North Railroad Avenue Plume Superfund Site

Española, Rio Arriba County, New Mexico

EPA ID # NMD986670156

Operation & Maintenance Plan

New Mexico State Fiscal Year 2027

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LIST OF ACRONYMS

3DME®	3-D Microemulsion
BDI® Plus	Bio-Dechlor INOCULUM® PLUS
bgs	below ground surface
Cascade	Cascade Drilling, L.P.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
***cis*-1,2-DCE**	*cis*-1,2 dichloroethene
COC	Chain-of-Custody Form
CRS®	Chemical Reducing Solution
CVOC	Chlorinated Volatile Organic Compounds
D&D	Decommissioning and Demolition
DHC	*Dehalococcoides*
DIE	Directional Injection Enhancements
DO	Dissolved Oxygen
ECHC	El Centro Health Clinic
EPA	Environmental Protection Agency
ERD	Enhanced Reductive Dechlorination
ESD	Explanation of Significant Differences
ETS	Enhanced Treatment Strategy
FROG	Field Roving Gas Chromatograph
FS	Feasibility Study
GAC	Granular Activated Carbon
GIS	Geographic Information System
GWQB	Ground Water Quality Bureau
HSU	Hydrostratigraphic unit
INTERA	INTERA Incorporated
ITRC	Interstate Technology Regulatory Council
L	Liter
lb	Pound
LCCS	Las Cumbres Community Services
LTRA	Long-term Remedial Action
MCL	Maximum Contaminant Levels
NMOSE	New Mexico Office of State Engineer
NRAP	North Railroad Avenue Plume Superfund Site
µg/L	Micrograms Per Liter
µg/m^3	Micrograms Per Cubic Meter
NPL	National Priorities List

NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
O&M	Operation and Maintenance Plan
ORP	Oxidation-Reduction Potential
PCE	Tetrachloroethene or perchloroethylene
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
q-PCR	Quantitative polymerase chain reaction
RAO	Remedial Action Objective
ROD	Record of Decision
RPD	Relative Percent Difference
SAP	Sampling Analysis Plan
SEAR	Surfactant Enhanced Aquifer Remediation
SFY	State Fiscal Year
Site	North Railroad Avenue Plume Superfund Site
SIM	Selected Ion Monitoring
S-MicroZVI™	Sulfidated Micro-scale Zero-valent Iron
SOP	Standard Operating Procedure
SOS	Superfund Oversight Section
TCE	Trichloroethylene
***trans*-1,2-DCE**	*trans*-1,2 dichloroethene
TO	Toxic Organic
TOC	Total Organic Carbon
USGS	United States Geological Survey
VC	Vinyl Chloride
VI	Vapor Intrusion
VISL	Vapor Intrusion Screening Levels
VOC	Volatile Organic Compound

1. INTRODUCTION

This Operation & Maintenance (O&M) Plan has been updated by the New Mexico Environment Department (NMED) Groundwater Quality Bureau (GWQB) Superfund Oversight Section (SOS) as a guidance document for conducting O&M activities at the North Railroad Avenue Plume Superfund Site (NRAP or Site) located in Española, New Mexico (**Figure 1**). This O&M Plan is being implemented per the United States Environmental Protection Agency (EPA) Record of Decision (ROD) dated September 2001 (EPA, 2001) and the subsequent Explanation of Significant Differences (ESD) dated March 2008 (EPA, 2008). This report covers New Mexico State Fiscal Year (SFY) 2027, from July 1, 2026, through June 30, 2027.

2. SITE BACKGROUND

The Site is located in the downtown area of the City of Española and on Santa Clara Pueblo trust lands in Rio Arriba County, New Mexico (**Figure 1**). The Site consists of a groundwater plume contaminated with dissolved tetrachloroethene (also known as perchloroethylene or "PCE"). The Site's groundwater plume extended to approximately 58 acres when the PCE contamination was first discovered. The current dissolved PCE groundwater plume has decreased to approximately 23 acres. The dissolved PCE groundwater plume has an approximate depth of 260 feet below ground surface. The source of contamination has been identified as the former Norge Town Dry Cleaners facility located at 113 North Railroad Avenue in Española, Rio Arriba County, New Mexico.

