Compliance Monitoring Implementation Plan for 40 CFR §191.14(b), Assurance Requirement

U.S. Department of Energy

Revision 6

May 2010

This document supersedes Revision 5 of DOE/WIPP-99-3119.

This document has been submitted as required to:

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ABBREVIATIONS AND ACRONYMS

CARD	Certification Application Review Document
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
LWA	Land Withdrawal Act
M&OC	Management and Operating Contractor
TRU	transuranic
WIPP	Waste Isolation Pilot Plant
WDS	Waste Data System
WWIS	WIPP Waste Information System

1.0 INTRODUCTION

This Compliance Monitoring Implementation Plan outlines monitoring activities conducted by the U.S. Department of Energy (DOE) at the Waste Isolation Pilot Plant (WIPP) to demonstrate compliance with the U.S. Environmental Protection Agency (EPA) disposal regulations at Title 40 *Code of Federal Regulations* (CFR) Part 191, "Environmental Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," Subparts B and C; and the EPA criteria for certifying compliance at 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. This plan does not address monitoring activities intended to demonstrate compliance with 40 CFR Part 191 Subpart A.

WIPP is a mined repository designed for the permanent disposal of defense-related transuranic (TRU) waste located in the Chihuahuan Desert, 26 miles east of Carlsbad, New Mexico. The suitability of the WIPP site for TRU waste disposal is supported by more than three decades of environmental studies. Monitoring the WIPP facility is one of the DOE's top priorities. Monitoring activities are implemented in compliance with various federal and state of New Mexico regulatory and operational safety requirements. These activities are conducted to ensure environmental protection, public and worker health and safety, and proper characterization of the disposal system. Monitoring activities will continue at WIPP through the operational period and until well after closure of the facility.

The monitoring activities described in this plan are performed as assurance measures to detect substantial and detrimental deviations from expected disposal system performance. This program consists of a preclosure and postclosure monitoring program using monitoring techniques that do not jeopardize the isolation of the waste. A postclosure monitoring program will continue until both agencies agree there is no further benefit. Preclosure parameters can no longer be collected/monitored after the disposal phase has ended. The long-term performance expectations for the disposal system are derived from conceptual models, scenarios, and assumptions developed for the WIPP performance assessment (PA).

The compliance monitoring program outlined in this Compliance Monitoring Implementation Plan is the result of the certification process which began with preparation of a compliance certification application (CCA) demonstrating compliance with the disposal standards and culminated with an EPA Certification Decision authorizing the disposal of TRU waste at WIPP. For the purpose of this document, Compliance Certification is defined as the EPA determination of compliance as documented in the *Federal Register*. The determination includes the terms and conditions of the certification, and is based upon the information provided within the CCA and Compliance Recertification Applications (CRAs), as well as information submitted by request of the EPA. Recertification is the process that the EPA uses to assess the ability of the DOE to continue to comply with the disposal standards. The Waste Isolation Pilot Plant Land Withdrawal Act (LWA) (PL 102-579; 104-201) requires

the DOE to provide the EPA with documentation of continued compliance once every five years.

This plan implements a monitoring program focused on demonstrating compliance with 40 CFR §191.14(b), which reads as follows:

> *Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance. This monitoring shall be done with techniques that do not jeopardize the isolation of the wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring.*

The EPA provides criteria for demonstrating compliance with this assurance requirement at 40 CFR §194.42. The criteria identify disposal system features that may have an effect on waste containment in the disposal system and require the DOE to conduct an analysis to identify parameters considered to be significant to waste containment in the disposal system. These criteria also require the DOE to conduct preclosure and postclosure monitoring of the significant parameters. The DOE analysis and proposed monitoring of disposal system parameters are based on the results of the parameter analysis documented in the CCA, Chapter 7.0, and Appendix MON, Attachment MONPAR. The EPA documented its approval of the DOE monitoring approach in the compliance certification decision (EPA, 1998a) and Compliance Application Review Document (CARD) (EPA, 1998b). The DOE reassessed the CCA, Appendix MON, Attachment MONPAR, for the CRA-2004 and determined the original conclusions and monitoring parameters identified in MONPAR remain valid and unchanged (Kirkes and Wagner, 2003). For the CRA-2009, the DOE once again assessed the original MONPAR analysis and determined the conclusions of the MONPAR analysis remain valid and continue to be adequate for inclusion in the CRA-2009 (Wagner, 2008). The parameters selected for monitoring are discussed in detail in Section 3.0 of this plan.

The objectives of this plan are to:

- Identify monitoring of disposal system parameters required to comply with 40 CFR Part 191, Subparts B and C, and Part 194; and the terms and conditions of the EPA Certification/Recertification Decision.
- Implement a Compliance Monitoring Program that identifies the disposal system parameters being monitored, the organizations responsible for monitoring the parameters and the frequency for conducting the monitoring and reporting results.
- Describe how monitoring data are assessed against repository performance expectations.
- Define the quality assurance process used to ensure the validity of the monitoring data.

- Define the process for reporting compliance monitoring.

- Provide documentation of continued compliance for the DOE recertification program as described in DOE/CBFO 99-2296, *Waste Isolation Pilot Plant Certification Management Plan*.

The remainder of this document is organized in the following manner:

- Section 2.0 describes the historical events leading to the EPA certification/recertification of WIPP for the permanent disposal of TRU waste.

- Section 3.0 describes the Compliance Monitoring Program identifying disposal system parameters and the responsibilities of WIPP organizations in monitoring the parameters.

- Section 4.0 describes the preclosure monitoring program.

- Section 5.0 describes the planned postclosure monitoring program.

