Federal #13) had the first 358 feet air drilled while the other four had the conductor casing drilled with air which consists of the first 40 feet of the borehole and is not usually reported in the drilling process. The conductor casing is typically drilled, set in place, and cemented prior to setting up the rotary drilling rig that will eventually drill the well.

The records on the new wells spudded during the last year (September 1, 2016 through August 31, 2017) are reviewed as they become available at the NMOCD Internet site for instances of air drilling. The records can be submitted to the NMOCD offices as late as two years after the well has been drilled. None of the records reviewed to date have indicated any additional instances of air drilling. Air drilling is not a common practice in the vicinity of the WIPP site. Table 3 shows the known indications of air drilling that have occurred in the New Mexico portion of the Delaware Basin.

2.2 Shallow Drilling Events

The criteria in 40 CFR Part 194.33 require that the CCA and subsequent CRAs adequately and accurately characterize the frequency of shallow drilling within the Delaware Basin, as well as, support the assumptions and determinations, particularly those that limit consideration of shallow drilling events based on the presence of resources of similar type and quantity found in the controlled area. The EPA defined shallow drilling as “drilling events in the Delaware Basin that do not reach a depth of 2,150 feet below the surface relative to where such drilling occurred.” The DOE concluded in CCA, Appendix SCR that shallow drilling could be removed from PA consideration based on low consequence. As a result, the DOE did not include shallow drilling in its PA drilling rate calculations and did not include any reduction in shallow drilling rates during the active and passive institutional control periods. In the CCA, Compliance Application Review Document (CARD) 33 (EPA 1998b), the EPA accepted the DOE’s finding that shallow drilling would be of low consequence to repository performance and need not be included in PA.

Although the EPA has agreed, in CARD 33, shallow drilling is of low consequence and could be eliminated from PA, the DBDSP collects data on wells reported to be drilled within the boundaries of the Delaware Basin. Table 4 shows a breakdown of the various types and number of shallow wells located within the Delaware Basin.

2.3 Deep Drilling Events

In accordance with the criteria, the DOE used the historical rate of drilling for resources in the Delaware Basin to calculate a future drilling rate. In particular, in calculating the frequency of future deep drilling, the EPA provided the following criteria in 40 CFR §194.33(b)(3)(i) (EPA 1996) to the DOE:

> Identify deep drilling that has occurred for each resource in the Delaware Basin over the past 100 years prior to the time at which a compliance application is prepared.

The DOE used the historical record of deep drilling for resources below 2,150 feet that has occurred over the past 100 years in the Delaware Basin. This was chosen because it is the depth of the repository, and the repository could not be directly breached by boreholes less than this depth. In the past 100 years, deep drilling occurred for oil, gas, potash, and sulfur. These drilling events were used in calculating a rate for deep drilling for the PA as discussed in CCA, Appendix DEL. The period of calculation used was from January 1896 through June 1995. Historical drilling for purposes other than resource exploration and recovery (such as WIPP site investigation) were excluded from the calculation in accordance with criteria provided in 40 CFR §194.33.

In the Delaware Basin, deep drilling events are usually associated with oil and gas drilling. Information obtained from commercial databases and state regulatory agencies is used to identify these events. The DBDSP collects data on drilled wells within the Delaware Basin, making no distinction between resources. One combined Microsoft® SQL Server® based well tracking application is maintained on hydrocarbon wells for Texas and New Mexico. As information on wells is acquired, it is entered into this well tracking application. The Texas portion of the well tracking application contains information only on the current status of the well, when it was drilled, its location, the name of the operator, and the total depth of the well. For the purpose of reporting the Texas portion is used only for calculating the drilling rate. The New Mexico portion contains the same basic information as Texas, along with the required features, events, and processes for PA-related drilling events identified in the Delaware Basin Drilling Surveillance Plan (NWP, 2017).

The DBDSP continues to monitor hydrocarbon drilling activity and any new potash, sulfur, water, or monitoring wells for deep-drilling events. Information from the drilling of these wells is added to the well tracking application maintained for these resources. During the last year, there were 3,512 new wells added to the well tracking application. Most of the completed wells were drilled for hydrocarbon extraction and were deep-drilling events. Two of these new wells are in the nine-township area immediately surrounding the WIPP site. Table 5 shows the number and type of deep wells located in the Delaware Basin.

2.4 Past Drilling Rates

The EPA provided a formula for calculating the current drilling rate or intrusion rate when 40 CFR Part 194 was promulgated. The formula is as follows:

$$\text{Deep Drilling Rate} = \frac{(\text{\# of deep boreholes}) \times 10{,}000\ \text{years}}{23{,}102.1\ \ \text{square kilometers (km}^2\text{)}} \times \frac{1}{100\ \text{years}}$$

The DBDSP uses any deep drilling events (except WIPP Project-related boreholes) to calculate the drilling or intrusion rate.

The annual (September 1 – August 31) drilling rates since the submittal of the CCA in 1996 are shown in Table 6. The large increase between 1996 and 1997 was the result of updating the databases with information from June 1995 through August 1997. Also, the 100-year period is considered a moving period; in which 100 years of data are used each time the calculation is performed. As each new year of data is added, the oldest year of data is dropped. For example, the drilling rate was calculated in 1999 by using the data from 1900 through 1999. In 2000, the data from 1901 through 2000 were used to calculate the drilling rate.

2.5 Current Drilling Rate

The calculated deep drilling rate for 2017 was derived from the information provided in Table 5. There were 21,582 boreholes deeper than 2,150 feet. Two wells were removed from the count because they were no longer within the 100-year interval. This brings the total deep well count to 21,580 boreholes for 2017. Applying the formula results in the following:

$$\text{Deep Drilling Rate} = \frac{(21{,}580\ \text{boreholes}) \times 10{,}000\ \text{years}}{23{,}102.1\ \text{km}^2} \times \frac{1}{100\ \text{years}}$$

This results in a deep drilling rate of 93.4 boreholes per km^2 over 10,000 years.

This is an increase from the 46.8 boreholes per km^2 reported in the CCA. The deep drilling rate is anticipated to rise for several more years before it begins to drop because the Delaware Basin is currently experiencing a period of increased drilling activity and because of the effect of the 100-year moving time frame used for drilling results. Currently a large number of wells are being added annually, while only a few are being removed due to the 100-year rolling time frame.

2.5.1 Nine-Township Area Drilling Activities

From September 1, 2016 to August 31, 2017, there were two new wells spudded in the nine-township area immediately surrounding the WIPP site. One well was drilled to the northeast, and one to the southeast of the WIPP site. Figure 3 shows the status of known hydrocarbon wells drilled within one mile of the WIPP site boundary. Both of the new wells spudded in the nine-township are in Lea County.

2.5.2 Drilling Activities Outside the Nine-Township Area

In the New Mexico portion of the Delaware Basin outside of the nine-township area, there were 154 new wells spudded during the reporting period of September 1, 2016 through August 31, 2017. Of the 154 wells, 101 are located in Eddy County and 53 are in Lea County.

In the Texas portion of the Delaware Basin, 1,153 new wells were spudded during the reporting period. The DBDSP monitors drilling activities in portions of seven counties and all of one county (Loving). The majority of the wells were drilled in Loving, Reeves, Ward, and Culberson counties.

2.6 Castile Brine Encounters

The WIPP PA included the assumption that a borehole results in the establishment of a flow path between the repository and a pressurized brine pocket that might be located beneath the repository in the Castile Formation. DBDSP records indicated that 27 out of 620 wells encountered pressurized brine in the Castile Formation; of these, 25 wells were hydrocarbon wells scattered over a wide area in the vicinity of the WIPP site. The remaining wells, ERDA 6 and WIPP 12, were drilled in support of WIPP site characterization.

The search of the records performed in 1999 looked for instances of pressurized brine. Although the search of the records noted a number of instances of encounters with sulfur water and brine water, only the original 27 were found to have been pressurized brine encounters in the Castile Formation.

The DBDSP researches the well records of new wells drilled in the New Mexico portion of the Delaware Basin each year by looking for instances of encounters with pressurized brine. As of this report, none of the records indicated encounters with pressurized brine during the drilling of new wells spudded in the New Mexico portion of the Delaware Basin between September 1, 2016 and August 31, 2017.

Seven wells drilled since the CCA have encountered Castile Brine. Six were identified when WIPP site personnel performing field work talked to area drillers and the information was documented in the DBWTA. The other encounter was reported by an operator in the Annual Survey of area drillers. The new encounters have been in areas where, because of historical Castile Brine encounter data (Powers, Sigda, and Holt 1996), Castile Brine is expected to be encountered during the drilling process. Table 7 shows known Castile Brine encounters in the vicinity of the WIPP site.

In the CCA, the probability for encountering a Castile Brine reservoir was calculated at 8 percent with 27 Castile Brine encounters out of 345 boreholes. In the Performance Assessment Verification Test (PAVT), the EPA mandated a range of 1 percent to 60 percent. These higher values did not influence the predicted performance of the repository. The CRA-2004 continued to use the higher values and a probability for encountering a Castile Brine reservoir was not calculated. The CRA-2009 uses the values from the PAVT. However, due to the increased drilling in the area it was necessary to verify that the original value was still valid. The same parameters were used and the rate was calculated at 5 percent with 34 Castile Brine encounters out of 678 boreholes. For 2017, the same parameters were used and the rate was calculated at 3.4 percent with 34 Castile Brine encounters out of 990 boreholes.

2.7 Borehole Permeability Assessment - Plugging Practices

The hydrocarbon well plugging assumptions used for the borehole permeability assessment remain valid. The regulations in place since the submittal of the CCA have not changed. The assessment will not change unless the regulations change to allow a different method of plugging. Regulations require the well to be plugged in a manner that will permanently confine oil, gas, and water in the separate strata in which they were originally found. These regulations require a notice of intent to plug from the operator to the regulating agency. This notice includes a diagram of the well bore and the placement of the plugs. A 24-hour notice to the NMOCD or to the Bureau of Land Management (BLM) is required before plugging may commence.

Approximately 1,019 wells in the vicinity of the WIPP site are in the KPLA. Under NMOCD R-111-P regulations, the operator is required to provide a solid cement plug through the salt section and any water-bearing horizon in addition to installing a bridge plug above the perforations. The above requirement provides protection to mineralized potash areas and workings by requiring a continuous plug so there is virtually no chance of flooding nearby mines throughout their development and operation.

In the New Mexico portion of the Delaware Basin, the DBDSP retrieves a copy of the plugging report from the NMOCD Internet site when a well has been plugged and abandoned. This information is added to the records maintained by the DBDSP on each well drilled within the Delaware Basin. By maintaining records in such a fashion, should the regulations change and the plugging methods differ from what is now occurring, a trend would be noticed and the borehole permeability assessment revisited. **Error! Reference source not found.** shows plugging information on the wells plugged and abandoned within the New Mexico portion of the Delaware Basin from September 1, 2016 to August 31, 2017.

The CCA, Appendix MASS, Attachment 16-1 (DOE, 1996), describes the development of a conceptual model for long-term performance of plugged boreholes. The study did not attempt to predict the effectiveness of plugs, but to identify the location and physical characteristics of plugs, which might be important to PA. Guidance in 40 CFR Part 194.33 states; "Performance assessments should assume that the permeability of sealed boreholes will be affected by natural processes, and should assume that the fraction of boreholes that will be sealed by man equals the fraction of boreholes which are currently sealed in the Delaware Basin." The criteria also state that "...drilling practices will remain as those of today." Only wells plugged in the New Mexico portion of the Delaware Basin and drilled after 1988, when the current plugging regulation went into effect, were used for the study. The results of this study indicated the PA should assume a 100 percent plugging frequency.

To determine the typical configuration and composition of a borehole plug, the study considered plugging practices to arrive at a model depicting six different types of plugging configurations (see Figure 4):

Type I — Plugs will be located at the transition between the surface and intermediate casings and the transition between the intermediate and production casings. This area is usually the top of the Salado Formation and the bottom of the Castile Formation, roughly 800 feet and 4,000 feet below the surface, respectively.

Type II — This plugging configuration has a portion of the production casing salvaged. Where the production casing was cut, a plug must be installed. If a plug occurs between 2,150 feet and 2,700 feet (above the hypothetical brine pocket) and the other plugs occur at the top of the Salado Formation and below the Castile Formation, it is considered a Type II configuration.

Type III — This configuration is the same as above except the removed production casing plug occurs above 2,150 feet.

Type IV — Extra plugs, in addition to those of Type II, have been emplaced above 2,150 feet.

Type V — The minimum regulatory requirements require a surface plug and a plug occurring at the bottom, provided no water-bearing zones were encountered. This type of plugging configuration is not common.

Type VI — This configuration has a solid cement plug through a significant portion of the salt section. This configuration, like the others, may have additional plugs above and below the salt-section plug.

There were 86 wells plugged during the reporting period. Twenty wells are in the nine-township area and 66 are outside the nine-township area. Thirteen of the 86 wells are in the KPLA. All 86 of the wells will be used in the permeability assessment update (see Table 8 and Table 9).

2.8 Seismic Activity in the Delaware Basin

Known seismic events occurring in southeast New Mexico and West Texas, specifically in the Delaware Basin, are recorded in the DBWTA. This information is obtained every quarter in a report from the New Mexico Institute of Mining and Technology (NMIMT), Socorro, New Mexico, utilizing data from an array of nine seismographs in the vicinity of the WIPP site (NMIMT 2017, NMIMT 2017a, NMIMT 2017b, NMIMT 2017c).