The groundwater contamination was first discovered after PCE was detected in two municipal water supply wells in 1989. The wells were taken off-line and have remained removed from the drinking water supply system. NMED conducted several investigations between 1990 and 1998 to determine the source and extent of the contamination.

EPA proposed the Site to the National Priorities List (NPL) of Superfund sites on July 30, 1998, and the listing of the Site became final on January 19, 1999. The ROD was signed in September 2001 and defined the Site as a single operable unit to address the contamination. The following areas of contamination were targeted for cleanup: 1) the Source Area for soil and groundwater; 2) a "Hotspot" of shallow and deep aquifer groundwater contamination downgradient from the Source Area (**Figure 2**); and 3) dissolved-phase groundwater plumes in the Shallow Aquifer (Shallow Plume - Biocurtain) (**Figure 3**); 4) and four other aquifer zones of intermediate (**Figure 4**) and deep (**Figure 5**) depths (collectively referred to as the "Deep Zone"). EPA's selected remedy consisted of enhanced surfactant and/or co-solvent treatment of the Source Area contamination and enhanced in-situ bioremediation for the Hotspot, Shallow Plume, and Deep Zone. The ROD estimated that the cleanup would be completed within 30 years from the remedy implementation, starting in June 2009. The ROD also stated that other remedial action alternatives (e.g., pump and treat) that were evaluated during the feasibility study (FS), could take as long as 70 to 80 years, or longer, to reach the Remedial Action Objectives (RAOs) established by EPA.

Construction of the remedy began in 2005. Initial operations and field pilot tests were performed on the remedial systems in 2007 and 2008. Based on the pilot test results, EPA eliminated the operation of a surfactant enhanced aquifer remediation (SEAR) system at the Source Area and proposed the use of enhanced reductive dechlorination (ERD) as a bioremediation technology for the Source Area. EPA and NMED conducted a pre-final inspection on April 8, 2008 and determined that the groundwater remediation system was constructed in accordance with the remedial design plans and specifications. Deep Zone treatment injections were initiated on April 28, 2008, and the Source Area, Hotspot, and Shallow Plume treatment systems went online in May 2008. The remedial systems were determined to be operational and functional on June 30, 2009. After this date, the continued operation of the remedial systems was conducted by NMED as a ten-year, long-term response action (LTRA) until June 30, 2019. On June 30, 2019, the LTRA for groundwater was transferred to NMED for O&M until the Site RAOs and remediation goals (cleanup levels) are achieved. The selected remedies and their implementation status are summarized in **Table 1**, and the Site chronology from initial discovery through the current O&M phase is provided in **Table 2**.

3. GROUNDWATER REMEDIATION & MONITORING

This section outlines the groundwater remedy (including ERD operations), the monitoring network, and the sampling and maintenance activities that support the long-term remedy performance.

3.1. OPERATIONS & NETWORK OVERVIEW AND HISTORY

The primary objective of the NRAP Site O&M is to continue implementation of the selected remedial alternative defined in the ROD until the RAOs and cleanup levels are met. NMED is conducting ongoing O&M of the Site remedial system with assistance from NMED's contractor, INTERA Incorporated (INTERA). Current Site remedial O&M activities include targeted remedial injections in the Source Area (as needed) and targeted remedial injections in the Intermediate and Deep Zone Aquifers. Five-year annual cost estimates are included in **Table 3**.

To date, there have been six rounds of electron donor substrate injections completed in the Hotspot area, eight rounds at the Source Area, eight rounds in the Deep Zone, and nine rounds of injections completed at the Biocurtain. The final substrate injections at the Biocurtain were completed between December 2012 and April 2013. The final substrate injections at the Hotspot area were completed in September 2017. Additional substrate injections in the Biocurtain and Hotspot treatment areas are not anticipated to be necessary. Decommissioning and demolition (D&D) of the shallow zone remediation system infrastructure was completed between November 2019 and November 2020 and is detailed in separate reports titled Final Remediation Systems Demolition and Decommissioning Technical Summary Report, North Railroad Avenue Plume Superfund Site, Española, Rio Arriba County, New Mexico (INTERA, 2020a) and Final Remediation Systems Demolition and Decommissioning Addendum Technical Summary Report, North Railroad Avenue Plume Superfund Site, Española, Rio Arriba County, New Mexico (INTERA, 2020b).

