40 CFR Part 191
Subparts B and C
Compliance Recertification Application 2026
for the
Waste Isolation Pilot Plant

Consideration of Drilling Events in Performance Assessments (40 CFR 194.33)

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Compliance Recertification Application 2026
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(40 CFR 194.33)

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ACRONYMS AND ABBREVIATIONS

CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CRA	Compliance Recertification Application
DBMAR	Delaware Basin Monitoring Annual Report
DOE	U.S. Department of Energy
DPA	Designated Potash Area
EPA	U.S. Environmental Protection Agency
km^2	square kilometer
PA	Performance Assessment
PBRINE	Probability that drilling intrusion in excavated area encounters pressurized brine
PRELHS	PA code that extracts probability distribution data from the parameter database
RPPCR	Replacement Panels Planned Change Request
SNL	Sandia National Laboratories
WIPP	Waste Isolation Pilot Plant
yrs	years

33.0 CONSIDERATION OF DRILLING EVENTS IN PERFORMANCE ASSESSMENTS (40 CFR 194.33)

33.1 Requirements

§ 194.33 Consideration of Drilling Events in Performance Assessments

(a) Performance assessments shall examine deep drilling and shallow drilling that may potentially affect the disposal system during the regulatory time frame.

(b) The following assumptions and process shall be used in assessing the likelihood and consequences of drilling events, and the results of such process shall be documented in any compliance application:

(1) Inadvertent and intermittent intrusion by drilling for resources (other than those resources provided by the waste in the disposal system or engineered barriers designed to isolate such waste) is the most severe human intrusion scenario.

(2) In performance assessments, drilling events shall be assumed to occur in the Delaware Basin at random intervals in time and space during the regulatory time frame.

(3) The frequency of deep drilling shall be calculated in the following manner:

(i) 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

(ii) The total rate of deep drilling shall be the sum of the rates of deep drilling for each resource.

(4) The frequency of shallow drilling shall be calculated in the following manner:

(i) Identify shallow 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.

(ii) The total rate of shallow drilling shall be the sum of the rates of shallow drilling for each resource.

(iii) In considering the historical rate of all shallow drilling, the Department may, if justified, consider only the historical rate of shallow drilling for resources of similar type and quality to those in the controlled area.

(c) Performance assessments shall document that in analyzing the consequences of drilling events, the Department assumed that:

(1) Future drilling practices and technology will remain consistent with practices in the Delaware Basin at the time a compliance application is prepared. Such future drilling practices shall include but shall not be limited to: the types and amounts of drilling fluids; borehole depths, diameters, and seals; and the fraction of such boreholes that are sealed by humans.

(2) Natural processes will degrade or otherwise affect the capability of boreholes to transmit fluids over the regulatory time frame.

(d) With respect to future drilling events, performance assessments need not analyze the effects of techniques used for resource recovery subsequent to the drilling of the borehole.

33.2 Background

Title 40 Code of Federal Regulations (CFR) 194.33 (U.S. EPA 1996) requires the U.S. Department of Energy (DOE) to make assumptions about future deep and shallow drilling in the Delaware Basin that may potentially affect the disposal system. These assumptions pertain to the timing and duration of drilling, frequency of drilling, drilling practices and technology, and the effects

of natural processes on boreholes. Deep drilling rates and related assumptions directly affect the cumulative potential for radionuclide releases to the surface or subsurface geologic units above and below the repository.

The DOE monitors the number of shallow and deep wells drilled in the Delaware Basin. A deep well is one drilled to a depth equal to, or greater than, the depth of the repository. A shallow well is one drilled to a lesser depth. The DOE reports the data in the Delaware Basin Monitoring Annual Report (DBMAR). Currently, most drilling within the Delaware Basin is deep drilling for oil and gas exploration/exploitation, which will likely remain the case for the foreseeable future. As postulated by the U.S. Environmental Protection Agency (EPA) when formulating their long-term disposal standards, current deep drilling rates are a suitable surrogate for future deep drilling rates, which may include drilling previously unknown or desired resources. The DOE incorporates the drilling rate into Performance Assessment (PA) as a single event or combination of events based upon different scenarios.

The information in this section applies to both the approved interim state of the repository (with 12 waste panels) and the expected final state of the repository (with 19 waste panels). The CRA-2019 (U.S. DOE 2019) contains information and data from previous compliance recertification applications.