During the reporting period there were 19 seismic events recorded in the Delaware Basin. Seven seismic events occurred in Reeves County with magnitude range of 1.04 and 2.16. Three seismic events were recorded in Pecos County with magnitudes between 0.75 and 1.34. One seismic event was recorded in Loving with a magnitude of 0.77. Two seismic events were recorded in Jeff Davis County with magnitudes of 0.9 and 1.36. One seismic even was recorded in Ward County with a magnitude of 1.03. Three seismic events were recorded in Lea County with magnitudes from 1.12 to 1.25 and two seismic event were recorded in Eddy County with magnitudes of 0.53 and 0.7. Table 10 provides information on all recorded seismic events, which have occurred in the Delaware Basin.

2.9 Secondary and Tertiary Recovery

Secondary recovery is defined by the oil industry as the first improved recovery method of any type applied to a reservoir to produce oil not recoverable by primary recovery methods. Waterflooding is one such method. This method involves pumping water through the existing perforations in a well. As the water is pumped into a formation, it stimulates production of oil or gas in other nearby wells. This is a proven method of recovering hydrocarbons. Waterflooding has been a popular form of secondary recovery for over 40 years. Waterflooding can be accomplished by one injection well or several injection wells in the immediate vicinity of other producing wells.

In the New Mexico portion of the Delaware Basin, there are three major waterflood projects and several injection well operations. One of the major waterflood projects in the area is the El Mar, located in T26S-R32E, on the Texas border. At one time, this project had 31 permitted injection wells. Currently, there are three injection well actively injecting water. The remaining wells are shut-in, temporarily abandoned, or plugged and abandoned. The Paduca waterflood project, located in T25S-R32E, has three permitted injection wells but no wells are actively injecting water into the formation. The third major waterflood project in this area is the Indian Draw, located in T22S-R28E, has six permitted injection wells and is currently injecting into all of its permitted wells.

Tertiary recovery is defined by the oil industry as the use of any improved recovery method to remove additional oil after secondary recovery. At the time of this report, there are no known tertiary recovery projects being operated in the vicinity of the WIPP site, although several projects are being operated by oil companies in the Texas portion of the Delaware Basin using carbon dioxide (CO_2).

2.9.1 Nine-Township Injection Wells

Secondary recovery projects occurring in the nine-township area are on a small scale. There are seven injection wells located in the nine-township area surrounding the WIPP site. *ConocoPhillips Company* operates two injection wells northwest of the site in the Cabin Lake field. The other five injection wells are operated by *OXY USA INC* and are located south and east of the site. The six wells are injecting into the Brushy Canyon Formation of the Delaware Mountain Group at a depth of approximately 7,200 feet. Figure 5 shows a typical injection or salt water disposal well configuration. Table 11 provides information on the injection wells located in the nine-township area.

2.9.2 Nine-Township Salt Water Disposal Wells

The most common type of injection well is for the disposal of produced water coming from the producing formation in oil and gas wells. Figure 6 shows the location of active injection and salt water disposal wells in the nine-township area. Most active oil and gas wells produce brine water in addition to oil and gas. Salt Water Disposal (SWD) wells have become necessary as a result of the EPA's ruling that formation water may no longer be disposed of on the surface. The oil and gas producers now dispose of this water by injecting it into approved SWD wells.

There are currently 67 SWD wells located in the nine-township area surrounding the WIPP site. Three operators, *Devon Energy Production Company LP*, *OXY USA INC*, and *EOG Resources Inc.*, operate the majority of the SWD wells. Injection depths range from 3,400 feet to 18,000 feet. During the last year, based on injection records, the three companies operated within their maximum permitted injection pressure. The volume of disposed brine water depends on the number of producing oil and gas wells maintained by the operator in the immediate vicinity of the SWD well. Table 11 provides information on SWD and injection wells in the nine-township area.

2.10 Mining

Resources found in the Delaware Basin that can be mined are potash, sulfur, caliche, gypsum, and halite (NMBMMR 1995).

2.10.1 Potash Mining

Potash mining in the immediate vicinity of the WIPP site continues as reported since the CCA, Appendix DEL. Figure 7 shows the location and the extent of the potash mines in the vicinity of the WIPP site. There have been several changes to the companies that operate in the area, most notably; only two potash companies are actively mining. No plans have been promulgated by either company to sink new shafts or develop new mines.

In August 1996, *Mississippi Potash* (a subsidiary of *Mississippi Chemical Corporation*) purchased the assets of *New Mexico Potash Corporation* and *Eddy Potash, Inc*. These plants were renamed Mississippi East and Mississippi North, respectively. In early 2004, *Mississippi*

Potash sold its Carlsbad properties to *Intrepid Mining LLC*, a Denver based mining company. Recently the company changed the name to *Intrepid Potash – New Mexico, LLC.* The former *Eddy Potash, Inc.* mine (Mississippi North) has been shut down. In July 2016 *Intrepid Potash – New Mexico, LLC* idled their west location and transitioned it into "maintenance mode. In addition, they have relinquished their mineral easements below the Eddy-Lea County Consortium.

The other potash producer in the area is *The Mosaic Company*, formerly known as *IMC Kalium Potash*, which was a wholly-owned subsidiary of *IMC Global*. *Western Ag-Minerals* was purchased by *IMC Global* in September 1997. This acquisition doubled the potash reserves for *IMC Kalium*. *IMC Global* merged with *Freeport-McMoRan*, a major world potash producer, in December 1997 with *IMC Global* as the surviving entity in the transaction. In 2004, *IMC Global* and *Cargill, Inc.* merged to form *The Mosaic Company*.

2.10.2 Sulfur Extraction

The only sulfur mining activity within the Delaware Basin was conducted by *Freeport-McMoRan Sulphur, Inc.*, formerly operated by *Pennzoil Sulphur Company*. The mine is located in Culberson County, Texas. The mine recovered sulfur utilizing the Frasch process, which consists of a hole drilled into the sulfur bearing formation and then cased. The next step involves the placement of three concentric pipes within the protective casing to facilitate pumping superheated water down the hole, melting the sulfur, then using compressed air to lift the molten sulfur to the surface. The mine was operated until it permanently ceased production on June 30, 1999. Abandonment and salvage operations continued until early summer of 2000.

2.10.3 Solution Mining

Solution mining is the process by which water is injected into a mineral formation, circulated to dissolve the mineral, with the solution then pumped back to the surface where the minerals are removed from the water, by evaporation. There are several brine mines or wells in the area, two in New Mexico and ten in Texas (see Figure 8), that use this process to provide a brine solution for area drilling operators to use in the drilling process. These are shallow wells using injected fresh water to dissolve salt into a brine solution.

Brine wells are classified as Class II injection wells. In the Delaware Basin, the process involves injecting fresh water into a salt formation to create a saturated brine solution, which is then extracted and used as a drilling agent when drilling a new well. These wells are tracked by the DBDSP.

Table 13 provides the status of brine wells in the Delaware Basin.

A moratorium on new brine wells was enacted by the NMOCD in mid-November 2008 due to the collapse of two brine wells in the vicinity of Loco Hills, New Mexico, neither of which is located in the Delaware Basin. One well was in an isolated area and was actively producing brine for sale. This well collapsed in July 2008. The second well that collapsed was located just outside of Loco Hills and was plugged and abandoned. This well collapsed in early November 2008.

One brine well, Eugenie #1, is closely being monitored by the NMOCD as it fits the geological profile of the two collapsed wells. This well is located within the Carlsbad city limits and is within the New Mexico portion of the Delaware Basin. It was voluntarily plugged and abandoned by the operator in October 2008.

In early 1997, *Mississippi Potash, Inc.* proposed to set up a pilot potash solution mining project at the former *Eddy Potash, Inc.* mine located north of the WIPP site and outside of the Delaware Basin In March 2002, *Mississippi Potash, Inc.* applied for a permit to operate a pilot in-situ potash solution mining project. In May 2002, the project was given approval to proceed by the BLM. *Intrepid Potash*, formerly *Mississippi Potash, Inc.*, has continued with the project by developing a required EIS, which was approved by the BLM on March 19, 2012. The in-situ solution mining project is currently extracting potash enriched brine from the former *Eddy Potash, Inc.* mine and evaporating the brine in surface ponds. After evaporation of potash enriched brine occurs, the ponds will be ready for potash production.

In the late 1960s, *Conoco Minerals* installed a pilot solution mining project on leases it held on the former *AMAX* property north of the Delaware Basin and the WIPP site. The project was designed to test solution mining of potassium minerals and consisted of one injection well and three withdrawal wells, but the potash ore zone was deemed too thin to make this method viable at this location.

2.11 New Drilling Technology

New drilling methods are researched by the DBDSP for impacts to the drilling methods currently used in the area. A technique recently employed in the Delaware Basin is zipper fracturing. Zipper fracturing involves simultaneous stimulation of two parallel horizontal wells. The fractures are off-set such that that if one were to view a cross section of them they would appear like a zipper. The purpose of this technique is to create a more extensive fracture network.

2.12 Alternative Energy Activities

The DBDSP researches alternative energy activities that may have impact on PA. Alternative energy activities that may be conducted in the Delaware Basin include solar, wind, and geothermal power. Currently there are no known geothermal power projects being performed in the Delaware Basin. Solar power is currently being pursued in the Delaware Basin. *Sun Edison* completed construction of a photovoltaic solar power plant on the southern edge of the Carlsbad city limits, which is located within the Delaware Basin. Wind power is a proven technology and has been ongoing in the Delaware Basin since 1995. Two wind farms operated by *FPL Energy* are located in the western mountains of the Delaware Basin. One farm operates approximately 140 turbines and the second one has 40 turbines. Both are located adjacent to each other approximately 10 miles south of the Guadalupe Mountains National Park and 75 miles southwest of the WIPP site. The DBDSP continues to identify and document alternative energy activities.

3.0 Survey of Well Operators for Drilling Information

The DBDSP surveys local well operators annually to acquire information on drilling practices normally not available on the Sundry notices supplied to the local state and federal offices by the operator or through commercial sources maintained by the DBDSP. Participation in the survey is voluntary. This survey requests information on other items of interest to the WIPP Project such as hydrogen sulfide (H_2S) encounters, Castile Brine encounters, or whether any section of the well was drilled with air. The DBDSP personnel review the records on new wells drilled to look for the above data. The survey provides an additional source of information on drilling activities in the New Mexico portion of the Delaware Basin. The DBDSP submits the survey annually. The most recent responses the DBDSP has received were from 2016. No changes were made as a result of those responses.

4.0 Summary - 2017 Delaware Basin Drilling Surveillance Program

- No new instances of air drilling.
- No Castile Brine encounters reported.
- The drilling rate increased to 93.4 boreholes per square kilometer from 88.4 boreholes per square kilometer reported in the 2016 annual report (DOE 2016).
- Four new SWD wells were completed in the nine-township area compared to no SWD wells reported in the 2016 annual report (DOE 2016).
- Two wells were spudded in the nine-township area compared to six wells in the 2016 annual report (DOE 2016).
- One hundred fifty-four wells were spudded outside the nine-township area in New Mexico compared to 98 wells in the 2016 annual report (DOE 2016).
- In the Texas portion of the Delaware Basin 1,153 wells were spudded compared to 591 wells in the 2016 annual report (DOE 2016).

5.0 References

Kirkes, G. Ross. 1998. *Current Drilling Practices Near WIPP*. EPA Air Docket No. A-93-02, IV-G-7, January 22, 1998.

New Mexico Bureau of Mines and Mineral Resources (NMBMMR). 1995. *Evaluation of Mineral Resources at the Waste Isolation Pilot Plant*. Final Report, Vols. I-IV.

New Mexico Institute of Mining and Technology (NMIMT). 2017. *A Report on the Seismicity of the WIPP Site for the Period July 1, 2015 through September 30, 2015*. Socorro, New Mexico.

New Mexico Institute of Mining and Technology (NMIMT). 2017a. *A Report on the Seismicity of the WIPP Site for the Period October 1, 2015 through December 31, 2015*. Socorro, New Mexico.

New Mexico Institute of Mining and Technology (NMIMT). 2017b. *A Report on the Seismicity of the WIPP Site for the Period January 1, 2016 through March 31, 2016*. Socorro, New Mexico.

New Mexico Institute of Mining and Technology (NMIMT). 2017c. *A Report on the Seismicity of the WIPP Site for the Period April 1, 2016 through June 30, 2016*. Socorro, New Mexico.

Nuclear Waste Partnership LLC. 2014. *Delaware Basin Drilling Surveillance Plan, Rev. 7.* December 2014. WP 02-PC.02. Carlsbad, NM: Carlsbad Field Office.

Powers, D.W., J.M. Sigda, and R.M. Holt. 1996. *Probability of Intercepting a Pressurized Brine Reservoir Under the WIPP*. July 10, 1996. Albuquerque, NM: Sandia National Laboratories.

U.S. Department of Energy (DOE). 1996. *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant*. October 1996. DOE/CAO-1996-2184. Carlsbad, NM: Carlsbad Area Office.

U.S. Department of Energy (DOE). 2004. *Title 40 CFR Part 191 Compliance Recertification Application for the Waste Isolation Pilot Plant*. March 2004. DOE/WIPP 2004-3231. Carlsbad, NM: Carlsbad Field Office.

U.S. Department of Energy (DOE). 2009. *Title 40 CFR Part 191 Compliance Recertification Application for the Waste Isolation Pilot Plant*. March 2009. DOE/WIPP 2009-3424. Carlsbad, NM: Carlsbad Field Office.