Between February 17 and March 20, 2020, INTERA conducted pilot testing of an enhanced treatment strategy (ETS) to augment previous groundwater remedial actions and installed new monitoring wells to further delineate the Intermediate and Deep Zone plumes. Three new injection wells (SAI-8, SAI-9 and SAI-10) and one new monitoring well (SMW-9(D)) were installed in the Shallow Zone in the Source Area. One new Deep Zone monitoring well (R-32(D2)) and nested Intermediate Zone wells (R-33(I1, I2)) were installed at the southern end of the Intermediate and Deep Zone plumes. Analytical results from groundwater samples collected from the new Intermediate and Deep Zone monitoring wells and from discrete-depth (push-ahead) samples collected from the boreholes confirmed the southern extent of the plume in each of the four impacted Intermediate (I1, I2) and Deep Zone (D1, D2) hydrostratigraphic units (HSUs).

The pilot test injections in the Source Area's three new injection wells were designed to evaluate the effectiveness of directional injection enhancements (DIEs) and to enable better distribution of treatment amendments within fine-grained lithologies. The Source Area and Deep Zone injections were also designed to evaluate alternative amendments supplied by REGENESIS Remediation Services. The amendments 3-D Microemulsion (3DME®), a patented molecular structure containing oleic acids bound to lactates/polylactates, and sulfidated micro-scale zero-valent iron (S-MicroZVI™) were selected for testing via DIEs in the Source Area. 3DME® and Chemical Reducing Solution (CRS®) were selected for testing in four existing Deep Zone injection wells (DI-1(D1), DI-2(D1), DI-1(D2), and DI-2(D2)) located at the Plaza de Española. Additional details of the initial pilot test of the enhanced treatment strategy are provided in a separate report titled Final Report for the Enhanced Treatment Strategy Pilot Test and Monitoring Well Installations at the North Railroad Avenue Plume Superfund Site (INTERA, 2020c).

Due to the success of the March 2020 pilot test injections, two rounds of alternative amendment injections were completed in the deep zone and one round in the shallow aquifer. In February 2021, 3DME® and CRS® were injected into R-09(I1), R-09(D1), R-09(D2), and DI-2(D1). In March 2023, 3DME®, S-MicroZVI™, and Bio-Dechlor INOCULUM® PLUS (BDI® Plus), an enriched, microbial consortium containing species of Dehalococcoides sp. (DHC), were injected into R-34(I2), R-15(D1), R-35(D1), and R-35(D2). In March 2024, 3DME®, S-MicroZVI™, and BDI® Plus were injected into the shallow aquifer source area injection wells – SAI-9, SAI-11, SAI-12, SAI-13, and SAI-14 (INTERA, May 2024). In December 2025, 6,000 pounds (lbs) of 3DME®, 2,000 lbs of S-MicroZVI™, and 29 liters (L) of BDI® Plus were mixed with water and injected into the Intermediate (I2) and Deep Zone (D1, D2) HSUs wells – R-08(I2), DI-1(D1), DI-2(D2), M-20(D2), and R-36(D2) (INTERA, 2026c). From March 2021 to May 2026, 15 wells have been installed: 1) as injection wells, 2) to monitor the effects of amendment injections, and/or 3) to help determine the western and southern delineation of the HSU-D2 deep zone. See **Table 2** for the Site's chronology.

3.2. GROUNDWATER MONITORING & SAMPLING

The specific objective of the groundwater monitoring program is to evaluate the overall effectiveness of the ERD groundwater remedy in the four treatment areas (Source Area, Hotspot,

Biocurtain, and Deep Zone) and to reduce contaminant concentrations in groundwater to below the Site's cleanup levels.