- Section 6.0 describes the quality assurance requirements applicable to the Compliance Monitoring Program.

- Section 7.0 describes the reporting of monitoring data.

2.0 HISTORICAL SUMMARY

In 1957, the National Academy of Sciences recommended bedded salt formations as the best type of underground formation for a geologic repository for the disposal of TRU radioactive waste. In 1973, the U.S. Geological Survey identified a portion of the Permian Basin in southeastern New Mexico containing a 2,000-foot thick salt formation that has been stable for more than 200 million years as a site meeting the desired criteria for a TRU waste repository. After extensive exploratory work and field investigations, a site in the Chihuahuan Desert 26 miles east of Carlsbad, New Mexico, was chosen for the repository. In 1983, construction of WIPP was authorized by the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980, Public Law 96-164, Section 213, to demonstrate safe methods for disposal of TRU waste. The EPA, on September 19, 1985, first published standards for the management and disposal of radioactive waste, 40 CFR Part 191. In 1987, the U.S. Court of Appeals for the First Circuit vacated and remanded Subpart B of the standards to the EPA for reconsideration (NRDC v. EPA, 824 F.2d 1258 [1st Cir. 1987]). In October 1992, Public Law 104-201, referred to as the WIPP LWA, withdrew 10,240 acres of land from public use and reinstated Subpart B of the EPA 1985 disposal standards except for the aspects of the standards which the court specifically questioned (that is, 40 CFR §191.15, "Individual Protection Requirements;" and 40 CFR §191.16, "Ground Water Protection Requirements").

The LWA also established the following requirements as prerequisites for initiating TRU waste disposal.

- The DOE is to prepare and submit a compliance application to the EPA to demonstrate that the WIPP site can safely comply with the final disposal regulations.

- The EPA is to evaluate the DOE compliance application and determine whether or not the WIPP site can comply with deep geologic standards for the disposal of TRU waste.

- The EPA must reevaluate the ability of the DOE to comply with the disposal standards every five years through site closure.

In accordance with the requirements of Section 7(b) of the LWA, the EPA, on December 20, 1993, issued a Final Rule that amends its regulations codified at 40 CFR Part 191. The amendment went into effect January 19, 1994, and provided the DOE a definitive set of disposal regulations with which WIPP must comply. In February 1996, the EPA met the requirement at Section 8(c) of the LWA by promulgating a Final Rule establishing criteria for use in determining whether WIPP complies with the applicable disposal standards set forth in Subparts B and C of 40 CFR Part 191. The criteria, found in 40 CFR Part 194, became effective April 9, 1996. Following the EPA issuance of the certification criteria the DOE submitted a CCA (DOE/CAO 96-2184) to the EPA on October 29, 1996, as required by Section 8(d) of the LWA. The EPA published their decision on May 18, 1998, and certified that the DOE properly demonstrated that WIPP complies with the standards set forth at 40 CFR Part 191, Subparts B and C.

The DOE began emplacing TRU waste in the WIPP repository on March 26, 1999. With the initial receipt of waste the requirement at Section 8(f) of the LWA was initiated. Section 8(f) requires the DOE to submit a recertification application to the EPA to demonstrate continued compliance with the disposal regulation not later than five years after the initial receipt of TRU waste for disposal and at five-year intervals thereafter until the end of the decommissioning phase. Each recertification application submitted to the EPA for certification must be prepared in accordance with the criteria at 40 CFR §194.15. Based on the DOE submittal, the EPA will determine whether or not WIPP continues to be in compliance with the disposal regulations. The DOE submitted the first CRA to the EPA on March 26, 2004, and the EPA recertified the WIPP facility on March 29, 2006. The DOE submitted the second CRA to the EPA on March 24, 2009, and the EPA will evaluate the CRA to determine recertification of WIPP.

3.0 COMPLIANCE MONITORING PROGRAM

The purpose of the Compliance Monitoring Program is to demonstrate compliance with the requirement at 40 CFR §191.14(b) in accordance with the criteria at 40 CFR §194.42 to monitor disposal system parameters that the DOE determined to be most useful in gauging the performance of the repository. The EPA approved the

selection of these monitoring parameters in their Certification Decision (EPA, May 18, 1998) and their Recertification Decision (EPA, March 29, 2006). The EPA discussed acceptability of the selected disposal system parameters and their appropriateness for monitoring the long-term performance of the disposal system, as documented in Certification Application Review Document Number 42 (EPA, October 1997and EPA, March 2006). In the 2009-CRA, the DOE confirmed the monitoring parameters remain valid for monitoring the long-term performance of the disposal system (Wagner 2008) (see CRA-2009, Section 42.6, Changes or New Information Since the 2004 Recertification).

As part of the EPA certification of WIPP, the DOE conducted an analysis determining disposal system parameters appropriate for evaluating the long-term repository performance. The analysis identified ten parameters to be monitored in the Compliance Monitoring Program. The analysis and the ten parameters selected for monitoring are addressed in Chapter 7 and Appendix MON of the CCA. The analysis was reevaluated and determined to still be appropriate for evaluating the long-term repository performance as part of the EPA March 2006 Recertification Decision (EPA March 29, 2006). The EPA documented its agreement with the DOE monitoring approach in the Certification Application Review Document Number 42 (EPA, October 1997 and EPA, March 2006). The 2009-CRA assessed the original analysis and determined the conclusions of the analysis remain valid and the ten parameters continued to be adequate for monitoring long-term repository performance (Wagner, 2008). The appropriateness of the monitoring parameters will continue to be evaluated, at a minimum, once every five years as a part of each recertification effort. The ten monitored parameters are as follows:

- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features
- Waste activity
- Culebra groundwater composition
- Change in Culebra groundwater flow
- Drilling rate in the Delaware Basin
- Probability of encountering a Castile brine reservoir in the Delaware Basin
- Subsidence in the vicinity of the repository

All of the above parameters are being monitored during the preclosure period.