U.S. Department of Energy (DOE). 2016. *Delaware Basin Monitoring Annual Report*. September 2016. DOE/WIPP-16-2308. Carlsbad, NM: Carlsbad Field Office.

U.S. Department of Energy (DOE). 2014. *Title 40 CFR Part 191 Compliance Recertification Application for the Waste Isolation Pilot Plant (March)*. DOE/WIPP-14-3503. Carlsbad, NM: Carlsbad Field Office.

U.S. Environmental Protection Agency (EPA). 1993. "Title 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule." *Federal Register*, vol. 58 (Dec. 20, 1993): 66398-416.

U.S. Environmental Protection Agency (EPA). 1996. "Title 40 CFR Part 194, Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations; Final Rule." *Federal Register*, vol. 61 (February 9,1996): 5223–45.

U.S. Environmental Protection Agency (EPA). 1998a. "Title 40 CFR Part 194, Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision; Final Rule." *Federal Register*, vol. 63 (May 18,1998): 27353–406.

U.S. Environmental Protection Agency (EPA). 1998b. "CARD No. 33: Consideration of Drilling Events in Performance Assessments." *Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR 191 Disposal Regulations: Final Certification Decision*. May 1998. Washington, DC: Office of Radiation and Indoor Air.

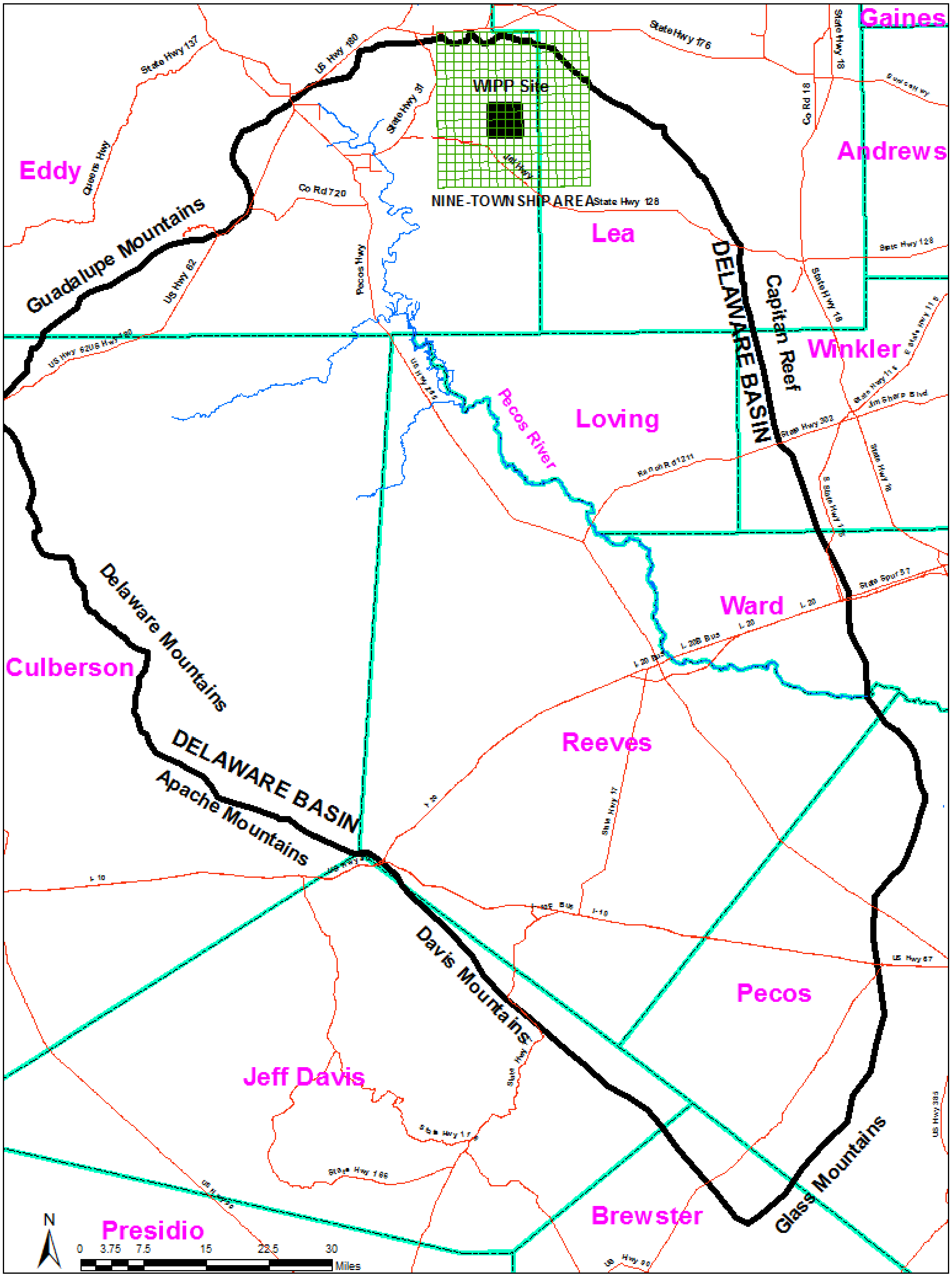


Figure 1: WIPP Site, Delaware Basin, and Surrounding Area

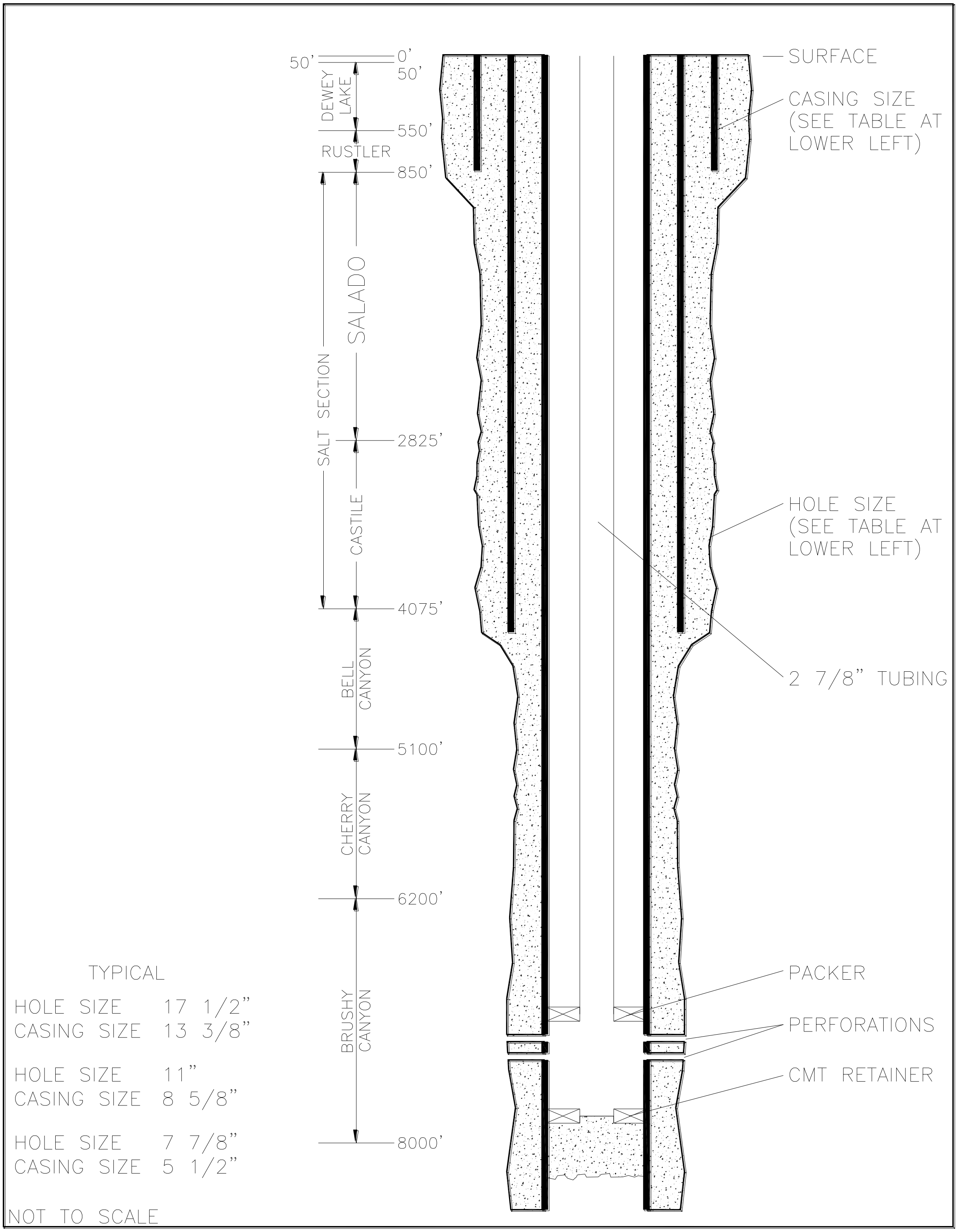


Figure 2: Typical Well Structure and General Stratigraphy Near the WIPP Site

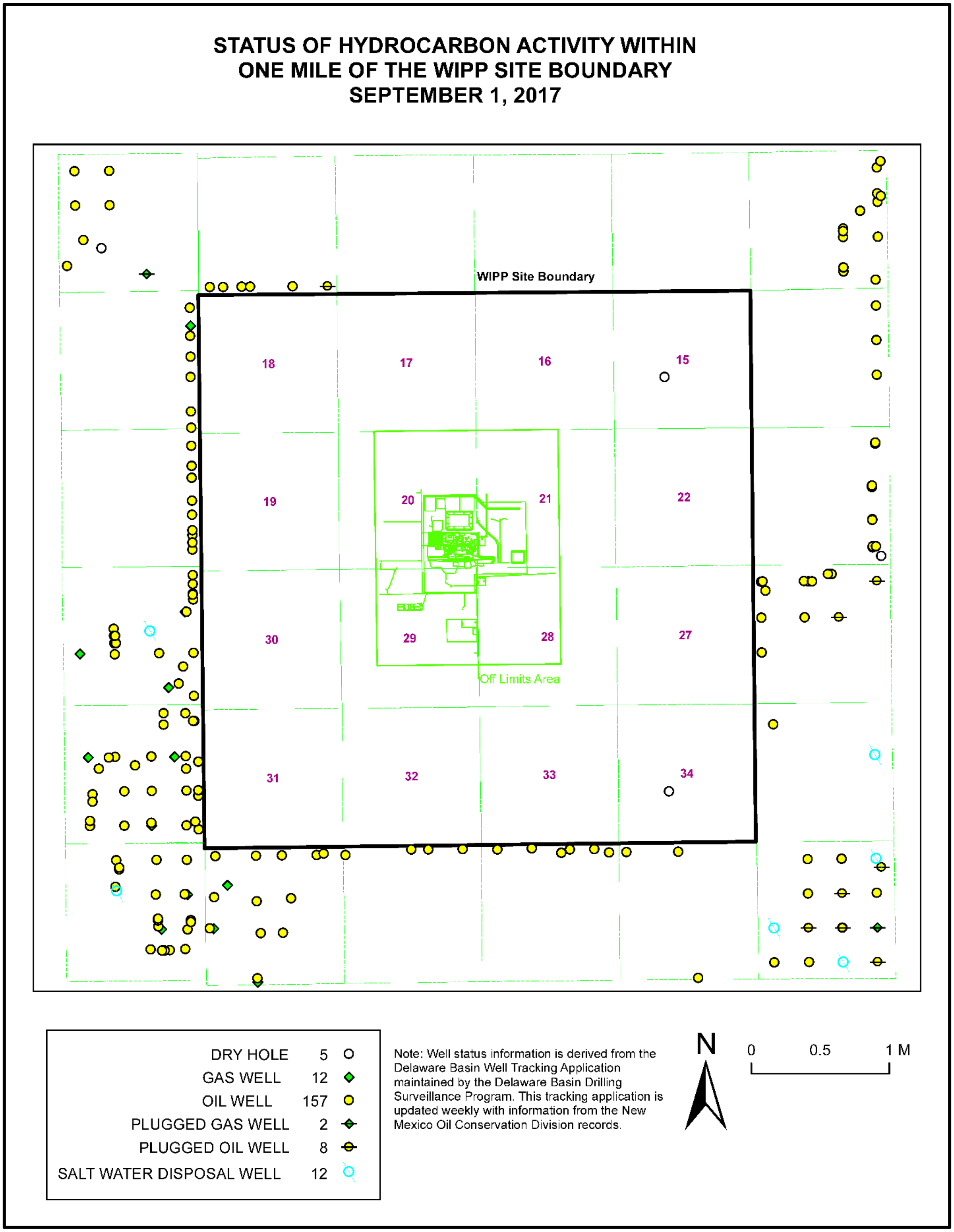


Figure 3: Oil and Gas Wells within One Mile of the WIPP Site

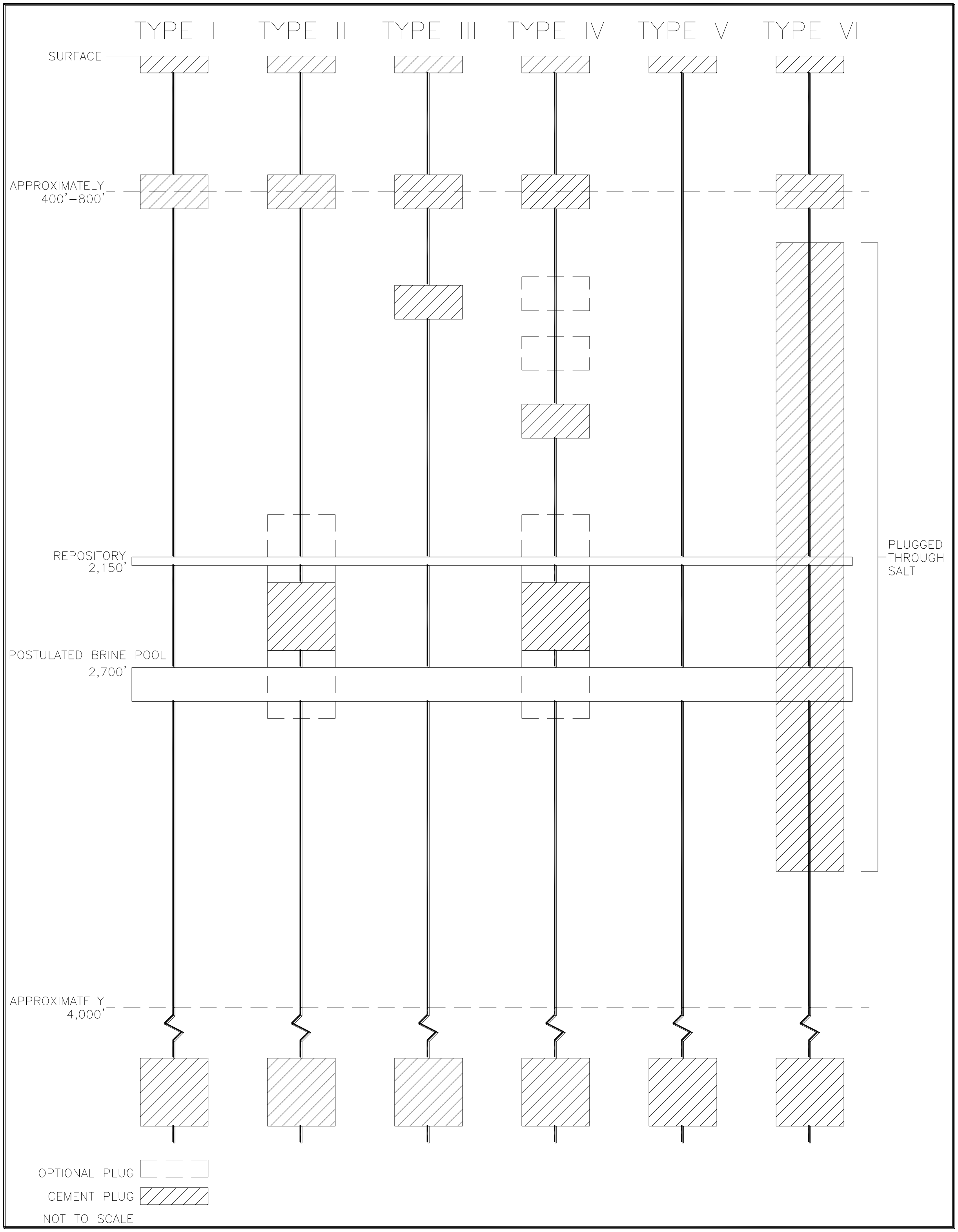


Figure 4: Typical Borehole Plug Configurations in the Delaware Basin

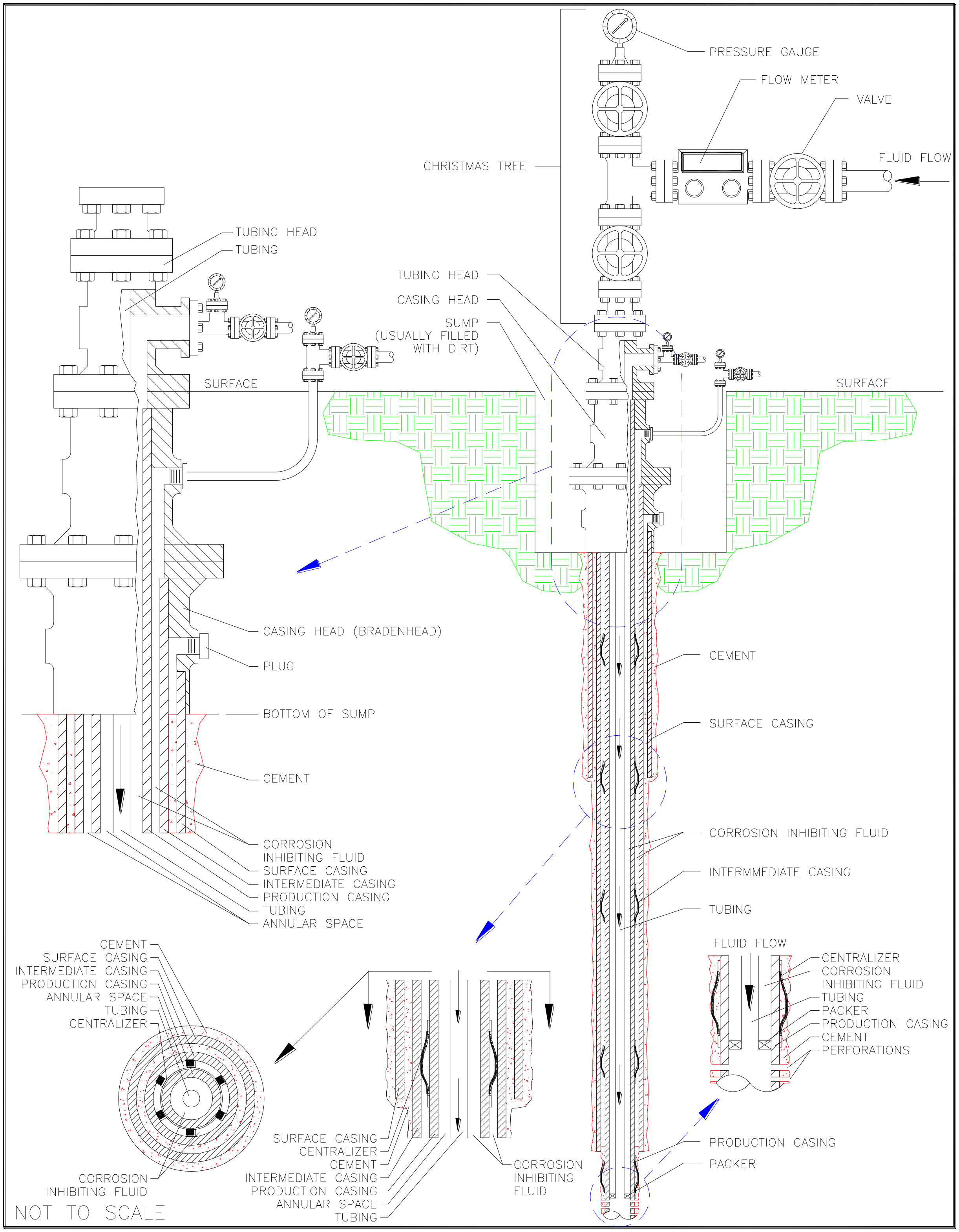


Figure 5: Typical Injection or SWD Well

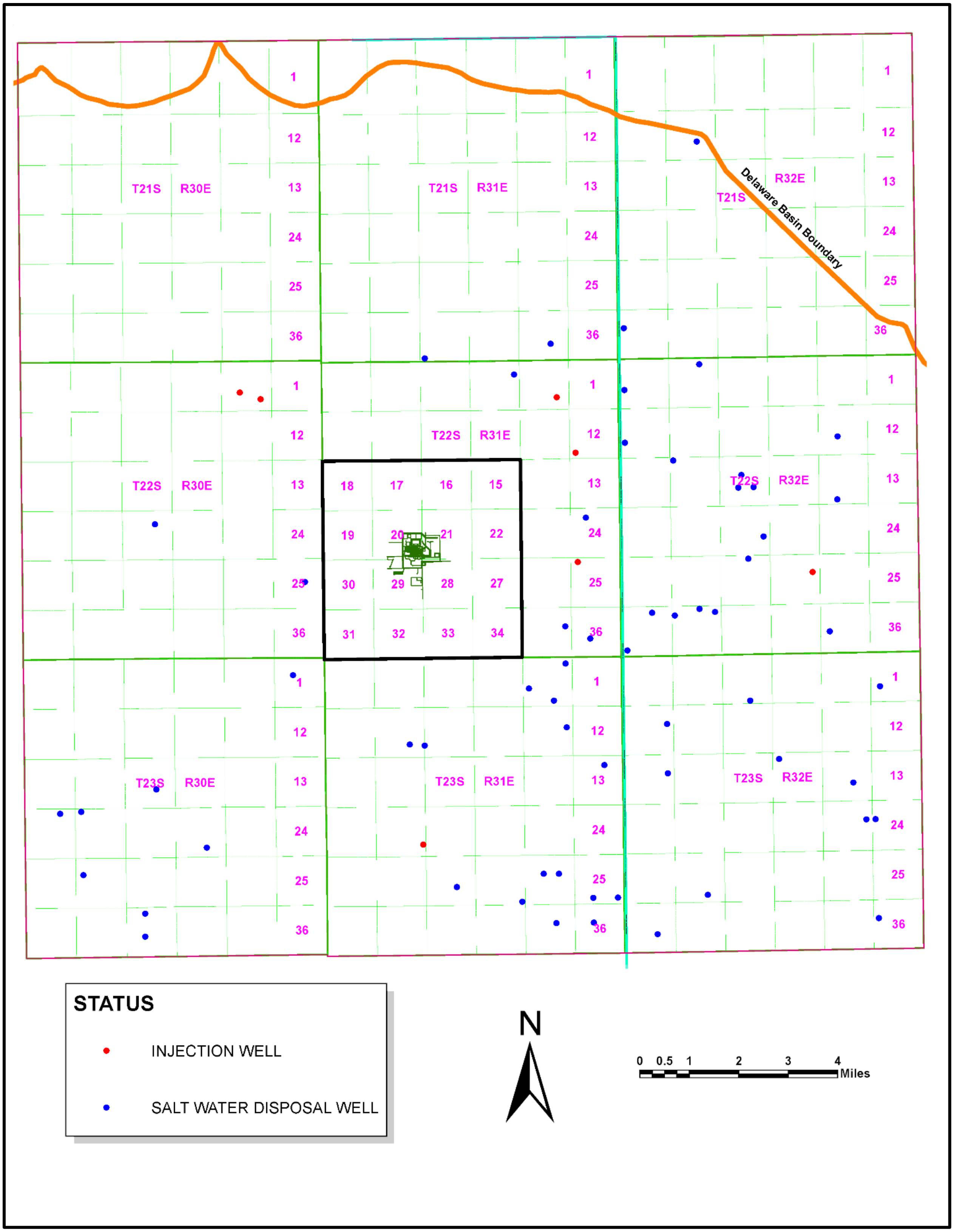


Figure 6: Active Injection and SWD Wells in the Nine-Township Area

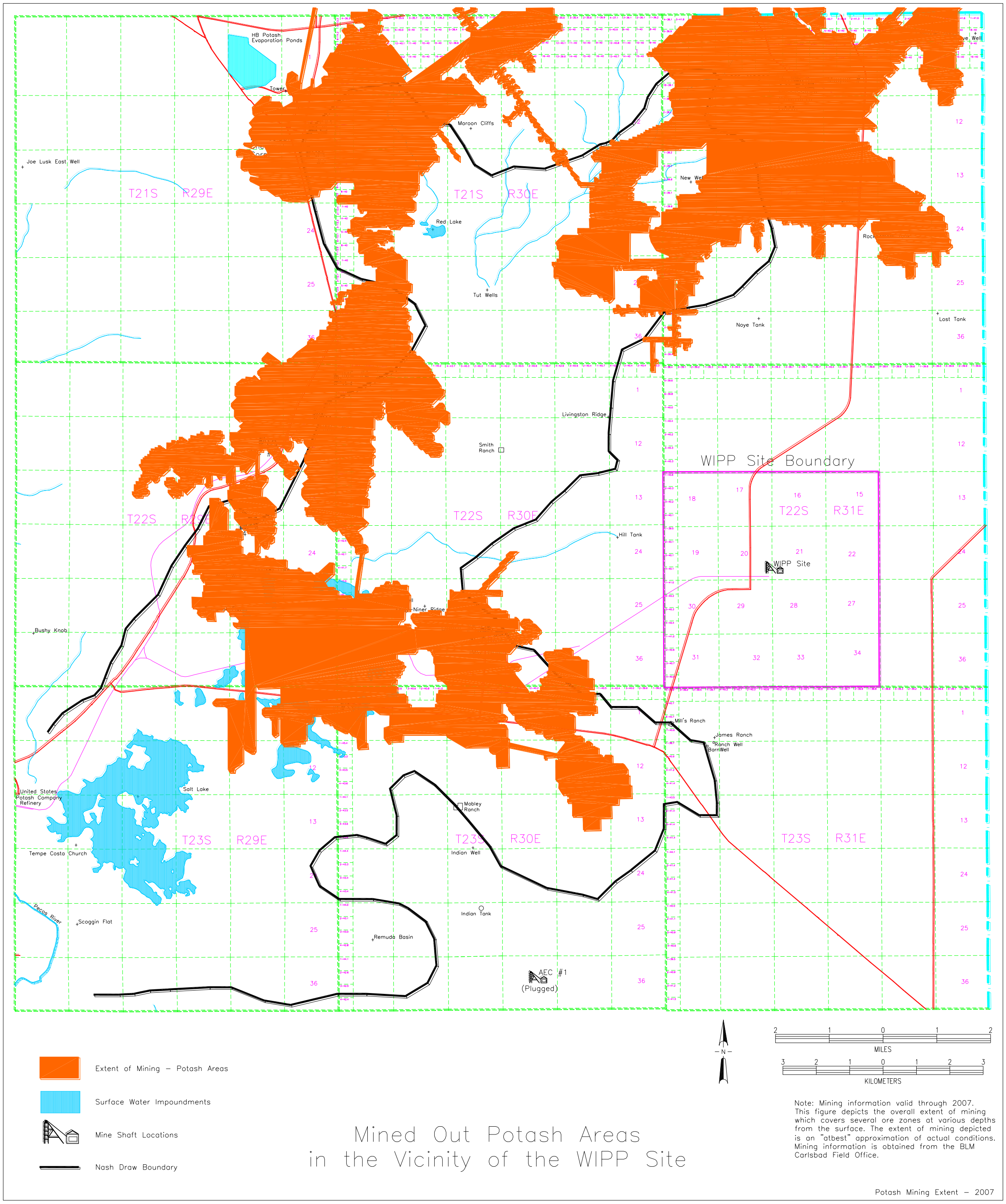


Figure 7: Potash Mining in the Vicinity of the WIPP Site

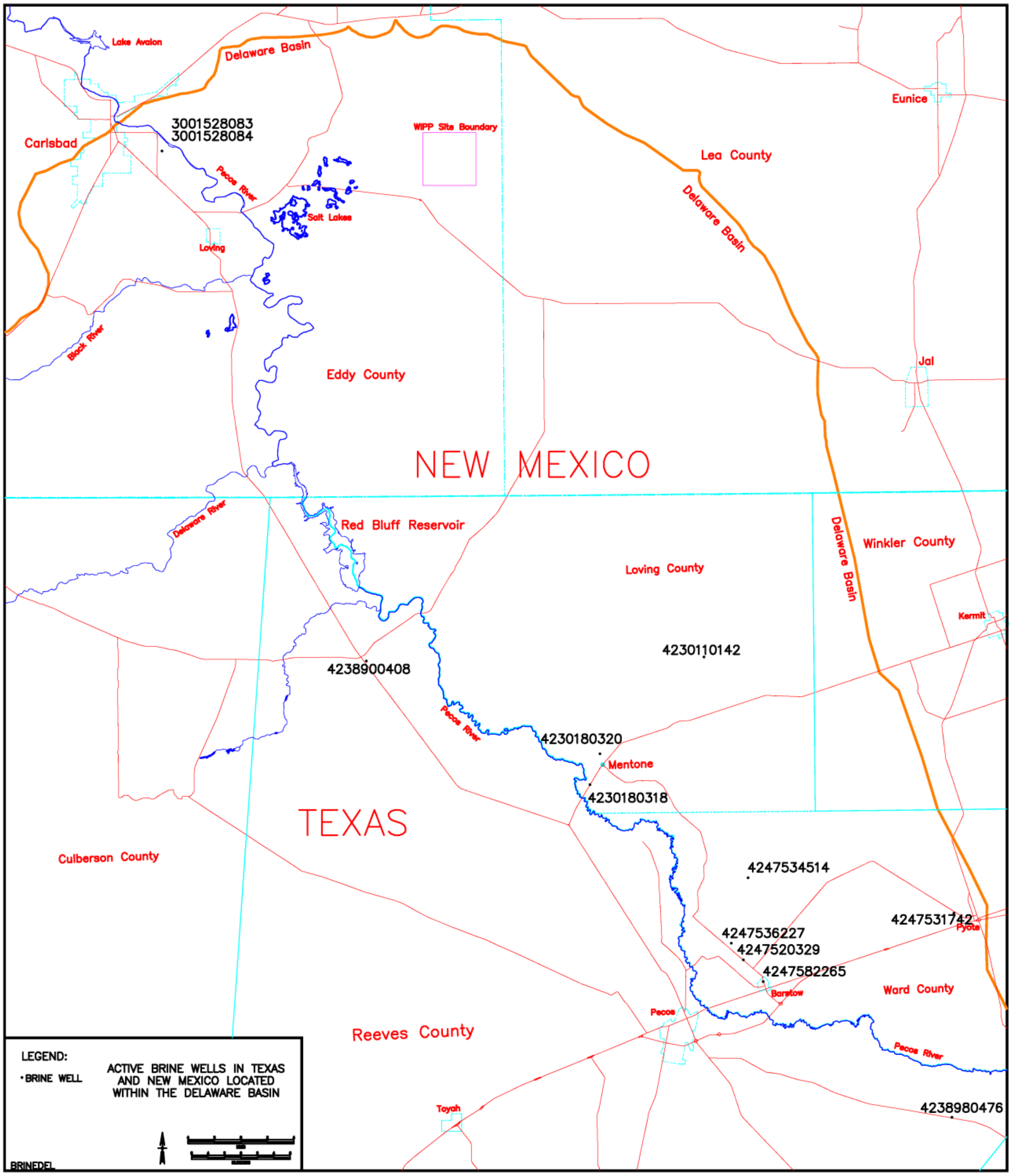


Figure 8: Active Brine Well Locations in the Delaware Basin

Table 1: Nine-Township Area Casing Sizes

Casing Size (Inches)	Surface Casing	Intermediate Casing	Production Casing
16	0	0	0
13 3/8	2	0	0
11 3/4	0	0	0
10 3/4	0	0	0
9 5/8	0	2	0
8 5/8	0	0	0
7 5/8	0	0	0
7	0	0	1
5 1/2	0	0	1

NOTE: There were 2 wells drilled in the nine-township area between September 1, 2016 and August 31, 2017. All of the wells had complete records available on casing sizes.

Table 2: Nine-Township Area Bit Sizes

Bit Size (Inches)	Surface Hole	Intermediate Hole	Production Hole
20	0	0	0
17 1/2	2	0	0
16	0	0	0
14 3/4	0	0	0
12 3/4	0	0	0
12 1/4	0	2	0
11	0	0	0
10 5/8	0	0	0
9 7/8	0	0	0
8 3/4	0	0	1
8 1/2	0	0	1
7 7/8	0	0	0
7 3/4	0	0	0
7	0	0	0
6 1/8	0	0	0

NOTE: There were 2 wells drilled in the nine-township area between September 1, 2016 and August 31, 2017. All of the wells had complete records available on bit sizes.