Figure 6 depicts the current groundwater sampling network. Groundwater monitoring will include water level measurements and the collection of groundwater samples for laboratory analyses. Groundwater samples are collected from 108 Site monitoring wells and remediation wells. A total of 81 wells (counting individual FLUTe well monitoring ports) will be sampled for volatile organic compounds (VOCs) on an annual basis with the remaining 27 wells included on a triennial (every third year) sampling event. The 81 wells sampled annually are primarily located within the treatment areas and plume core, where the highest concentrations of chlorinated solvent have been historically observed, and at the leading edge of the historical shallow aquifer plume. The 27 remaining wells will be sampled triennially for VOCs to verify that the plume boundaries within each aquifer zone have not changed. **Table 4** provides a list of all site monitoring wells and remediation treatment wells included in the sampling program and a brief explanation for the criteria for sampling. The table is organized by aquifer zone and area, and is color coded for wells included in the annual (blue) and triennial (yellow) sampling schedule. INTERA samples 22 wells (counting individual FLUTe well monitoring ports) and is color coded in orange. INTERA and NMED sample six wells jointly using low flow and HydraSleeve™ sampling methods and is color coded in purple. These wells will be sampled and analyzed for one or more of the following analytes: VOCs, total organic carbon (TOC), dissolved gases, and biological parameters to measure ERD performance. Forty one (41) wells located within and immediately downgradient of the ERD treatment areas will be analyzed by NMED or INTERA for dissolved metals to determine if the reducing conditions created by the ERD remedy cause arsenic, manganese, and iron to persist at concentrations above the New Mexico Water Quality Control Commission (NMWQCC) standards.

Groundwater samples will be analyzed in accordance with **Table 5**. Groundwater sampling and monitoring activities are primarily conducted by NMED with support from INTERA, in accordance with the NMED GWQB SOS Quality Management Plan (QMP) (NMED, 2026b), Quality Assurance Project Plan (QAPP) (NMED, 2026c), and **Standard Operating Procedure 09 (SOP 09)** (NMED, 2022). A Sampling and Analysis Plan (SAP) will be prepared for each annual event to include event-specific details.

3.2.1. Water Table Elevation Measurements

Water level measurements are collected to evaluate groundwater flow direction, hydraulic gradients, and seasonal variations within the alluvial aquifer. Water table levels are measured from all monitoring wells at the start of each sampling event, prior to sampling, using electronic water level probes in accordance with **NMED SOP 08, Section 8.1** (NMED, 2022).

3.2.2. Groundwater Analytical Parameters

Groundwater samples are analyzed for parameters that assess both contaminants of concern (COC) concentrations and the effectiveness of the ERD process. The ROD identified PCE and

trichloroethylene (TCE) as site-related COCs. Other site-related contaminants are the PCE degradation products *cis*-1,2 dichloroethene (*cis*-1,2-DCE), *trans*-1,2 dichloroethene (*trans*-1,2-DCE), and vinyl chloride (VC). They were detected in groundwater at the time the ROD was issued, in 2001, but were not identified as COCs in the ROD because their concentrations were below federal drinking water maximum contaminant levels (MCLs). However, since 2001, the concentrations of these contaminants have increased to levels that now exceed the federal drinking water MCLs. Supporting analyses can include nitrate, sulfate, chloride, total organic carbon, and dissolved metals (iron, manganese, arsenic), which indicate redox conditions and substrate utilization. Additional parameters such as methane, ethane, ethene, and sulfide confirm the presence of reducing conditions favorable for dechlorination. Quantitative polymerase chain reaction (q-PCR) analyses for DHC and associated reductive dehalogenase genes are used to verify the microbial activity responsible for solvent degradation. Sample containers, analytical methods, preservatives, and maximum hold times are presented in **Table 5.**

3.2.3. Groundwater Sampling Methods

Passive Sampling

HydraSleeve™ samplers have been used in the majority of groundwater monitoring wells since the November 2022 groundwater sampling event. HydraSleeve™ samplers are primarily used because they provide representative groundwater samples with minimal purge water generation, reduced field time, and lower overall cost compared to traditional methods. Because passive samplers are no-purge methods, field parameters (pH, conductivity, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP)) are not collected during sampling at most wells. At a subset of wells, field parameters may be collected by pouring water from the passive sampler into a container for measurement or by deploying a down well multiparameter water quality meter.

Prior to field activities, the correct HydraSleeve™ size, configuration, and tether length will be determined during the purchasing process of the HydraSleeve™. The tether length will be determined for each well based on the placement of the HydraSleeve™ in the middle of the screened interval, and each tether will be cut to length by the manufacturer. The manufacturer's specifications and operating manual for the HydraSleeve™ passive sampler are provided in **Attachment A**.