The ten monitoring parameters can be divided into those relating to performance assessment parameters and those relating to conceptual models, Features, Events, and Processes, and confirmation of related modeling assumptions. The monitoring parameters related to performance assessment parameters are:

- Waste activity
- Culebra groundwater composition
- Change in Culebra groundwater flow

- Drilling rate in the Delaware Basin
- Probability of encountering a Castile brine reservoir in the Delaware Basin

The monitoring parameters related to conceptual models, Features, Events, and Processes and modeling assumptions are:

- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features
- Subsidence in the vicinity of the repository

The relationship of each of the ten parameters to performance assessment and to the Features, Events, and Processes is described in Table 3.1.

Data are collected to monitor the ten parameters of the Compliance Monitoring Program by the following WIPP programs:

- Geotechnical Engineering
- Groundwater Monitoring
- Delaware Basin Drilling Surveillance
- Subsidence Monitoring
- Waste Tracking

Data from the monitoring programs are submitted periodically to the WIPP scientific advisor. The scientific advisor refers to this collection of data from the five monitoring programs as Compliance Monitoring Parameters.

The scientific advisor, upon receiving the Compliance Monitoring Parameters, reviews, analyzes, and evaluates them using processes and procedures governed by their quality assurance and document control procedures and determines whether the results are within performance assessment expectations. The scientific advisor then documents the evaluation in a Compliance Monitoring Parameter Assessment issued to the DOE.

Table 3.1 - Compliance Monitoring Program Parameters Relationship to Performance Assessment and Features, Events, and Processes

Parameters Monitored	Monitoring Program	Relationship to Performance Assessment	Related FEPs Evaluation Cycle
Creep Closure and Stresses	Geotechnical Monitoring Program	Not directly related to a PA parameter. May provide a short-term (operational) observation of the geomechanical response of repository excavation. Can provide confidence in the creep closure model.	Salt creep, excavation-induced stress changes in stress field, pressurization, consolidation of waste/backfill.

Table 3.1 - Compliance Monitoring Program Parameters Relationship to Performance Assessment and Features, Events, and Processes

Parameters Monitored	Monitoring Program	Relationship to Performance Assessment	Related FEPs Evaluation Cycle
Extent of Brittle Deformation	Geotechnical Monitoring Program	Not directly related to a PA parameter. Can provide confidence in the long-term behavior of the disturbed rock zone (DRZ), as modeled. Intrinsic shaft DRZ permeability and effective shaft seal permeability is calculated from this parameter.	DRZ, roof falls, consolidation of seals.
Initiation of Brittle Deformation	Geotechnical Monitoring Program	Not directly related to a PA parameter. Can provide confidence in the anhydrite fracture model implemented in the BRAGFLO code. May provide related repository observation data on initiation or displacement of major brittle deformation features in the roof or surrounding rock.	Disruption due to gas effects.
Displacement of Deformation Features	Geotechnical Monitoring Program	Not directly related to a PA parameter. Provides related repository operational data on initiation or displacement of major brittle deformation features in the roof or surrounding rock.	Stability of open panel.
Drilling Rate	Delaware Basin Drilling Surveillance Program	Drilling rate per unit area. The number of holes is used to calculate a frequency of potential future intrusions into the repository.	Drilling.
Probability of Encountering a Castile Brine Reservoir	Delaware Basin Drilling Surveillance Program	Probabilities of encountering a Castile brine reservoir, reservoir pressure, and volume are performance assessment parameters. This parameter is significant to long-term repository performance.	Drilling fluid flow, drilling fluid loss, blowouts, brine reservoirs.
Subsidence Measurements	Subsidence Monitoring Program	Not directly related to a performance assessment parameter. Can provide spatial information on surface subsidence (if any) over the influence area of the underground openings during operation.	Changes to groundwater flow due to mining effects and subsidence baseline.
Change in Culebra Groundwater Flow (water level)	Groundwater Monitoring Program	Culebra transmissivity, fracture and matrix porosity, fracture spacing, dispersivity, and climate index. Changes in Culebra groundwater flow are moderately significant to performance and incorporated into the PA.	Groundwater flow, recharge/discharge, infiltration, and precipitation.
Culebra Groundwater Compositions	Groundwater Monitoring Program	Average Culebra brines composition and matrix distribution coefficient for uranium (U) (IV, VI), plutonium (Pu) (III, IV), thorium (Th) (IV), americium (Am) (III). Matrix distribution coefficient is not a sensitive PA parameter.	Groundwater geochemistry, actinide sorption.

Table 3.1 - Compliance Monitoring Program Parameters Relationship to Performance Assessment and Features, Events, and Processes

Parameters Monitored	Monitoring Program	Relationship to Performance Assessment	Related FEPs Evaluation Cycle
Waste Activity	WIPP Waste Tracking	Radionuclide inventory and material parameter weights important to PA are listed in Section 4.5.3, Program Output.	Waste radiological characteristics.

4.0 PRECLOSURE COMPLIANCE MONITORING

This section provides a description of the preclosure compliance monitoring program and the resulting data. The ten parameters, the associated monitoring program for each and the frequency of data collection and reporting are addressed in this section.