Table 3: Air-Drilled Wells in the New Mexico Portion of the Delaware Basin

#	Location	Well Name and No.	Spud Date	Status	Well Information
1	21S-28E-33	Richardson & Bass #1	7/27/1961	P&A	Air drilled through the salt. Between 2,545 ft. and 2,685 ft. encountered water and changed from air to mud-based drilling.
2	21S-32E-26	Lincoln Federal Unit #1	4/1/1991	P&A	Lost circulation at 1,290 ft. Hole was dry drilled to 1,792 ft. Supposedly, air drilled from 2,984 ft. to 4,725 ft.
3	23S-26E-17	Exxon "17" Federal #1	8/1/1989	Gas Well	Air drilled through the salt from 575 ft. to 2,707 ft.
4	23S-28E-11	CP Pardue #1	10/28/1958	P&A	Air drilled through the salt from 390 ft. to 2,620 ft.
5	23S-28E-11	Amoco Federal #1	8/4/1979	Oil Well	Air drilled from 475 ft. to 9,700 ft.
6	23S-28E-11	Amoco Federal #3	2/28/1980	Oil Well	Air drilled from 6,271 ft. to 9,692 ft.
7	23S-28E-23	South Culebra Bluff Unit #3	1/21/1979	Oil Well	Air drilled from 6,345 ft. to 8,000 ft.
8	23S-28E-23	South Culebra Bluff Unit #4	8/9/1979	Oil Well	Air drilled from 450 ft. to 9,802 ft.
9	24S-31E-03	Lilly "ALY" Federal #2	5/1/1994	Oil Well	Air drilled conductor hole to 40 ft.
10	24S-31E-03	Lilly "ALY" Federal #4	5/16/1994	Oil Well	Air drilled conductor hole to 40 ft.
11	24S-34E-04	Antelope Ridge Unit #2	9/13/1962	Gas Well	Attempted to drill with gas. Had to convert to water at 1,035 ft. Tried again several times at different depths.
12	24S-34E-09	Federal "9" Com #1	12/3/1963	Gas Well	Hit water while gas drilling at 4,865 ft.
13	24S-34E-13	Federal Johnson #1	6/23/1958	P&A	Proposed to drill with air, but no information in the records indicate air drilling.
14	26S-32E-20	Russell Federal #1	3/16/1966	Oil Well	Drilled with air to 1,330 ft.
15	26S-32E-36	North El Mar Unit #44	2/19/1959	Oil Well	Proposed to drill with air, but no information in the records indicate air drilling.
Wells Drilled after Supplemental Information Provided to the EPA Docket in 1997.					
16	22S-26E-28	Sheep Draw "28" Federal #13	7/1/1997	Oil Well	Air drilled the first 358 ft.

Table 4: Shallow Well Status in the Delaware Basin

Well Type	Texas	New Mexico	Totals
Core Hole	31	2	33
Dry Hole	348	159	507
Gas Well	1	0	1
Injection Well	1	0	1
Junked and Abandoned Well	63	31	94
Oil Well	102	5	107
Oil and Gas Well	4	0	4
Plugged Gas Well	1	5	6
Plugged Oil Well	21	29	50
Plugged Oil and Gas Well	1	3	4
Plugged Brine Well	2	3	5
Plugged Salt Water Disposal Well	0	5	5
Drilling or Waiting on Paperwork	0	3,057	3,057
Brine Well	1	2	3
Salt Water Disposal Well	0	1	1
Service Well	11	0	11
Stratigraphic Test Hole	1,170	0	1,170
Sulfur Core Hole	502	0	502
Potash Core Hole	0	1,791	1,791
Water Well	1,706	1,244	2,950
WIPP Well	0	211	211
Other (Mine Shafts, Gnome Project Wells)	0	31	31
TOTALS	3,965	6,579	10,544