Low-Flow Sampling

Samples not collected using HydraSleeve™ are collected using one of the following purge/sampling methods based on the water levels and purge volume requirements. "Shallow zone" (S1 and S2) and some "shallow intermediate" zone wells (I1 wells) with static water levels of less than 15 feet below ground surface (bgs) are purged with low-flow peristaltic pumps with dedicated tubing. The three remediation drive-point wells (RDP-01, -02, and -03) will be sampled using certified-clean disposable hand bailers due to their remote location. Shallow wells requiring greater purge volumes (4-inch diameter), and deep wells (less than 190 feet) will be purged and sampled using 12-volt battery operated submersible pumps (Mega-Monsoon®) with dedicated

tubing. Deep wells (greater than 190 feet) are sampled using submersible pumps equipped with a 200 to 300 ft reel of reusable tubing (Grundfos®) that will be decontaminated between wells (**NMED SOP 23,** (NMED, 2022)). The pump intake for wells with screens completed across the water table interface will be positioned at the midpoint of the screen interval. The pump intake for wells with screens completed below the static water table will be positioned approximately 2 feet above the top of the screen interval. Sample containers, analytical methods, preservatives, and maximum hold times are presented in **Table 5**.

3.2.4. Comparison Study

To determine if the HydraSleeve™ samplers could be a viable option for collecting groundwater samples for VOCs and dissolved metals, eight wells were used in a comparison between HydraSleeve™ samplers and the low flow sampling method in November 2022. In the annual groundwater sampling events from 2023 to 2025, nine to 12 wells were used to compare HydraSleeves™ to the low-flow purging and sampling methods. In the Interstate Technology Regulatory Council's (ITRC) Passive Sampling Technology Update, the United States Geological Survey (USGS) recommends using relative percent difference (RPD) to compare two sampling data points for technology usability at a site. A lower RPD means the results are similar. The USGS recommends using RPD up to +25% for VOCs and trace metal concentrations greater than 10 microgram per liter (µg/L) and RPD up to +50% for VOCs and trace metal concentrations less than 10 µg/L (ITRC, 2024).

The results of the comparison data set compiled from November 2022 to October 2025 showed that HydraSleeve™ samplers work well at most locations. However, they produced results that deviate from the comparison sample locations in recently treated groundwater. Therefore, HydraSleeve™ samplers will be used to collect groundwater samples at monitoring wells that are not located close to injection wells that have recently had groundwater treatment injections. One of three purge/sampling methods (peristaltic pump, hand bailer, or submersible pump) will be used at the monitoring wells near recent treatment injections. Also, many of the high RPD values are due to low concentration results. Comparison samples of selected wells should continue to be collected at the annual groundwater monitoring events to determine the trends of HydraSleeve™ and low-flow sampling techniques.

3.2.5. Field Documentation & Supporting Field Procedures

Field activities are documented in accordance with **NMED SOP 04** (NMED, 2022), including site logbooks and well sampling forms. Additional supporting procedures are conducted to ensure data quality, regulatory compliance, and safe field operations. These include equipment decontamination between wells (**NMED SOP 23** (NMED, 2022)), proper management of waste (**NMED SOP 09, Section 9.4** (NMED, 2022)), and shipping samples under chain-of-custody procedures (**NMED SOP 09, Section 9.7** (NMED, 2022)).

3.3. Network Maintenance

Site O&M activities include the inspection, maintenance, and repair of groundwater monitoring wells to ensure the continued functionality of the monitoring network. Routine maintenance is performed during groundwater sampling events, and it includes the inspection of well vaults for issues such as stripped threads, missing bolts, loose vaults, missing well caps, corroded inner vaults, etc. Observations are recorded in field forms and logbooks. Wells may be redeveloped, as necessary, if their condition is suspected to affect monitoring results or impede future bioremediation injections. Service contracts will be obtained with an outside consulting contractor to complete well vault repairs depending upon the number of repairs needed (quantity) and available funding each year.

4. Vapor Intrusion Mitigation & Monitoring

This section describes monitoring activities used to evaluate vapor intrusion (VI) conditions to ensure continued protectiveness.

4.1. Vapor Intrusion Monitoring & Sampling

The VI monitoring program monitors sub-slab soil gas, indoor air, and outdoor air concentrations. Results are compared to EPA Vapor Intrusion Screening Levels (VISLs) and baseline conditions to assess exposure risks and ensure long-term protectiveness.