4.1 Geotechnical Monitoring Program

The WIPP Geotechnical Engineering Program Plan (WP 07-1) defines the field programs and investigations carried out by the Geotechnical Engineering group within the management and operating contractor (M&OC) organization. The geotechnical engineering activities provide geologic information related to geotechnical characteristics and assess the stability and performance of the underground facility. The activities defined in the WIPP Geotechnical Engineering Program Plan that collects data related to PA parameters and make up the Geotechnical Monitoring Program described in Table 3.1 can be divided into a Geomechanical Monitoring Scope and Geosciences Monitoring Scope.

4.1.1 Geomechanical Monitoring Scope

Geomechanical monitoring activities provide data to validate design, track short-term and long-term geotechnical performance of underground openings, and support routine safety and stability evaluations of the excavations. Geomechanical monitoring generates data related to the following four parameters:

- Creep closure and stresses
- Extent of deformation
- Initiation of brittle deformation
- Displacement of deformation features

The geomechanical monitoring activities provide data on the WIPP design for evaluating the safety and stability of excavations and the behavior of underground openings. From an operational point of view, data related to identifying areas of potential instability allow corrective action to be taken in a timely manner. For underground opening behavior, in situ data are used to model long-term disposal system performance.

4.1.1.1 Instrumentation

Geomechanical instruments installed in the shafts and along drifts within the WIPP facility monitor the geotechnical parameters. Instrumentation in the shafts and the underground repository presently include tape extensometer stations, convergence meters, borehole extensometers, piezometers, embedment strain gauges, stress gauges, inclinometers, load cells, and crack meters. Instruments in the underground repository are either monitored remotely by a surface data logger or read manually.

4.1.1.2 Data Acquisition

Geomechanical data are acquired either remotely by the geomechanical data logging system or manually by geotechnical engineering technicians. Manually acquired data are collected on a quarterly basis and remotely acquired data are collected on a monthly basis, at a minimum.

4.1.1.3 Data Analysis and Dissemination

Data analysis is performed and published annually. The results of the analyses are published annually in the Geotechnical Analysis Report. An assessment of convergence measurements and geotechnical observations is made after each round of data collection. The results of each assessment are distributed to affected underground repository operations, engineering, and safety managers.

4.1.2 Geosciences Monitoring Scope

Geosciences monitoring document existing geologic conditions and characteristics and monitor for changes resulting from the excavations. These activities generate data related to the following four parameters:

- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features

Changes resulting from excavations are monitored by routine inspections of selected borehole arrays to detect and quantify the occurrences of discontinuities such as fractures and bed separations. The data collected from these inspections further the understanding of fracture development within the Salado Formation that occurs around the excavations. Geosciences activities also provide geologic and fracture mapping, geologic sampling, and seismic monitoring.

4.1.3 Schedule

The following activities are performed on the indicated schedule.

- Geomechanical Monitoring. This program uses instrumentation located in the shafts and drifts, including tape extensometer stations, convergence meters, borehole extensometers, piezometers, embedment strain gauges, stress gauges, inclinometers, load cells, and crack meters. Instruments are read as designated in Section 4.1.1.2.

- Seismic Monitoring. Regional seismic monitoring and evaluation are conducted by the New Mexico Institute of Mining and Technology. The network is operated continuously and monitoring results are reported quarterly.

- Geologic Mapping. Geologic mapping is conducted in newly excavated areas and in other areas when deemed necessary by the cognizant engineer or Geotechnical Engineering Manager.

- At a minimum, a complete analysis of geotechnical data is performed annually. The geotechnical activities will continue throughout the operational period.

4.1.4 Program Output

Data analysis is performed on an annual basis and published in the WIPP Geotechnical Analysis Report.

4.2 Groundwater Monitoring Program

Groundwater monitoring at WIPP is carried out in accordance with the WIPP Groundwater Monitoring Program Plan (WP 02-1). Its purpose is to collect groundwater data from numerous wells located near the facility.

4.2.1 Scope

The Culebra is the focus of the Groundwater Monitoring Program. It has been extensively studied during past hydrologic characterization programs, and was found to be the most likely hydrologic pathway to the accessible environment or compliance point for any potential human-intrusion-caused release scenario.

Data obtained through the Groundwater Monitoring Program are used to generate the Culebra groundwater composition and the Culebra groundwater flow parameters. Details on how the program is implemented are provided in the WIPP Groundwater Monitoring Program Plan (WP 02-1).

The Groundwater Monitoring Program Plan addresses requirements for sample collection, groundwater surface elevation monitoring, groundwater flow direction, data

management, and reporting of groundwater monitoring data. It also identifies analytical parameters selected to assess groundwater quality.

As part of the WIPP Groundwater Quality Sampling Program (WQSP), six wells (WQSP-1 through WQSP-6) were completed to the Culebra. A seventh well (WQSP-6a) was completed to the Dewey Lake Formation. Water samples are collected from these wells and analyzed for certain chemical and physical parameters. This activity generates data in support of the Culebra Groundwater Composition parameter. This parameter calls for analyzing the following ions:

Cations: Ca^{2+}, K^{+}, Na^{+}, Mg^{2+}

Anions: Cl^{-}, HCO_3^{-}, SO_4^{2-}

Water level data are collected to assess changes in Culebra groundwater flow. Water level measurements are tracked over time using WQSP wells and other wells that are widely distributed across the WIPP area to monitor the area's potentiometric surface and groundwater flow directions. If changes in water level(s) occur, the cause is investigated, and any potential impact on the long-term performance of the repository is assessed. These wells can be seen in Figure 1.