NOTE: Only the known holes that occur in the Delaware Basin are listed in the above table. The 3,057 wells under the "Drilling or Waiting on Paperwork" category do not have an associated depth until one has been reported on paperwork. These are listed as shallow wells but may eventually be placed in the deep classification when a depth has been listed in the paperwork.

Table 5: Deep Well Status in the Delaware Basin

Well Type	Texas	New Mexico	Totals
Core Hole	5	0	5
Dry Hole	2,180	813	2,993
Gas Well	1,706	978	2,684
Injection Well	371	49	420
Junked and Abandoned Well	55	18	73
Oil Well	7,542	4,137	11,679
Oil and Gas Well	279	11	290
Plugged Gas Well	314	255	569
Plugged Injection Well	88	68	156
Plugged Oil Well	1,084	695	1,779
Plugged Oil and Gas Well	54	0	54
Plugged Brine Well	2	1	2
Plugged Salt Water Disposal Well	5	59	64
Plugged Service Well	6	1	7
Drilling or Waiting on Paperwork	13	0	13
Brine Well	8	0	9
Salt Water Disposal Well	233	238	471
Service Well	61	0	61
Stratigraphic Test Hole	44	2	46
Sulfur Core Hole	85	0	85
Potash Core Hole	0	111	111
WIPP Well	0	11	11
Other (Mine Shafts, Gnome Project Wells)	0	0	0
TOTALS	14,135	7,447	21,582

NOTE: The 13 wells under the "Drilling or Waiting on Paperwork" category have a depth associated with them which classifies them as deep wells, but the paperwork classifying these wells as oil, gas, or some other type of well have yet to be posted. When posted, the classification of these types of wells will be changed.

Table 6: Drilling Rates for the Delaware Basin

Reporting Period September 1 – August 31	Number of Deep Boreholes	Drilling Rate Boreholes/km^2
1996	10,804 Boreholes Deeper Than 2,150 ft.	46.8
1997	11,444 Boreholes Deeper Than 2,150 ft.	49.5
1998	11,616 Boreholes Deeper Than 2,150 ft.	50.3
1999	11,684 Boreholes Deeper Than 2,150 ft.	50.6
2000	11,828 Boreholes Deeper Than 2,150 ft.	51.2
2001	12,056 Boreholes Deeper Than 2,150 ft.	52.2
2002[1]	12,139 Boreholes Deeper Than 2,150 ft.	52.5
2003	12,316 Boreholes Deeper Than 2,150 ft.	53.3
2004	12,531 Boreholes Deeper Than 2,150 ft.	54.2
2005	12,819 Boreholes Deeper Than 2,150 ft.	55.5
2006	13,171 Boreholes Deeper Than 2,150 ft.	57.0
2007	13,520 Boreholes Deeper Than 2,150 ft.	58.5
2008	13,824 Boreholes Deeper Than 2,150 ft.	59.8
2009	14,173 Boreholes Deeper Than 2,150 ft.	61.3
2010	14,403 Boreholes Deeper Than 2,150 ft.	62.3
2011	14,816 Boreholes Deeper Than 2,150 ft.	64.1
2012	15,558 Boreholes Deeper Than 2,150 ft.	67.3
2013	16,633 Boreholes Deeper Than 2,150 ft.	72.0
2014	17,937 Boreholes Deeper Than 2,150 ft.	77.6
2015	19,313 Boreholes Deeper Than 2,150 ft.	83.6
2016	20,425 Boreholes Deeper Than 2,150 ft.	88.4
Current	21,580 Boreholes Deeper Than 2,150 ft.	93.4

NOTE: The notable increase in the drilling rate between 1996 and 1997 was not due to the drilling of wells, but to the fact that the Delaware Basin Drilling Surveillance Program did not begin until 1997 when a review of the records from July 1995 through 1997 was necessary to bring the databases up to date.