33.3 Changes or New Information Since the CRA-2019

Three changes in the CRA-2026 relate to the consideration of drilling events in PA. First, we adjusted the probability distribution for a drilling intrusion intersecting pressurized brine beneath the repository. The adjustment is necessary due to a correction in the Sandia National Laboratories (SNL) PA code PRELHS (SNL 2022). Second, the drilling rate was updated based on recent drilling activities in the Delaware Basin per 40 CFR 194.33(b)(3). This update also included a change in the depth of the repository from 2,150 feet to 2,104 feet (U.S. DOE 2022) and a change involving wells of unknown depth. A fraction of the number of wells of unknown depth is now added to the deep well total (Equation 33.1). Third, the target area over which borehole plugging data are collected was changed from the Designated Potash Area (DPA)[1] to the Waste Isolation Pilot Plant (WIPP) Nine-Township Area (Day 2023). The DOE collects borehole plugging data as part of the ongoing Delaware Basin Drilling Surveillance Program. The adjustment to the pressurized brine probability distribution, the updated depth of the repository, and the change to the area for collection of plugging data were first implemented in PA for the DOE's Replacement Panels Planned Change Request (RPPCR) submitted to the EPA in March 2024 (U.S. DOE 2024).

The primary objective of this document is to demonstrate that with the updates to 1) the probability of encountering pressurized brine, 2) the drilling rate, the depth of the repository, the new formula for determining the deep drilling rate, and 3) the target area for collecting borehole plugging data, the DOE continues to comply with 40 CFR 194.33. To put this discussion

[1] The DPA was previously known as the Known Potash Leasing Area. The Known Potash Leasing Area is defined in Exhibit A of State of New Mexico 1988.

in proper perspective, it is worth noting that the CRA-2019 PA was submitted in December 2019 (henceforth the "Deferred PA"), some 9 months after submittal of the CRA-2019. Consequently, the drilling rate and plugging frequencies used in the Deferred PA are different from the values reported in the CRA-2019.

33.3.1 Probability of Encountering Pressurized Brine

The probability of encountering pressurized brine while inadvertently drilling through the WIPP repository is represented by the PA parameter GLOBAL:PBRINE, or simply PBRINE. In 2017, the EPA specified that the DOE use the EPA's updated probability distribution for PBRINE in future PAs (U.S. EPA 2017a; U.S. EPA 2017b). For the CRA-2026, the DOE inserted a cumulative probability of 0.0 at PBRINE value 0.04 in the EPA's cumulative PBRINE distribution (U.S. EPA 2017b, Table B-1). This became necessary after an error discovered in the PA code PRELHS was corrected (SNL 2022). Docherty (2023) assessed the impact of the correction to PRELHS and tabulated the cumulative probability distribution of PBRINE.

33.3.2 Drilling Rates used in PA

As noted in the 2024 DBMAR (U.S. DOE 2025) the DOE concludes, and the EPA concurs, that shallow drilling is of low consequence in PA. A shallow drilling rate has not been determined for this CRA; however, the number of shallow wells is included in the total known depth boreholes (Equation 33.1) influencing the deep drilling rate.

The deep drilling rate for the CRA-2026 is updated based on recent deep drilling activities in the Delaware Basin. A well is considered deep if drilled to a depth equal to, or greater than, the depth of the repository. For the CRA-2026, the DOE defines the repository depth as 2,104 feet, a 46-foot decrease from the 2,150 feet specified in the CRA-2019. The repository depth decreased because the marker bed used to anchor mine roof bolts occurs at a shallower depth owing to a regional southeasterly dip of approximately one degree in the Salado Formation (Powers et al. 1978). In addition, the DOE adjusted the formula for determining the deep drilling rate to better address wells of unknown depth; that is, boreholes that are either in the process of being drilled or for which records are incomplete. The formula adds a proportion of the wells of unknown depth to the deep well total, as the EPA first suggested (U.S. EPA 2022). The deep drilling rate for the CRA-2026 is (U.S. DOE 2025, Equation 1):

$$Deep\ drilling\ rate$$

$$= \left[(known\ deep\ boreholes) + (unknown\ depth\ boreholes) \times \left(\frac{known\ deep\ boreholes}{total\ known\ depth\ boreholes}\right)\right] \times \frac{(regulatory\ period\ in\ yrs)}{(area\ of\ Delaware\ Basin) \times (100\ yrs)} \qquad Equation\ (33.1)$$

$$= \left[(33{,}848) + (1{,}813)\left(\frac{33{,}848}{38{,}450}\right)\right] \times \frac{(10{,}000\ yrs)}{(23{,}102.1\ km^2) \times (100\ yrs)}$$

$$= 153.4\ boreholes/km^2 \quad .$$

Table 33-1 compares current and previous drilling rates.