4.2.1.1 Sampling and Reporting for Water Quality

Sampling for water quality is performed at seven groundwater monitoring wells. The Culebra is monitored using wells WQSP-1 through WQSP-6, and the Dewey Lake is monitored using well WQSP-6a. Two types of water samples are collected: serial samples and final samples.

Serial samples are taken at regular intervals and analyzed for various physical and chemical parameters (called field indicator parameters) in a mobile field laboratory positioned at the wellhead. The serial sample data are used to determine when a representative sample of the formation water can be taken. The field indicator parameters are chloride, divalent cations, alkalinity, total iron, pH, Eh, temperature, specific conductance, and specific gravity. Interpretation of the serial sampling data determines when conditions representative of undisturbed groundwater are attained in the pumped groundwater.

When the field indicator parameters have stabilized, indicating that the sample is representative of formation groundwater, final samples are collected in the appropriate type of container for the specific analysis to meet state and federal groundwater requirements. The final samples are submitted to laboratories for chemical analysis. Section 4.2.1 lists the analytes needed to support the PA parameter.

The sample tracking system at WIPP uses uniquely numbered Chain of Custody forms and Request for Analysis forms. For storage or transportation, the primary consideration is that samples must be analyzed within the prescribed holding times for the parameters of interest.

4.2.1.2 Sampling and Reporting for Water Level Fluctuations

Water level measurements are taken in the six groundwater monitoring wells (WQSP-1 through WQSP-6) and other available WIPP wells in the monitoring network shown in Figure 1. The water level monitoring will identify water level fluctuations.

In addition to the water level measurements, density is determined in the wells. This density is used to convert the water level measurements to equivalent freshwater heads for developing potentiometric surface maps.

4.2.2 Schedule

Background water quality in both the upgradient and downgradient monitoring wells has been established for the WIPP. The seven WQSP monitoring wells constructed for the Groundwater Monitoring Program are sampled on a semiannual basis to compare to the baseline water quality.

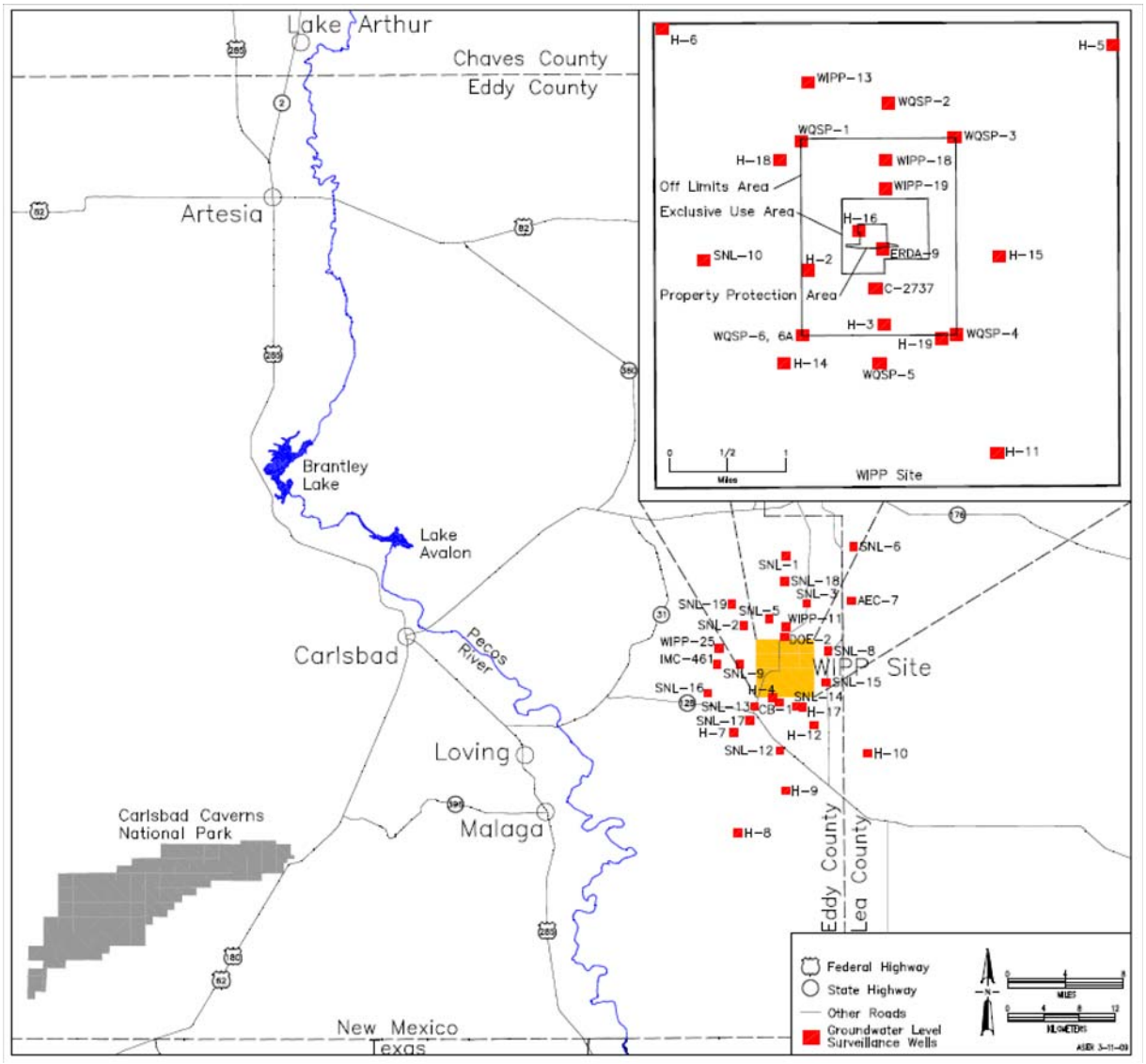

Figure 1 Groundwater Wells

The groundwater level is measured by monitoring the wells at least on a monthly basis. Groundwater level measurements are monitored and collected for other WIPP wells as well as for the WQSP wells. The water levels are determined in at least one accessible, completed interval at each available well pad, and quarterly in redundant wells at well pads where two or more wells are completed in the same interval. Groundwater level measurements primarily examine changes in groundwater flow rate and direction to identify any changes pertinent to compliance. These groundwater data supplement the area water level database.