[1] In Rev. 3 of this report dated September 2002, the drilling rate for 2002 was shown as 52.9 with 12,219 deep holes. While reviewing the databases to develop reports for the Compliance Recertification Application, it was noticed that 80 shallow wells in Texas were listed as being deep. The classification of the 80 holes to shallow resulted in a reduction in the drilling rate from 52.9 to 52.5. This was reported in December 2002.

Table 7: Castile Brine Encounters in the Vicinity of the WIPP Site

#	Location	Well Name and No.	Spud Date	Status	Well Information
Original CCA-related Castile Brine Encounters - 1896 Through June 1995					
1	21S-31E-26	Federal #1	10/31/1979	P&A	Identified as encountering Castile Brine.
2	21S-31E-35	ERDA-6	6/13/1975	P&A	Identified as encountering Castile Brine.
3	21S-31E-35	Federal "FT" #1	9/25/1981	P&A	Identified as encountering Castile Brine.
4	21S-31E-36	Lost Tank "AIS" State #1	12/7/1991	Oil Well	Identified as encountering Castile Brine.
5	21S-31E-36	Lost Tank "AIS" State #4	11/19/1991	Oil Well	Identified as encountering Castile Brine.
6	21S-32E-31	Lost Tank SWD #1	11/12/1991	SWD	Identified as encountering Castile Brine.
7	22S-29E-09	Danford Permit #1	5/18/1937	P&A	Identified as encountering Castile Brine.
8	22S-31E-01	Unocal "AHU" Federal #1	4/2/1991	Oil Well	Identified as encountering Castile Brine.
9	22S-31E-01	Molly State #1	9/25/1991	Oil Well	Identified as encountering Castile Brine.
10	22S-31E-01	Molly State #3	10/20/1991	Oil Well	Identified as encountering Castile Brine.
11	22S-31E-02	State "2" #3	11/28/1991	Oil Well	Identified as encountering Castile Brine.
12	22S-31E-11	Martha "AIK" Federal #3	5/6/1991	Oil Well	Identified as encountering Castile Brine.
13	22S-31E-11	Martha "AIK" Federal #4	9/2/1991	Oil Well	Identified as encountering Castile Brine.
14	22S-31E-12	Federal "12" #8	3/28/1992	Oil Well	Identified as encountering Castile Brine.
15	22S-31E-13	Neff "13" Federal #5	2/4/1991	Oil Well	Identified as encountering Castile Brine.
16	22S-31E-17	WIPP-12	11/17/1978	Monitoring	Identified as encountering Castile Brine.
17	22S-32E-05	Bilbrey "5" Federal #1	11/26/1981	Oil Well	Identified as encountering Castile Brine.
18	22S-32E-15	Lechuza Federal #4	12/29/1992	Oil Well	Identified as encountering Castile Brine.
19	22S-32E-16	Kiwi "AKX" State #1	4/28/1992	Oil Well	Identified as encountering Castile Brine.
20	22S-32E-25	Covington "A" Federal #1	2/7/1975	Oil Well	Identified as encountering Castile Brine.
21	22S-32E-26	Culberson #1	12/15/1944	P&A	Identified as encountering Castile Brine.
22	22S-32E-34	Red Tank "34" Federal #1	9/23/1992	Oil Well	Identified as encountering Castile Brine.
23	22S-32E-36	Richardson State #1	7/20/1962	P&A	Identified as encountering Castile Brine.
24	22S-32E-36	Shell State #1	2/22/1964	Oil Well	Identified as encountering Castile Brine.
25	22S-33E-20	Cloyd Permit #1	9/7/1937	P&A	Identified as encountering Castile Brine.

#	Location	Well Name and No.	Spud Date	Status	Well Information
26	22S-33E-20	Cloyd Permit #2	6/22/1938	P&A	Identified as encountering Castile Brine.
27	23S-30E-01	Hudson Federal #1	2/25/1974	SWD	Identified as encountering Castile Brine.
			Castile Brine Encounters Since July 1995		
1	21S-31E-35	Lost Tank "35" State #4	09/11/2000	Oil Well	Estimated several hundred barrels per hour. Continued drilling.
2	21S-31E-35	Lost Tank "35" State #16	2/6/2002	Oil Well	At 2,705 ft., encountered 1,000 barrels per hour. Shut-in to get room in reserve pit with pressure of 180 psi and water flow of 450 B/H. Two days later no water flow and full returns.
3	22S-31E-02	Graham "AKB" State #8	4/12/2002	Oil Well	Estimated 105 barrels per hour. Continued drilling
4	23S-30E-01	James Ranch Unit #63	12/23/1999	Oil Well	Sulfur water encountered at 2,900 ft. 35 ppm was reported but quickly dissipated to 3 ppm in a matter of minutes. Continued drilling.
5	23S-30E-01	Hudson "1" Federal #7	1/6/2001	Oil Well	Estimated initial flow at 400 to 500 barrels per hour with a total volume of 600 to 800 barrels. Continued drilling.
6	22S-30E-13	Apache "13" Federal "3	11/26/2003	Oil Well	Encountered strong water flow with blowing air at 2,850-3,315 ft. No impact on drilling process.
7	21S-31E-34	Jacque "AQJ" State #7	3/4/2005	Oil Well	Encountered water flow of 104 barrel per hour at 2,900 ft. No impact on drilling process.