Table 33-1. Deep Drilling Rate (boreholes/km²)

CCA	CRA-2004	CRA-2009	CRA-2014	CRA-2019	Deferred PA	RPPCR	CRA-2026
46.8	52.5	58.5	67.3	93.4	99.0	138.9	153.4

33.3.3 Borehole Plugging Techniques and Frequency

The 2024 DBMAR (U.S. DOE 2025) indicates that drilling practices that are relevant to WIPP intrusion models have not changed since previous reports. Since the last recertification decision, borehole diameters, depths, and plugging methods have not changed. However, the plug placement, types, and frequencies have changed somewhat since the CRA-2019 due to a normal progression in borehole plugging and abandonment activities.

In October 2022, the DOE and the EPA convened a Technical Exchange to resolve issues from the CRA-2019, which included a discussion of borehole plugging patterns (Peake 2022, Issue 19). The DOE's proposal to collect data from the WIPP Nine-Township Area, starting December 1, 2022 (Day 2023), was accepted by the EPA (Santillan 2023). The proposed area includes the nine townships surrounding WIPP, truncated to the north by the boundary of the Delaware Basin (Figure 33-1).

Prior to the RPPCR, plugging data had been drawn from two different geographic areas. Starting with the 1996 Compliance Certification Application (CCA) until and including the CRA-2019, plugging data were gathered from plugged and abandoned wells in the New Mexico portion of

the Delaware Basin, and for the Deferred PA, plugging data were gathered only from wells in the DPA.