VI monitoring is performed by NMED once per year. Sampling procedures, analytical methods, and quality control requirements are outlined in the SAP (NMED, 2026a) and QAPP (NMED, 2026c), which provide detailed guidance for sub-slab, indoor, and outdoor air sampling in accordance with EPA Methods Toxic Organics (TO)-15 and TO-15 Selected Ion Monitoring (SIM). During sampling, field staff record flow rates, sampling durations, and canister vacuum pressures before and after sampling to ensure proper sample collection. All samples are analyzed for site-specific COCs (PCE and TCE) and PCE degradation products (*cis*-1,2-DCE, *trans*-1,2-DCE, and VC) by EPA Methods TO-15 and TO-15 SIM using gas chromatography/mass spectrometry.

4.1.1. Sub-Slab Soil Gas Sampling

Sub-slab soil gas sampling is performed through one permanent sub-slab vapor pin installed in the floor of classroom three in the Las Cumbres Community Services (LCCS). Samples are collected using dedicated tubing connected to evacuated 1-L Summa® canisters with 5-minute regulators. Sub-slab soil gas samples measure chlorinated volatile organic compound (CVOC) concentrations directly beneath structures to assess potential VI risk. The sub-slab sampling location is shown in **Figure 7**.

4.1.2. Air Sampling (Indoor and Outdoor/Ambient)

Air samples are collected using 6-L Summa® canisters deployed for an 8-hour or 24-hour integrated sampling period. Indoor air samples are collected from the former dry cleaner and the

El Centro Health Clinic (ECHC) Annex buildings for 8-hour commercial use and the LCCS building for 24-hour residential use. NMED and EPA consider the more stringent residential VISLs to be appropriate in assessing the need for further action at the LCCS, since the LCCS is occupied during the day by infants and toddlers when in use – such young children are considered a sensitive sub-population by EPA in assessing the potential for health concerns. Outdoor samples are placed near the former dry cleaner and the LCCS structures to represent ambient background conditions. Analytical results for CVOCs are compared to EPA VISLs to evaluate VI risk. The number of structures sampled during each monitoring event is dependent on property access agreements and resident participation. **Figure 7** shows structures that are sampled annually.

4.1.3. Sample Custody & Shipping

All samples are labeled with unique IDs and documented on chain-of-custody forms. Summa® canisters are sealed, packed in coolers or shipping containers, and shipped under custody seals to a certified laboratory for analysis.

5. Summary of Recent & Planned O&M Activities

5.1. Recent O&M Activities

5.1.1. ERD Amendment Injections

INTERA and its subcontractor, REGENESIS®, injected into the Intermediate (I2) and Deep Zone (D1 and D2) HSUs in December 2025 due to increasing concentrations in those HSUs. The following wells were targeted: R-08(I2), DI-1(D1), DI-2(D2), M-20(D2), and R-36(D2) (**Figure 4** and **Figure 5**). The injections focused on areas with elevated PCE concentrations and had limited or no prior treatment (INTERA, 2026c).

5.1.2. Annual Groundwater Monitoring

NMED and INTERA conducted the annual groundwater sampling event from September 22 to October 14, 2025. Water levels were measured in 108 monitoring wells and groundwater samples were collected from 81 monitoring wells. Results indicate stable groundwater conditions for the HSUs - S1/S2, I1, and I2. However, the groundwater conditions for HSUs D1 and D2 need to be reevaluated with an updated conceptual site model as a result of 1) new monitoring wells drilled to define the southern (along Santa Clara Bridge Road) and western (Plaza de Española) edges of the HSU-D2 PCE plume, 2) increasing PCE concentrations on the western (Plaza de Española) edge of the HSU-D2 PCE plume, and 3) the May 2025 aquifer test. There is a continued presence of PCE and its daughter products in the Shallow Aquifer (HSUs - S1, S2) Source Area and Hotspot. The average total CVOCs have decreased in the Source Area and Hotspot after the March 2024 injections. PCE is the primary CVOC in the Intermediate (I1, I2) and Deep (D1, D2) HSUs. PCE is below MCLs where the amendment injections have been implemented. There has been increasing concentrations of PCE in the HSUs - I2, D1, and D2 which prompted amendment injections (INTERA, 2026e). The September-October 2025 groundwater data will be presented in the 2025 O&M Report, which is yet to be published.