Table 8

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
1	21S-31E-34	30-015-32000	4/19/17	Yes	8322	CIBP 6776 4135 – 800 50 – 0	35 ft. 3335 ft. 50 ft.
2	21S-31E-34	30-015-31792	12/8/16	Yes	8200	CIBP 6692 – 6521 4182 – 4056 903 – 725 60 – 0	171 ft. 126 ft. 178 ft. 60 ft.
3	21S-31E-36	30-015-26751	4/3/17	Yes	8610	CIBP 7010 – 6782 5502 – 5214 4542 – 0	228 ft. 288 ft. 4542 ft.
4	21S-31E-36	30-015-32527	12/8/16	Yes	8500	CIBP 6784 – 6475 5576 – 4032 972 – 641 60 – 0	309 ft. 1544 ft. 331 ft. 60 ft.
5	21S-32E-27	30-025-31095	6/8/17	Yes	14715	9382 – 9262 8732 – 8570 8550 – 8294 5460 – 5260 4786 – 3765 3740 – 2525 2505 – 1308 715 – 0	120 ft. 162 ft. 256 ft. 200 ft. 1021 ft. 1215 ft. 1197 ft. 715 ft.
6	21S-33E-28	30-025-41107	9/28/16	No	95	12 – 0	12 ft.
7	22S-26E-28	30-015-27688	4/28/17	No	4975	CIBP 4173 – 3926 3300 – 3045 CIBP 2500 – 2384 1547 – 1286 400 – 0	247 ft. 255 ft. 116 ft. 261 ft. 400 ft.
8	22S-26E-28	30-015-29532	4/18/17	No	4950	CIBP 2500 – 2288 1700 – 1484 400 – 0	212 ft. 216 ft. 400 ft.
9	22S-26E-29	30-015-28848	4/13/17	No	4500	CIBP 2450 2450 – 2190 1775 – 1376 400 – 0	35 ft. 260 ft. 399 ft. 400 ft.
10	22S-26E-29	30-015-29232	4/11/17	No	4857	CIBP @ 2758 – 2596 2420-2255 1775-1284 400-0	162 ft. 165 ft. 491 ft. 400 ft.
11	22S-26E-33	30-015-27632	6/23/17	No	5050	CIBP 2375 – 2128 CIBP 1675 – 1428	247 ft. 247 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
						930 – 830 395 – 0	100 ft. 395 ft.
12	22S-26E-33	30-015-27736	6/23/17	No	3300	CIBP 2600 – 2386 1884 – 1632 450 – 0	214 ft. 252 ft. 450 ft.
13	22S-26E-33	30-015-27736	6/22/17	No	5030	CIBP @ 2600 – 2386 1884-1632 450-0	214 ft. 252 ft. 450 ft.
14	22S-26E-33	30-015-27738	5/8/17	No	5025	CIBP 4471 – 4224 3400 – 3012 CIBP 2525 – 2278 1850 – 1600 500 – 0	247 ft. 388 ft. 247 ft. 250 ft. 500 ft.
15	22S-26E-33	30-015-28554	4/25/17	No	4990	CIBP 4507 – 4260 3400 – 3153 CIBP 2400 – 2153 1725 – 1473 400 – 0	247 ft. 247 ft. 247 ft. 252 ft. 400 ft.
16	22S-26E-33	30-015-27015	4/20/17	No	4990	4423 – 4176 3400 – 3153 CIBP 2300 – 2053 1750 – 1465 450 – 0	247 ft. 247 ft. 247 ft. 285 ft. 450 ft.
17	22S-28E-16	30-015-23851	4/25/17	No	12690	CIBP 3700 – 3265 2695 – 2586 2220 – 2074 550 – 0	435 ft. 109 ft. 146 ft. 550 ft.
18	22S-28E-18	30-015-21958	6/11/17	No	3450	CIBP 2850 – 2815 2400 – 2200 450 – 0	35 ft. 200 ft. 450 ft.
19	22S-28E-18	30-015-20918	3/18/17	No	12450	CIBP 3150 2400 – 2200 415 – 0	35 ft. 200 ft. 415 ft.
20	22S-28E-35	30-015-27117	1/19/17	No	6410	CIBP 5800 – 5553 5075 – 4782 2850 – 2318 1276 – 1010 590 – 386 60 – 0	247 ft. 293 ft. 532 ft. 266 ft. 204 ft. 60 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
21	22S-28E-35	30-015-27026	1/12/17	No	6360	5987 – 5593 5400 – 4734 4680 – 4234 2850 – 2241 1375 – 1037 550 – 344 167 – 0	394 ft. 666 ft. 446 ft. 609 ft. 338 ft. 206 ft. 167 ft.
22	22S-28E-35	30-015-27118	1/3/17	No	6380	CIBP 5988 – 5646 5440 – 4763 2950 – 2475 1355 – 807 471 – 0	342 ft. 677 ft. 475 ft. 548 ft. 471 ft.
23	22S-28E-35	30-015-25590	12/28/16	No	6350	CIBP 6150 – 5897 5100 – 4671 2874 – 2395 1375 – 1278 690 – 0	253 ft. 429 ft. 479 ft. 97 ft. 690 ft.
24	22S-28E-35	30-015-32526	12/21/16	No	6400	6150 – 5897 5100 – 4671 2874 – 2395 1374 – 1278 690 – 0	253 ft. 429 ft. 479 ft. 96 ft. 690 ft.
25	22S-30E-1	30-15-26437	10/10/16	Yes	7716	CIBP @ 6500-5880 6450 – 4500 3875 – 3135 1650 – 1370 1100 – 910 909 – 661 659 -360 359 – 103 102 - 0	620 1950 ft. 740 ft. 280 ft. 190 ft. 248 ft. 299 ft. 256 ft. 102 ft.
26	22S-30E-12	30-15-28012	6/19/17	Yes	14139	13448 – 13190 CIBP 12145 - 11557 11557 – 11007 7886-7574 4600 – 3400 3108 – 3304 3267 – 2240 1213 - 0	258 ft. 588 ft. 550 ft. 312 ft. 1200 ft. 196 ft. 1027 ft. 1213 ft.
27	22S-30E-27	30-015-04734	6/2/17	Yes	15854	CIBP @ 3780 - 0	3780 ft.
28	22S-31E-36	30-015-35673	9/19/16	No	8570	CIBP @ 8050 – 7837 6245 – 6047 4273 – 3983 1145 – 997 750 - 0	213 ft. 198 ft. 290 ft. 205 ft. 750 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
29	22S-32E-10	30-025-32331	6/14/17	No	9000	CIBP @ 7120 – 6873 4756 – 4551 2275 – 2145 135 - 0	247 ft. 205 ft. 130 ft. 135 ft.
30	23S-25E-34	30-015-21656	9/16/16	No	11700	CIBP @ 11030 -10030 9525 – 9225 8500 – 8270 5270 – 4900 2560 – 2210 1200 - 0	1000 ft. 300 ft. 230 ft. 370 ft. 350 ft. 1200 ft.
31	23S-26E-15	30-015-29583	2/17/17	No	12000	CIBP @ 11448 – 10677 8680 – 8531 5540 – 5090 2740 – 2584 1945 – 1376 715 – 520 140 - 0	771 ft. 149 ft. 450 ft. 156 ft. 569 ft. 195 ft. 140 ft.
32	23S-26E-27	30-015-20885	4/11/17	No	11882	CIBP @ 10250 – 10013 8725 -8625 6180 – 6080 5322 – 5205 3350 – 3250 1805 – 1705 682 – 515 100 - 3	237 ft. 100 ft. 100 ft. 117 ft. 100 ft. 100 ft. 167 ft. 97 ft.
33	23S-26E-35	30-015-22583	12/16/16	No	12007	8630 -8468 5540 – 5201 5050 – 4626 2160 – 1595 565 -0	162 ft. 339 ft. 424 ft. 565 ft. 565 ft.
34	23S-28E-18	30-015-24708	7/7/17	No	12650	5500 – 5300 2435 – 2200 1600 – 1350 490 – 0	200 ft. 235 ft. 250 ft. 490 ft.
35	23S-28E-31	30-015-24640	2/15/17	No	7775	CIBP @ 5498 – 5318 2465 – 2135 998 – 875 585 – 195 26 - 3	180 ft. 330 ft. 123 ft. 390 ft. 23 ft.
36	23S-30E-31	30-015-31007	9/9/17	No	7400	CIBP @ 5860 4450 – 4350 3585 – 2950 635 - 0	35 ft. 100 ft. 635 ft. 635 ft.
37	23S-31E-22	30-015-32203	11/8/16	Yes	8375	CIBP @ 7495 – 7245 3740 – 2310	250 ft. 1430 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
						2310 – 961 120 - 0	1349 ft. 120 ft.
38	23S-31E-23	30-015-28342	5/1/17	Yes	6289	CIBP @ 5980 – 5740 5160 – 4920 4450 – 3218 3200 – 2010 1930 – 781 140 - 0	240 ft. 240 ft. 1232 ft. 1190 ft. 1149 ft. 140 ft.
39	23S-31E-24	30-015-32496	7/11/17	Yes	1909	CIBP @ 6987 – 6957 6030 – 5870 5215 – 5065 4407 – 838 480 - 0	30 ft. 160 ft. 150 ft. 3569 ft. 480 ft.
40	23S-31E-24	30-015-27695	1/23/17	No	8652	CIBP @ 7125 – 6895 5620 – 5360 4600 – 4195 1325 – 869 120 - 0	230 ft. 260 ft. 405 ft. 366 ft. 120
41	23S-31E-25	30-015-28805	1/30/17	No	8626	CIBP @ 5909 5115 -4090 3090 – 2090 2090 -1090 520 - 0	30 ft. 1025 ft. 1000 ft. 1000 ft. 520 ft.
42	23S-31E-28	30-015-27131	8/10/17	Yes	8130	CIBP @ 5909 5115 – 4090 3090 – 2090 2090 – 1090 520 - 0	30 ft. 1025 ft. 1000 ft. 1000 ft. 520 ft.
43	23S-32E-6	30-025-36486	4/25/17	No	8806	CIBP @ 6220 – 5970 4560 – 4154 1210 – 686 140 - 3	250 ft. 406 ft. 524 ft. 137 ft.
44	23S-32E-8	30-025-38367	3/17/17	No	8800	CIBP @ 6220 – 5970 4560 – 4154 1210 – 686 140 -3	250 ft. 406 ft. 524 ft. 137 ft.
45	23S-32E-28	30-025-36049	11/18/16	No	8750	CIBP @ 6912 4850 – 4600 4600 – 1250 910 – 810 100 - 0	35 ft. 250 ft. 3350 ft. 100 ft. 100 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
46	23S-33E-33	30-025-39893	5/25/17	No	13869	8700 – 8372 5380 – 4865 1880 -1175 250 - 0	328 ft. 515 ft. 705 ft. 250 ft.
47	23S-33E-33	30-025-40719	5/18/17	No	13231	8400 – 8073 5205 – 4770 2105 – 1805 1500 -1290 140 - 0	327 ft. 505 ft. 300 ft. 210 ft. 140 ft.
48	23S-33E-33	30-025-32138	5/10/17	No	9240	CIBP @ 8870 - 8670 7085 – 6845 5224 – 5024 2030 – 1865 1400 -1235 150 - 0	200 ft. 240 ft. 200 ft. 165 ft. 165 ft. 150 ft.
49	23S-33E-33	30-025-40016	3/10/17	No	13792	8300 – 7975 6160 -5860 5300 – 4840 3875 – 3500 1415 – 1258 150 - 0	325 ft. 300 ft. 460 ft. 375 ft. 157 ft. 150 ft.
50	23S-34E-30	30-025-37413	1/12/17	No	13870	CIBP @ 11500 -11300 8703 – 8495 7543 – 7423 7415 -7261 5176 – 4899 1500 – 1316 910 -0	200 ft. 208 ft. 120 ft. 154 ft. 277 ft. 184 ft. 910 ft.
51	24S-27E-1	30-015-24429	9/29/16	No	12840	CIBP – 5798 2150 -2113 500 – 438 100 - 0	35 ft. 37 ft. 62 ft. 100 ft.
52	24S-28E-13	30-015-24129	3/16/17	No	12983	10000 - 9440 6400 - 6280 3280 - 3127 2704 - 2420 405 - 0	560 ft. 120 ft. 153 ft. 284 ft. 405 ft.
53	24S-28E-24	30-015-42799	5/4/17	No	2760	CIBP @ 2600 – 2485 1200 – 1024 600 - 0	115 ft. 176 ft. 600 ft.
54	24S-30E-5	30-015-31538	12/22/16	No	7550	7200 – 5280 3358 – 2799 675 – 441 100 - 0	1920 ft. 599 ft. 234 ft. 100 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
55	24S-30E-13	30-015-28057	1/13/17	No	8170	CIBP @ 8090 7671 CIBP @ 4340 – 3588 3057 – 2869 842 - 0	419 ft. 752 ft. 188 842
56	24S-30E-19	30-015-33901	8/9/17	No	7473	CIBP – 5500 3252 – 3165 1880 – 2000 800 - 0	35 ft. 87 ft. 120 ft. 800 ft.
57	24S-30E-25	30-015-29213	7/14/17	No	8138	6755 – 6312 5445 – 5235 4275 – 3897 900 - 0	443 ft. 210 ft. 378 ft. 900 ft.
58	24S-31E-2	30-015-33004	10/9/16	No	8393	4340 – 4003 1506 – 813 345 - 0	337 ft. 693 ft. 345 ft.
59	24S-31E-7	30-015-33732	9/15/16	No	8308	CIBP @ 7878 – 7680 6593 – 5692 5248 – 4953 4264 – 4002 3772 – 3532 2398 – 2132 1032 – 852 310 - 0	198 ft. 901 ft. 295 ft. 262 ft. 240 ft. 266 ft. 180 ft. 310 ft.
60	24S-31E-8	30-015-28654	3/28/17	No	8340	CIBP @ 7300 - 4270 6050 – 5500 4400 – 3960 2410 – 2210 1100 - 0	3030 ft. 550 ft. 440 ft. 200 ft. 1100 ft.
61	24S-31E-8	30-015-32758	3/18/17	No	8265	CIBP @ 7800 5800 – 5600 4377 – 3980 1705 – 1505 1039 – 839 250 - 0	35 ft. 200 ft. 397 ft. 200 ft. 200 ft. 250 ft.
62	24S-31E-9	30-015-32558	3/22/17	Yes	8335	CIBP @ 8000 6041 – 5841 4515 – 4190 2410 – 2210 975 -0	35 ft. 200 ft. 325 ft. 200 ft. 975 ft.
63	24S-32E-15	30-025-42759	4/20/17	No	5810	5340 – 5212 4900 – 4653 2025 – 1925 1340 – 1040 225 - 0	128 ft. 247 ft. 100 ft. 100 ft. 225 ft.
64	24S-33E-19	30-025-33717	10/13/16	No	15966	CIBP @ 13584 – 13469 12530 – 12037	115 ft. 493 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
						10998 – 10876 9055 – 8886 5890 – 5760 5080 – 4272 1780 – 1545 700 – 540 130 - 0	122 ft. 169 ft. 130 ft. 808 ft. 234 ft. 160 ft. 130 ft.
65	24S-33E-36	30-025-31798	6/5/17	No	15560	CIBP @ 11840 9200 – 9059 6724 – 6566 5042 – 5018 2200 – 2054 1400 – 1254 714 -453 100 - 0	35 ft. 141 ft. 158 ft. 24 ft. 146 ft. 146 ft. 261 ft. 100 ft.
66	24S-34E-36	30-025-39713	12/29/16	No	525	525 - 0	525 ft.
67	25S-26E-22	30-015-37311	12/18/16	No	4948	CIBP – 2693 – 1833 1103 – 1091 497 - 3	860 ft. 12 ft. 495 ft.
68	25S-26E-23	30-015-35757	10/16/16	No	3917	CIBP – 2800 – 2692 1882 – 1460 400 - 3	108 ft. 422 ft. 397 ft.
69	25S-27E-7	30-015-23094	9/12/16	No	11970	9670 – 9421 8915 – 8283 5582 – 5349 4707 – 4550 2095 – 1870 1210 – 1010 420 - 0	249 ft. 632 ft. 233 ft. 157 ft. 225 ft. 200 ft. 420 ft.
70	25S-27E-19	30-015-33981	9/30/16	No	12080	7889 – 7470 5570 – 5361 4153 – 3863 2769 – 2416 2189 – 1481 500 - 0	419 ft. 209 ft. 290 ft. 353 ft. 708 ft. 500 ft.
71	25S-28E-5	30-015-35342	7/11/17	No	12910	6030 – 5868 5051 – 4880 2650 – 2530 2268 – 2109 700 – 530 100 -0	162 ft. 171 ft. 120 ft. 159 ft. 170 ft. 100 ft.
72	25S-28E-16	30-015-33450	6/27/17	No	6280	CIBP @ 5025 – 4925 2800 – 2700 860 – 260 60 - 0	100 ft. 100 ft. 600 ft. 60 ft.
73	25S-31E-13	30-015-43740	10/11/16	No	95	95 - 0	95 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
74	25S-33E-2	30-025-27178	5/3/17	No	15810	11734 – 11435 9661 – 9476 7162 – 6950 5300 – 4987 3000 – 2760 1200 – 1002 626 – 3	299 ft. 185 ft. 212 ft. 313 ft. 240 ft. 198 ft. 623 ft.
75	25S-33E-11	30-025-26729	4/9/17	No	15930	13693 – 13110 12546 – 11902 11834 – 11622 9634 – 9422 6238 – 5992 5179 – 4929 1450 – 1326 628 - 0	583 ft. 644 ft. 212 ft. 212 ft. 246 ft. 250 ft. 124 ft. 628 ft.
76	26S-25E-2	30-015-33562	8/14/17	No	11900	CIBP @ 56000 5600 – 2000 1850 – 1250 100 - 0	35 ft. 3600 ft. 600 ft. 100 ft.
77	26S-29E-4	30-015-37832	9/19/16	No	11740	CIBP @ 6636 – 6305 3013 – 2659 993 – 449 150 - 0	331 ft. 354 ft. 544 ft. 150 ft.
78	26S-29E-26	30-015-24249	11/17/16	No	6250	CIBP @ 5050 – 4672 2950 – 2450 1250 – 1110 410 – 65 65 - 0	378 ft. 500 ft. 140 ft. 345 ft. 65 ft.
79	26S-29E-35	30-015-25536	1/13/17	No	6260	CIBP @ 4900 – 4500 2980 – 2600 1112 – 975 465 – 0	400 ft. 380 ft. 137 ft. 465 ft.
80	26S-30E-15	30-015-36759	7/22/17	No	7376	CIBP @ 6350 – 6103 5065 – 4789 3691 – 3497 847 – 663 200 - 0	247 ft. 276 ft. 194 ft. 184 ft. 200 ft.
81	26S-30E-15	30-015-39935	7/22/17	No	7640	CIBP @ 5674 – 5421 5051 – 4855 3606 – 3372 895 – 713 200 - 0	253 ft. 196 ft. 234 ft. 182 ft. 200 ft.
82	26S-30E-21	30-015-37781	6/30/17	No	7250	CIBP @ 5525 – 5278 5050 – 4754 3505 – 3209	247 ft. 296 ft. 296 ft.

Plugged Well Information for Reporting Period 9/1/16 – 8/31/17							
#	**Location**	**API#**	**Plug Date**	**R-111-P Area**	**Well Depth**	**Plug Depth**	**Plug Length**
						1050 – 874 200 - 0	176 ft. 200 ft.
83	26S-30E-21	30-015-40849	2/9/17	No	12160	6322 – 5195 5100 – 4830 3693 – 2942 1071 – 800 360 - 0	1127 ft. 270 ft. 3451 ft. 271 ft. 360 ft.
84	26S-30E-24	30-015-25744	3/25/17	No	7060	CIBP @ 5725 – 5473 5350 – 5098 3645 – 3402 1530 – 1340 150 - 0	252 ft. 252 ft. 243 ft. 190 ft. 150 ft.
85	26S-30E-25	30-015-25951	3/17/17	No	5990	5725 – 5478 4659 – 4412 3721 – 3474 3265 – 3100 1250 – 1098 950 – 572 150 – 572 150 - 0	247 ft. 247 ft. 247 ft. 165 ft. 152 ft. 378 ft. 422 ft. 150 ft.
86	26S-34E-16	30-025-41649	10/10/16	No	17308	11820 – 10930 9913 – 9550 7916 – 7640 5955 5448 – 5048 3113 – 845 118 - 0	890 ft. 363 ft. 276 ft. 400 ft. 2268 ft. 118 ft.

Table 8: Past Plugging Summary by Well Type

Type	CCA Well Count	CCA Frequency	CRA-2004 Well Count	CRA-2004 Frequency	CRA-2009 Well Count	CRA-2009 Frequency
I	61	32.5%	116	34.1%	131	30.5%
II	37	20%	60	17.7%	84	19.5%
III	64	34%	111	32.6%	142	33%
IV	19	10%	38	11.2%	52	12.1%
V	3	1.5%	10	2.9%	13	3%
VI	4	2%	5	1.5%	8	1.9%
TOTALS	188	100.0%	340	100.0%	430	100.0%

Type	CRA-2014 Well Count	CRA-2014 Frequency	CRA-2019* Well Count	CRA-2019* Frequency
I	147	26.9%	172	21.7%
II	110	20.1%	193	24.3%
III	163	29.9%	189	23.8%
IV	90	16.5%	142	17.9%
V	14	2.6%	28	3.5%
VI	22	4.0%	70	8.8%
TOTALS	546	100.0%	794	100.0%

*The CRA-2019 has not been published, but this is the data as it will appear in the CRA-2019.