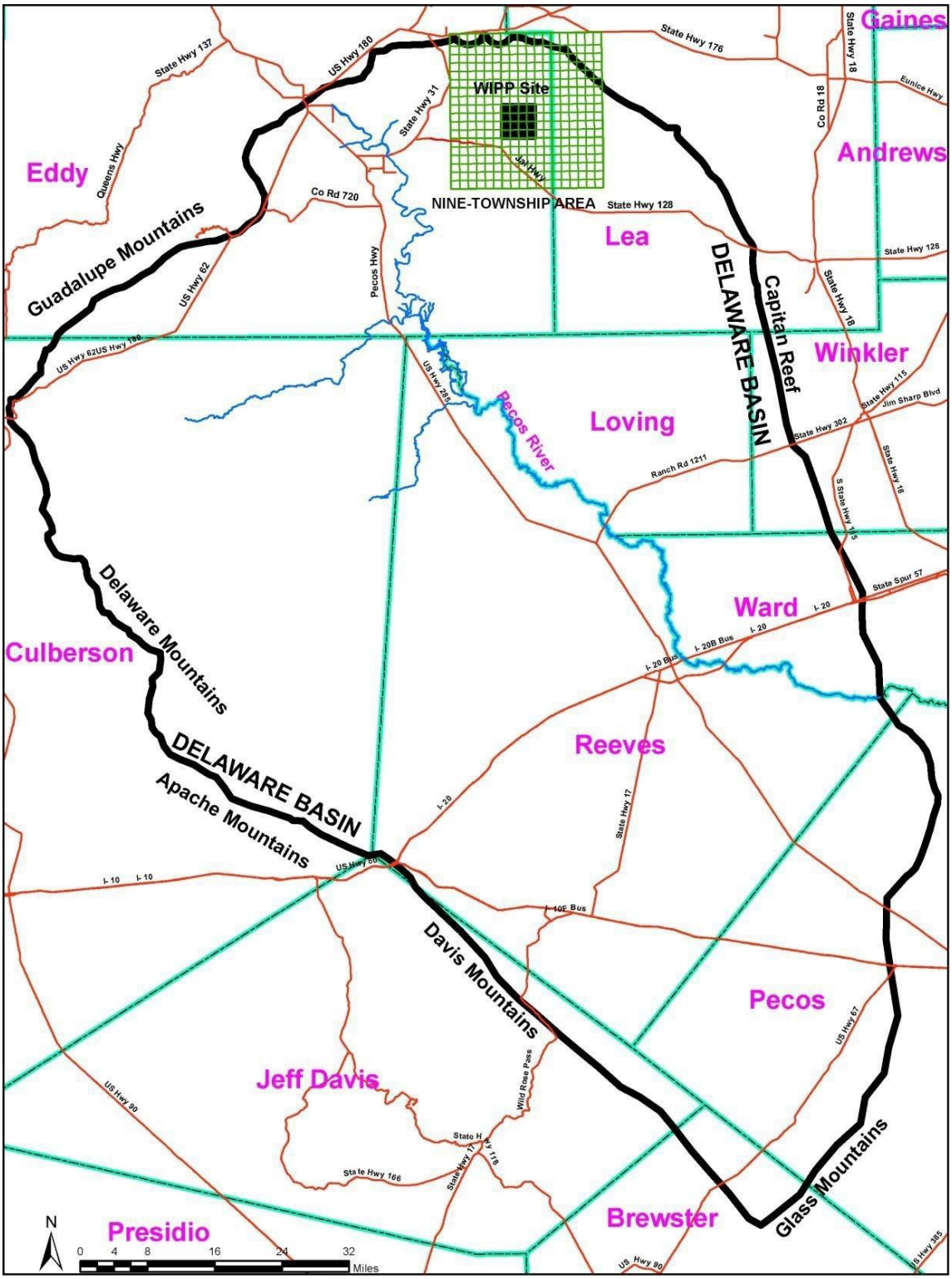


Figure 33-1. WIPP Site, Delaware Basin, and Nine-Township Area (U.S. DOE 2025, Figure 1)

The DOE conceptualizes borehole plugs into six types, and the plugging frequencies are updated annually. Table 33-2 shows the historical changes in these plug types since the CCA. The CRA-2026 data in Table 33-2 are from Table 8 of the 2024 DBMAR (U.S. DOE 2025)[2]. Of particular interest to repository performance is the use of the Type VI plug, a solid, continuous cement plug spanning the Salado and Castile Formations. The Type VI plug is the most effective in isolating the repository from any upward brine migration. The DOE uses a plugging frequency of 35.9 percent through the entire salt section for CRA-2026. Section 6.4.7.2 of the CCA (U.S. DOE 1996) describes long-term releases following a drilling intrusion, as well as an explanation of how the various plugs are implemented in PA.

Table 33-2. Plug Type and Frequency in WIPP Compliance Applications

Type	CCA	CRA-2004	CRA-2009	CRA-2014	CRA-2019	Deferred PA	RPPCR	CRA-2026
I	32.5%	34.1%	30.5%	26.9%	21.7%	14.3%	20.6%	20.7%
II	20.0%	17.7%	19.5%	20.1%	24.3%	16.9%	16.2%	11.4%
III	34.0%	32.6%	33.0%	29.9%	23.8%	6.5%	17.5%	22.3%
IV	10.0%	11.2%	12.1%	16.5%	17.9%	9.7%	4.2%	6.3%
V	1.5%	2.9%	3.0%	2.6%	3.5%	12.3%	4.9%	3.4%
VI	2.0%	1.5%	1.9%	4.0%	8.8%	40.3%	36.6%	35.9%

33.3.4 Summary of Compliance with 40 CFR 194.33

The DOE incorporates drilling events into evaluations of repository performance. The DOE made no changes in implementing drilling events within performance scenarios. Routine updates by the DOE that impact parameterization were described in the foregoing sections. The DOE continues to comply with 40 CFR 194.33.

33.4 References

(*Indicates a reference that has not been previously submitted.)

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[2] The plugging frequencies shown in Table 33-2 for the CCA, the CRA-2004, the CRA-2009, and the CRA-2014 are taken from Table 9 of the 2013 DBMAR (U.S. DOE 2013). The plugging frequencies for the CRA-2019 are from Table 9 of the 2017 DBMAR (U.S. DOE 2017) and the plugging frequencies for the Deferred PA are from Table 9 of the 2018 DBMAR (U.S. DOE 2018). The RPPCR plugging frequencies are from Table 3 of the Borehole Plugging Practices White Paper (Day 2023). Lastly, as mentioned, the CRA-2026 plugging frequencies are from Table 8 of the 2024 DBMAR (U.S. DOE 2025).

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