5.1.3. Monitoring Well Installation, Rehabilitation & Maintenance

Monitoring well, R-31(D2), was rehabilitated in Spring 2025 to remove a blockage due to bacteria or mineral growth observed in its screen and was inspected with a well camera in September 2025 by INTERA (INTERA, 2026d).

In April and May 2026, INTERA and its subcontractor, Cascade Drilling, L.P. (Cascade), installed one new monitoring well, R-33(D2), to define the southern edge of the HSU-D2 plume. The well was drilled to a depth of 265 ft bgs and screened from 238.5 to 248.5 ft bgs in HSU-D2. The base of the lower sand interval of HSU-D2 was chosen as the screen interval because the sand bed sat atop a 15-ft sequence of clay layers interbedded with fine-grained sand and field screening results obtained from a Field Roving Gas Chromatograph (FROG). A push-ahead sample from 247.5 to 249.0 ft bgs had detections of PCE, TCE, and *cis*-1,2-DCE below the MCLs from the FROG field screening results and the Eurofins laboratory. For the post development well R-33(D2) sample results, PCE was detected at 2.0 µg/L and TCE was detected at 3.8 µg/L by the Eurofins laboratory. PCE's degradation products, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC, were below the lab's reporting limit of 1.0 µg/L (INTERA, 2026d).

The monitoring well R-12(I2) had a knocked over well monument that separated from the well casing. Cascade removed the accumulated sediment in well R-12(I2) and installed a new 8-inch flush-grade well vault surface. The top of casing of well R-12(I2) must be repaired and extended in SFY2027 because Cascade did not have a pipe cutter to cut down the jagged break at the top of casing. Cascade removed blockages and redeveloped monitoring well R-09(S1) and injection well R-35(D2) (INTERA, 2026d).

5.1.4. Vapor Intrusion Monitoring

In February 2026, NMED sampled the former dry cleaner and ECHC Annex buildings for indoor air and the LCCS building for indoor air and sub-slab soil vapor. PCE was detected in the indoor air samples at the former dry cleaner building and the ECHC Annex, but PCE was below the VISL for both residential (10.8 micrograms per cubic meter (µg/m^3)) and commercial (47.2 µg/m^3) use. In the LCCS classrooms, PCE was detected in the indoor air samples and PCE and TCE were detected in the sub-slab soil vapor samples. The indoor air samples were below the EPA health-based VISLs for residential use of 10.8 µg/m^3. The current PCE and TCE concentrations beneath the building were below the target sub-slab soil vapor concentration for residential (PCE = 360 µg/m^3 and TCE = 15.9 µg/m^3) use. The indoor air samples confirm that PCE and TCE are not intruding into the building above residential VISLs. The February 2026 VI data will be presented in the 2026 O&M Report, which is yet to be published.

5.1.5. Aquifer Test

INTERA performed an aquifer test on May 1, 2025, to 1) determine if the HSU-D2 is bounded by a fault or a natural hydraulic barrier; 2) characterize HSU-D2's southwestern hydraulic properties; and 3) discover if there are hydraulic connections or barriers between HSUs D1 and

D2 (INTERA, 2026b). INTERA recommends additional testing and data collection to characterize and understand HSUs D1 and D2 (INTERA, 2026a).

5.2. SFY2027 O&M Activities

New Mexico SFY 2027 O&M budget allocations for July 1, 2026 through June 30, 2027 are summarized in **Table 3**.

5.2.1. ERD Amendment Injections

One ERD amendment injection event could be scheduled for SFY 2027 for one week depending on funding. It was discussed with INTERA that injections could be planned for the R-34 well cluster on Calle Chavez and the R-35 well cluster on the Hunter Ford property. Injections were last implemented in the R-35 well cluster and injection well R-34(I2) in March 2023. The wells R-34(I1), R-34(D1), and R-34(D2) have only been used for groundwater monitoring and have not been used as injection wells. In HSUs – I2, D1, and D2, there are increasing concentrations of PCE which could prompt amendment injections. If an HSU-I2 well is drilled on the Hunter Ford property or the southeastern quadrant of the Plaza de Española, an injection event could occur.