Table 9: Current Plugging Summary by Well Type for the CRA-2019

Type	CRA-2014	CRA-2014 Frequency	2013	2014	2015	2016	2017	Total	Current Frequency	Change
I	147	26.9%	3	3	1	9	9	172	21.7%	-5.2%
II	110	20.1%	2	9	11	20	41	193	24.3%	+4.2%
III	163	29.9%	2	6	5	9	4	189	23.8%	-6.1%
IV	90	16.5%	10	16	11	7	8	142	17.9%	+1.4%
V	14	2.6%	0	0	0	11	3	28	3.5%	+0.9%
VI	22	4.0%	0	3	13	11	21	70	8.8%	+4.8%
TOTALS	546	100.0%	17	37	41	67	86	794	100.0%	

NOTE: The 1996 Compliance Certification Application (CCA) used the 188 wells categorized into the above classifications to arrive at the percentage or frequency of each plugging event. The 2004 Compliance Recertification Application (CRA-2004) followed up on that study and 152 wells were added to the original value to update the frequency. For the CRA-2009, 90 wells were added to the CRA-2004 value to update the frequency. For the CRA-2014, 116 wells were added to the CRA-2009 value to update the frequency. For the CRA-2019, 248 wells were added to the CRA-2014 value to update the frequency.

Table 10: Seismic Activity in the Delaware Basin

County	No. of Events	Earliest Event	Latest Event	Smallest Magnitude	Largest Magnitude
Culberson	16	10/27/1992	3/28/2015	1.1	2.4
Eddy	22	11/28/1975	3/18/2017	-1.3	3.7
Jeff Davis	2	3/28/2015	5/27/2017	0.65	1.36
Lea	4	6/23/1993	4/2/2017	2.1	2.1
Loving	1	2/4/1976	9/11/2016	1.1	1.6
Pecos	88	1/30/1975	5/12/2017	0.9	3.0
Reeves	85	2/19/1976	5/13/2017	0.6	3.2
Ward	51	9/3/1976	11/30/2016	0.3	2.8
Winkler	9	9/24/1971	10/19/2007	0.0	3.0
TOTAL	278				

KEY:

Magnitude

Less than 2	Very seldom ever felt
2.0 to 3.4	Barely felt
3.5 to 4.2	Felt as a rumble
4.3 to 4.9	Shakes furniture; can break dishes
5.0 to 5.9	Dislodges heavy objects; cracks walls
6.0 to 6.9	Considerable damage to buildings
7.0 to 7.3	Major damage to buildings; breaks underground pipes
7.4 to 7.9	Great damage; destroys masonry and frame buildings
Above 8.0	Complete destruction; ground moves in waves

NOTE: Four of the 22 seismic events in Eddy County can be directly attributed to mining activities.

Table 11: Nine-Township Injection and SWD Well Information

#	Location	API#	Status	Injection Zone	First Injection	Last Injection	Cumulative Bbl
1	21S-31E-33	30-015-29330	SWD	4,166-5,160	1998	July 2016	9,722,543
2	21S-31E-35	30-015-40890	SWD	4,355-6,320	2014	July 2016	1,457,900
3	21S-31E-36	30-015-43367	SWD	15,265-15,600	2016	N/A	N/A
4	21S-32E-08	30-025-31412	SWD	4,826-5,978	1991	July 2016	17,255,217
5	21S-32E-31	30-025-31443	SWD	4,618-6,012	1992	June 2016	5,890,763
6	22S-30E-02	30-015-25758	Injection	7,200-7,264	1993	June 2016	26,315,613
7	22S-30E-02	30-015-26761	Injection	5,600-7,400	1991	June 2016	26,742,081
8	22S-30E-21	30-015-41074	SWD	15,291-16,801	2014	July 2016	10,908,847
9	22S-30E-25	30-015-33439	SWD	5,678-5,930	2010	June 2016	2,982,085
10	22S-30E-27	30-015-04734	SWD	3,820-4,620	1981	Feb 2015	6,166,342
11	22S-31E-02	30-015-32440	Injection	6,989-7,020	2003	July 2016	3,780,817
12	22S-31E-03	30-015-38254	SWD	5,355-6,137	2012	July 2016	2,784,812
13	22S-31E-12	30-015-26742	Injection	4,574-4,963	2014	June 2016	715,978
14	22S-31E-24	30-015-26848	SWD	4,519-5,110	1991	July 2016	14,462,632
15	22S-31E-25	30-015-28281	Injection	5,634-5,987	1995	July 2016	13,535,929
16	22S-31E-35	30-015-26629	SWD	4,500-5,670	1991	July 2016	26,941,004
17	22S-31E-36	30-015-26171	SWD	4,500-5,700	1998	June 2016	10,507,287
18	22S-32E-05	30-025-27620	SWD	8,250-8,602	2004	July 2016	10,425,244
19	22S-32E-06	30-025-31227	SWD	4,626-5,730	2012	July 2016	3,991,731
20	22S-32E-07	30-025-31076	SWD	4,676-5,814	1991	July 2016	13,667,639
21	22S-32E-11	30-025-31716	SWD	5,220-8,706	1994	July 2016	3,993,312
22	22S-32E-14	30-025-08113	SWD	5,750-6,080	1994	June 2016	6,856,868
23	22S-32E-16	30-025-31644	SWD	5,582-6,380	2010	July 2016	1,721,071
24	22S-32E-16	30-025-31889	SWD	5,240-8,710	1995	July 2016	12,133,291
25	22S-32E-16	30-025-36006	SWD	5,850-6,450	2010	July 2016	2,364,254
26	22S-32E-17	30-025-31926	SWD	6,807-6,828	2007	July 2016	2,769,418
27	22S-32E-21	30-025-08109	SWD	4,755-5,110	1992	July 2016	4,355,682
28	22S-32E-27	30-025-32436	Injection	6,831-8,388	1998	July 2016	12,579,207
29	22S-32E-28	30-025-31754	SWD	4,674-5,672	1993	July 2016	6,980,821
30	22S-32E-31	30-025-20423	SWD	4,734-5,590	1993	July 2016	7,181,151
31	22S-32E-31	30-025-32093	SWD	4,590-5,626	2004	July 2016	1,008,547
32	22S-32E-32	30-025-36004	SWD	6,744-8,518	2010	July 2016	4,729,195
33	22S-32E-32	30-025-36135	SWD	5,850-6,450	2013	July 2016	2,043,700
34	22S-32E-32	30-025-37799	SWD	5,750-6,500	2010	July 2016	3,448,228
35	22S-32E-35	30-025-33149	SWD	4,950-6,252	1995	July 2016	11,010,661
36	23S-30E-01	30-015-21052	SWD	4,040-4,825	2001	Oct 2015	4,129,932
37	23S-30E-16	30-015-20899	SWD	4,433-5,952	2003	July 2016	5,688,042
38	23S-30E-19	30-015-28901	SWD	3,402-3,912	1997	July 2016	3,794,459
39	23S-30E-20	30-015-29549	SWD	4,124-4,774	2006	June 2016	3,356,222
40	23S-30E-22	30-015-33637	SWD	4,510-5,780	2012	July 2016	2,620,407
41	23S-30E-29	30-015-28808	SWD	5,370-6,380	1996	July 2016	5,731,000

#	Location	API#	Status	Injection Zone	First Injection	Last Injection	Cumulative Bbl
42	23S-30E-33	30-015-26084	SWD	4,470-7,558	2005	Oct 2015	6,819,690
43	23S-30E-33	30-015-31744	SWD	4,227-6,770	2002	Oct 2015	6,384,098
44	23S-31E-02	30-015-05840	SWD	4,500-5,700	1997	June 2016	10,277,542
45	23S-31E-02	30-015-29792	SWD	4,500-5,850	1998	June 2016	10,307,447
46	23S-31E-02	30-015-35749	SWD	4,600-5,880	2010	Apr 2016	4,297,845
47	23S-31E-08	30-015-32619	SWD	7,900-7,933	2004	June 2016	3,939,532
48	23S-31E-09	30-015-33368	SWD	7,744-7,952	2005	June 2016	5,467,613
49	23S-31E-11	30-015-25419	SWD	5,210-5,800	2005	Feb 2016	1,243,027
50	23S-31E-13	30-015-28904	SWD	5,760-5,862	2005	Feb 2016	1,016,523
51	23S-31E-20	30-015-30605	Injection	7,740-7,774	2001	July 2016	11,377,116
52	23S-31E-25	30-015-28817	SWD	5,776-5,920	2008	June 2016	1,986,838
53	23S-31E-25	30-015-28859	SWD	5,236-5,498	2008	June 2016	1,088,664
54	23S-31E-26	30-015-20277	SWD	4,460-5,134	1992	June 2016	5,308,714
55	23S-31E-26	30-015-20302	SWD	4,390-6,048	1971	June 2016	7,350,156
56	23S-31E-27	30-015-27106	SWD	4,750-5,720	1998	June 2016	6,142,990
57	23S-31E-28	30-015-26194	SWD	4,295-5,570	1993	July 2016	8,840,156
58	23S-31E-35	30-015-25640	SWD	4,484-5,780	1993	July 2016	10,307,786
59	23S-31E-36	30-015-20341	SWD	5,980-6,560	1994	June 2016	33,666,233
60	23S-32E-01	30-025-36192	SWD	5,468-6,092	2013	June 2016	2,271,064
61	23S-32E-04	30-025-31650	SWD	4,884-5,886	2003	July 2016	5,688,928
62	23S-32E-07	30-025-33398	SWD	4,660-6,270	2009	June 2016	2,398,389
63	23S-32E-14	30-025-26844	SWD	5,496-6,014	1991	July 2016	2,330,140
64	23S-32E-15	30-025-35524	SWD	5,786-5,942	2008	June 2016	840,433
65	23S-32E-18	30-025-25017	SWD	16,700-18,000	2016	N/A	N/A
66	23S-32E-23	30-025-33653	SWD	5,950-6,065	2000	June 2016	2,393,898
67	23S-32E-24	30-025-33521	SWD	5,925-6,042	2001	June 2016	2,038,651
68	23S-32E-29	30-025-31515	SWD	4,844-6,160	1992	July 2016	14,407,218
69	23S-32E-31	30-025-32868	SWD	5,150-5,700	1996	July 2016	4,763,020
70	23S-32E-36	30-025-31929	SWD	5,364-6,138	1995	June 2016	5,436,399

NOTE: Information collected from New Mexico Oil Conservation Division (OCD) offices in Artesia and Hobbs, New Mexico. Also, cumulative barrels information is collected from the Internet site maintained by the New Mexico Institute of Mining and Technology (NMIMT) on behalf of the New Mexico OCD.

Table 12: Brine Well Status in the Delaware Basin

County	Location	API#	Well Name and No.	Operator	Status
Eddy	22S-26E-36	30-015-21842	City Of Carlsbad #WS-1	Key Energy Services, LLC	Plugged Brine Well
Eddy	22S-27E-03	30-015-20331	Tracy #3	Ray Westall	Plugged Brine Well
Eddy	22S-27E-17	30-015-22574	Eugenie #WS-1	I & W Inc.	Plugged Brine Well
Eddy	22S-27E-17	30-015-23031	Eugenie #WS-2	I & W Inc.	Plugged Brine Well
Eddy	22S-27E-23	30-015-28083	Dunaway #1	Pyote Well Service, LLC	Active Brine Well
Eddy	22S-27E-23	30-015-28084	Dunaway #2	Pyote Well Service, LLC	Active Brine Well
Loving	Blk 29-03	42-301-10142	Lineberry Brine Station #1	Chance Properties Company	Active Brine Well
Loving	Blk 01-82	42-301-30680	Chapman Ford #BR1	Herricks & Son Co.	Plugged Brine Well
Loving	Blk 33-80	42-301-80318	Mentone Brine Station #1D	Basic Energy Services, LP	Active Brine Well
Loving	Blk 29-28	42-301-80319	East Mentone Brine Station #1	Permian Brine Sales, Inc.	Plugged Brine Well
Loving	Blk 01-83	42-301-80320	North Mentone Brine Station #1	Chance Properties Company	Active Brine Well
Reeves	Blk 56-30	42-389-00408	Orla Brine Station #1D	Mesquite SWD, Inc.	Plugged Brine Well
Reeves	Blk 04-08	42-389-20100	North Pecos Brine Station #WD-1	Chance Properties Company	Plugged Brine Well
Reeves	Blk 07-21	42-389-80476	Coyanosa Brine Station #1	Chance Properties Company	Active Brine Well
Ward	Blk 17-20	42-475-31742	Pyote Brine Station #WD-1	Chance Properties Company	Active Brine Well
Ward	Blk 01-13	42-475-34514	Quito West Unit #207	Seaboard Oil Co.	Active Brine Well
Ward	Blk 34-200	42-475-20329	Barstow Brine Station #1	Basic Energy Services, LP	Active Brine Well
Ward	Blk 34-174	42-475-82265	Barstow Brine Station #1	Energy Equity Company	Active Brine Well
Ward	Blk 34-214	42-475-36227	Brine #1	Mesquite SWD, Inc.	Active Brine Well