The characteristics of the Groundwater Monitoring Program, such as the frequency of sampling and the location of the sampled wells, will be reevaluated if significant changes are observed in the groundwater flow direction or gradient. Reporting frequencies are listed in Table 4-1.

Table 4.1 - Sample Collection and Water-Level Reporting Frequency	
Type of Well	**Frequency**
Water Quality Sampling	
WQSP wells (seven)	Semiannually
Water-Level Monitoring	
Other available WIPP wells	Monthly/quarterly
WQSP wells (seven)	Monthly and before sampling events

4.2.3 Program Output

The data and results from this program are summarized and published on an annual basis in the WIPP *Annual Site Environmental Report.*

4.3 Delaware Basin Drilling Surveillance Program

The Delaware Basin Drilling Surveillance Program is implemented by the Delaware Basin Drilling Surveillance Plan (WP 02-PC.02). This plan provides for the surveillance of drilling activities within the Delaware Basin, with specific emphasis on the nine-township area surrounding the WIPP site.

4.3.1 Scope

The Delaware Basin Drilling Surveillance Plan collects information related to the following two parameters:

- Probability of encountering a Castile brine reservoir
- Drilling rate

In addition to the parameters listed above, the Delaware Basin Drilling Surveillance Program collects information on the following activities:

- Borehole plugging
- Enhanced recovery
- Natural gas storage
- Solution mining
- Potash mining
- Seismic events

The WIPP performance assessment includes the impacts of drilling on the performance of the repository. The number of deep boreholes drilled per square kilometer is a parameter used in performance assessment calculations for WIPP inadvertent intrusion scenarios. This parameter is based on actual drilling rates within the Delaware Basin over the last 100 years, as required by 40 CFR §194.33 (EPA, 1996).

The results of the Delaware Basin Drilling Surveillance Program continue to expand the existing database. This program updates these data to detect any substantial deviations from the assumptions used in the previous performance assessment (see Section 4.3.2, Table 4-2). Collecting additional information about resource exploration and exploitation activities and practices in the Delaware Basin provides information to determine whether the drilling scenarios, assumptions, and probabilities used in the performance assessment will continue to be valid for each five-year recertification of WIPP.

Drilling information for the study area is obtained through commercially available databases and the records of government agencies. The database is updated and reviewed weekly to reflect drilling activities in the Delaware Basin. Records of government agencies are updated as they become available.

4.3.2 Schedule

The Delaware Basin drilling database is updated by recording current information into the database. The information collected includes data significant to performance assessment and data of interest to the EPA. The frequency for collecting information for input into the database is listed in Table 4.2.

Table 4.2 - Delaware Basin Drilling Surveillance Plan Data Collection

Information Collected	Frequency
Borehole Plug	Weekly
Enhanced Recovery	Monthly
Gas Storage	Annually
Solution Mining	Annually
Potash Mining	Annually
Seismic Events	Quarterly
Drilling-Related	Weekly
Probability of Encountering a Castile Brine Reservoir	Weekly
Drilling Rate Calculations	Quarterly

4.3.3 Program Outputs

The Delaware Basin Drilling Surveillance Program updates and maintains a database and map of drilling activities and related practices in the Delaware Basin (see Table 4.2). The maps of the Delaware Basin are published on request. For the nine-township area surrounding WIPP, the Delaware Basin Drilling Surveillance Program maintains a database containing the following information:

- Plugging and abandonment activities, including descriptions of plugging configurations

- The fraction of plugged and abandoned boreholes that are sealed
- Well conversion activities (injection, disposal, and water)
- Injection well operation (disposal and secondary recovery)
- Drilling activities, including borehole depth, diameter, and type and amount of drilling fluid
- Ownership of state and federal minerals and hydrocarbon leases
- Occurrences of pressurized brine within the Castile Formation

Information collected and recorded in accordance with the Delaware Basin Drilling Surveillance Plan are reported annually in the *Delaware Basin Monitoring Annual Report*.

4.4 Subsidence Monitoring Program

The Subsidence Monitoring Program is implemented by the WIPP Underground and Surface Surveying Program (WP 09-ES.01). Subsidence monitoring measures vertical movement of the land surface relative to a reference location. The technique used to monitor subsidence at WIPP measures the vertical height difference between an array of markers and a fixed reference point outside the subsidence influence of the WIPP underground openings. The fixed reference point is used as the standard and the relative movement of the other markers are compared to it in order to detect vertical differential movement over a period of time. Subsidence monitoring is performed by leveling surveys using techniques to achieve better than Second Order Class II loop closures as outlined by the Federal Geodetic Control Subcommittee.

4.4.1 Scope

The activities associated with the subsidence Monitoring Program are designed to:

- Provide time-related spatial information on surface subsidence within 152.4 meters (m) (500 feet [ft]) surrounding the waste shaft during the operational phase of the repository.
- Provide time-related spatial information on surface subsidence over the influence area of the underground openings for comparison with subsidence predictions.
- Maintain a database of subsidence data.

Subsidence monitoring was chosen by the DOE as a long-term monitoring tool because it effectively meets the requirements in §191.14(b) for long-term monitoring. Subsidence

monitoring is conducted to detect substantial and detrimental deviations from expected repository performance by comparing actual subsidence to predicted subsidence.

Subsidence data currently being compiled will be compared to subsidence predictions. In addition, subsidence monitoring during the operational phase generates data to establish a baseline against which long-term subsidence data and information may be evaluated.

4.4.2 Schedule

Subsidence surveys are performed annually. After closure of the repository, subsidence surveys will be performed at ten-year intervals for the next 100 years, or until no further useful information may be obtained through continued monitoring.

4.4.3 Program Outputs

The Subsidence Monitoring Program generates annual surface subsidence data for 24.14 kilometers (km) (15 miles [mi]) of leveling loops through approximately 50 monuments. Results are reported annually in the WIPP Subsidence Monument Leveling Survey.

4.5 WIPP Waste Tracking

Information on the waste activity parameter is measured or estimated by generator sites through waste characterization activities. Sites are required to report certain information in the Waste Data System(WDS)/WIPP Waste Information System (WWIS).

4.5.1 Scope

Data from the WDS/WWIS is used to generate reports to tabulate key waste parameters. The waste activity parameter includes tracking the total material parameter weights and curie content of 10 radionuclides listed in Section 4.5.3.

Certified data, including radioisotope content and material parameter weight for every waste container are entered into the WDS/WWIS database at the time waste container is submitted for approval for shipment to WIPP. Radionuclide inventory data and material parameter weights for the waste emplaced in the WIPP repository is maintained within the WDS/WWIS database.

4.5.2 Schedule

Radionuclide inventory data and material parameter weights for the waste emplaced in the WIPP repository is maintained within the WDS/WWIS database and available upon request.

4.5.3 Program Outputs

The data collected for the waste activity parameter are tracked by the WDS/WWIS. The WDS/WWIS generates an annual Waste Emplacement Summary Report that is issued each November in the 40 CFR §194.4(b)(4) Annual Change Report. The waste activity parameters being tracked and reported include radiological activity (in curies) that were emplaced during the reporting period and the cumulative activity since waste was first emplaced in the repository. The radionuclides being tracked (in curies) include:

- ^{241}Am
- ^{238}Pu
- ^{239}Pu
- ^{240}Pu
- ^{242}Pu
- ^{233}U
- ^{234}U
- ^{238}U
- ^{90}Sr (strontium-90)
- ^{137}Cs (cesium137)

The WDS/WWIS tracks other waste-related components that are annually reported in the §194.4(b)(4) report. These waste components include:

- Emplaced magnesium oxide (kg per room and per panel)
- Emplaced cellulose, plastic and rubber materials (kg per room and per panel)
- Emplaced container volume (m^3)
- Emplaced ferrous metals (kg)
- Emplaced nonferrous metals (kg)

5.0 POSTCLOSURE LONG-TERM MONITORING

The compliance certification describes DOE plans for postclosure monitoring in accordance with 40 CFR §194.42(d). The DOE will develop a postclosure monitoring plan at the time of closure. Currently, postclosure monitoring has been defined to include the following parameters:

- Culebra water level changes and changes in groundwater flow
- Culebra groundwater composition
- Castile brine reservoir location
- Drilling practices (including plugging)
- Periodic subsidence surveys

The collection of data for each of the parameters will allow the DOE to identify deviation from expected performance. Analysis of such anomalies, if they do occur, may provide information regarding the conceptual models used to predict long-term repository performance. Postclosure monitoring of the disposal system will use subsidence monitoring as the disposal system's primary performance indicator.

5.1 Postclosure Monitoring Requirements

The postclosure monitoring plan will be implemented after final facility closure (sealing of the shafts). The postclosure monitoring plan, developed at the time of closure, will take into account the results of data collected under the preclosure monitoring program. The postclosure monitoring program will be implemented after review and approval by the appropriate authorities.

5.2 Postclosure Monitoring System Specifications

The postclosure monitoring specifications require:

- A monitoring system designed and implemented to detect substantial deviations from expected disposal system performance after closure.
- Monitoring techniques that do not jeopardize the containment of waste in the disposal system.
- Monitoring that will continue as long as practicable, and/or until the DOE can demonstrate to the EPA that there is no significant concern to be addressed by further monitoring.
- A postclosure monitoring system design that requires minimal support from humans.
- A system that will endure the natural environment.
- A system that does not require unreasonably large support facilities.
- A system that is secured from public access components which are susceptible to vandalism.

In the late operational phase of WIPP, a closure review study will be initiated to assess the condition of the facility at closure. The study is to determine the appropriate repository parameters to be monitored and to evaluate:

- Data generated during the operational phase.
- Regulatory requirements at the closure date.
- Determination of the appropriate disposal system parameters to be monitored.

6.0 MONITORING PROGRAMS QUALITY ASSURANCE REQUIREMENTS

The quality of the work performed under the Compliance Monitoring Program is accomplished per the criteria of 40 CFR §194.22(a)(2)(ii) and controlled by the application of the CBFO *Quality Assurance Program Document* (QAPD) DOE/CBFO-94-1012.

In addition to the management requirements, such as document and record control established in the QAPD, requirements related to sampling and monitoring activities are specified. In particular, the following two sections of the QAPD are directly related to the performance of monitoring work and the control of samples:

Section 2.4 – Inspection and Testing

- Qualification of personnel
- Inspection
- Test requirements
- Monitoring, measuring, testing, and data collection
- Use and control of measuring and test equipment
- Calibration

Section 4.0 – Sample Control Requirements

- Sample control
- Sample identification
- Handling, storing, and shipping samples
- Disposition of nonconforming samples

WIPP monitoring programs are subject to EPA inspections in accordance with 40 CFR §194.21 (EPA, 1996).

The Compliance Monitoring Implementation Plan relies on the individual monitoring plan's QA program to ensure compliance with DOE WIPP requirements for data quality assessments, objectives, and analyses. Each sampling and monitoring program is implemented through individual implementation plans, which include the QA descriptions, objectives, and references to the applicable governing QA documents.

7.0 REPORTING AND ASSESSMENT

Information flow is controlled to ensure that important monitoring results are communicated to the appropriate individuals and groups.

7.1 Management and Operating Contractor Monitoring Data Reporting

The monitoring programs that generate the data used in the Compliance Monitoring Program have been implemented by the M&OC. The reporting of the data for the Compliance Monitoring Parameters is coordinated through the M&OC.

The M&OC serves an information-exchange function by communicating important monitoring results to the scientific advisor.

7.2 Scientific Advisor Compliance Monitoring Assessment Report

The Scientific Advisor reports the results of the compliance monitoring parameter in the Compliance Monitoring Parameter Assessment Report. The results of this report may indicate two general cases: normal or expected conditions, in which results are generally consistent with existing data, parameter values, and conceptual models; and anomalous conditions, in which results are inconsistent with existing data, parameter values, or conceptual models. The DOE determines whether these results are consistent with expected conditions modeled in the PA or screening decisions used to support the compliance determination. The report also recommends if the compliance monitoring parameters should be modified based on results of the monitoring programs.

This report is sent to the EPA as part of the annual reporting requirement of 40 CFR §194.4(b)(4).

7.3 Carlsbad Field Office

7.3.1 Internal Reporting

The CBFO Office of Site Operations is the centralized point of contact for internal reporting of the Compliance Monitoring Program results and evaluations, the assessment of their significance, and the communication of important results and evaluations to external parties. In this role, the CBFO Office of Site Operations is responsible for the following:

- Reviewing Compliance Monitoring Program monitoring results, which may indicate:
  - Normal or expected conditions in which results are generally consistent with existing data, parameter values, and conceptual models
  - Anomalous conditions that are inconsistent with existing data, parameter values, or conceptual models. It is the responsibility of the CBFO Office of Site Operations to review recommendations provided by the M&OC and the scientific advisor generated through the monitoring programs to determine whether these results are consistent or inconsistent with expected conditions modeled in performance assessment or screening decisions used to support the compliance determination
- Defining responsive actions or changes in response to anomalous results that may warrant changes in the monitoring programs, research activities, performance assessment assumptions, or some other aspect of the overall compliance program
- Internal reporting of anomalous results to the CBFO Manager and recommending appropriate external reporting

7.3.2 External Reporting

The CBFO Office of Site Operations reviews the recommendations of the M&OC and the scientific advisor to evaluate their significance. Significance is determined based on consideration of the following criteria:

- The containment requirements established pursuant to 40 CFR §191.13 are, or are expected to be, exceeded.

- Releases from already emplaced waste lead to committed effective doses that are, or are expected to be, in excess of those established pursuant to 40 CFR §191.15 (not including emissions from operations covered pursuant to Subpart A of 40 CFR Part 191).

- Releases have caused, or are expected to cause, concentrations of radionuclides (or estimated doses due to radionuclides in underground sources of drinking water in the accessible environment) to exceed the limits established pursuant to Subpart C of 40 CFR Part 191.

If monitoring results meet any of these criteria, the results are considered significant. Significant monitoring results are promptly reported to the EPA. The report is accompanied by a recommended course of action, including the appropriate external reporting. If the monitoring results exceed or possibly exceed containment requirements or release limits as specified in 40 CFR §194.4(b)(3)(ii), the CBFO will immediately cease emplacement of waste in the WIPP and notify the EPA within 24 hours.

For normal conditions where monitoring results are within expectations, the compliance monitoring parameter assessment will document this condition.

8.0 REFERENCES

DOE, *Quality Assurance Program Document*, DOE/CBFO 94-1012, (Compliance Recertification Application Appendix QAPD) CBFO, Carlsbad, NM.

DOE, *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant*, DOE/CAO 96-2184, October 1996, CBFO, Carlsbad, NM.

DOE, *Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application 2004*, DOE/WIPP 2004-3231, March 2004.

DOE, *Waste Isolation Pilot Plant Certification Management Plan*, DOE/CBFO 99-2296.

EPA, 40 CFR Part 191, "Environmental Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes"; Final Rule, *Federal Register*, Vol. 5, No. 242, pp. 66398-66416, December 20, 1993, Washington, D.C.

EPA, 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, No. 95, p. 27354, May 18, 1998, Washington, D.C.

EPA, *Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*: Proposed Certification Decision, EPA 402-R-97-013, October 1997, Docket A-93-02, Item III-B-2.

M&OC, WIPP Geotechnical Engineering Program Plan, WP 07-1, WIPP, Carlsbad, NM.

M&OC, WIPP Groundwater Monitoring Program Plan, WP 02-1, WIPP, Carlsbad, NM.

M&OC, Delaware Basin Drilling Surveillance Plan, WP 02-PC.02, WIPP, Carlsbad, NM.

M&OC, WIPP Underground and Surface Surveying Program, WP 09-ES.01, WIPP, Carlsbad, NM.

Public Law 102-579, 104-201, Waste Isolation Pilot Plant Land Withdrawal Act.

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