5.2.2. Annual Groundwater Monitoring

NMED will lead the annual groundwater monitoring in Fall 2026. The annual groundwater sampling event will include approximately 83 monitoring wells to assess CVOCs, geochemical conditions, microbial activity, and water levels. INTERA will assist with the groundwater monitoring event by conducting low-flow sampling on selected monitoring and FLUTe wells. This sampling event is performed annually to monitor the Site's plume and evaluate the effectiveness of the amendment injections.

5.2.3. Monitoring Well Maintenance & Rehabilitation

INTERA will perform routine and site maintenance. Specific tasks include completing well pad maintenance of monitoring well R-12(I2), inspecting R-29 and R-30 FLUTe wells, and replacing cracked well vaults and missing bolts and padlocks. INTERA will rehydrate the granular activated carbon (GAC) drums before the annual groundwater monitoring event and dispose of the GAC drum if impaired. INTERA will trim the elms around the Source Area building and address any trespassing or vandalism around the Source Area and Biocurtain buildings and wells. If any wells are found in need of redevelopment during the annual groundwater monitoring event, solid and liquid waste generated from well redevelopment, including spent substrate or sediment, will be containerized and transported to an approved Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) disposal facility.

5.2.4. Monitoring Well Installation

PCE concentrations have increased in the past five years in FLUTe well port R-29(I2) from 8.7 µg/L in June 2020 to 37 µg/L in October 2025. Monitoring/injection wells in the HSU-I2 could be installed on the Hunter Ford property, on the southeast corner of the Plaza de Española, and in

other locations in the middle of the plume and at the leading edge of the plume. These wells could be used as injection wells into HSU-I2 to target the increasing PCE concentrations and downgradient locations.

The new well, R-33(D2), installed in 2026 to define the southern edge of the HSU-D2 plume had concentrations of COCs less than MCLs but higher than expected. Monitoring/injection wells in the eastern and southeastern part of the HSU-D2 could be installed and used to inject amendments into the eastern HSU-D2 plume core and leading edge.

Depending on funding, up to seven intermediate and deep zone monitoring/injection wells will be drilled and developed. NMED will observe INTERA and its subcontractors for the installation, development, and survey of intermediate and deep zone monitoring wells. Solid and liquid waste generated from well installations, including spent substrate or sediment, will be containerized and transported to an approved CERCLA disposal facility.

5.2.5. Annual Vapor Intrusion Monitoring

In Winter 2027, NMED will sample the former dry cleaner and ECHC Annex buildings for 8-hour indoor air and the LCCS building for 24-hour indoor air and 5-minute sub-slab soil vapor monitoring. NMED will collect two ambient air, six indoor air, and one sub-slab samples. This sampling event is performed annually to determine if chemical vapors are above EPA's VISLs and target sub-slab soil vapor for residential and commercial use.

5.2.6. Biocurtain Building

In 2024 and 2025, there were incidents of vandalism and trespassing at the Biocurtain Building. The Biocurtain Building is part of the Biocurtain treatment system that was decommissioned in 2020. The Biocurtain building could be donated or demolished depending on funding availability and if a willing party would take the modular building.

5.2.7. Annual Deliverables and Contractor Oversight

INTERA will manage the NRAP Access Database, and write a workplan, technical memos, and their summary of activities report for SFY 2027. NMED will participate in status update calls with INTERA, perform routine contract administration duties, and review INTERA's deliverables. INTERA will finalize previous SFY draft reports. NMED will finalize the 2025 Operation and Maintenance report and write the 2026 Operation and Maintenance Report. Annual groundwater monitoring reports from NMED and INTERA will continue to evaluate the effectiveness of the amendment injections. All NMED Operation and Maintenance reports and INTERA's technical memos and summary of activities reports inform scoping decisions about annual and future O&M plans and activities.

6. DATA EVALUATION

Groundwater monitoring data will be managed by INTERA in the Access database. Microsoft Excel and ArcGIS (Geographic Information System) Pro will be used to evaluate trends in the

data. Plume delineations will be developed using ArcGIS Pro to perform spatial visualization of CVOC concentrations across the Site monitoring network. Review of this data (with graphical presentation of trends as applicable) will be used to evaluate contaminant concentrations within the plume core and areas surrounding the Site.

7. Reporting & Documentation

An annual O&M report will summarize remedy performance, including injection activities, geochemical conditions, groundwater and vapor intrusion monitoring, and maintenance activities. The report will be submitted to EPA for review prior to final release. INTERA will prepare summary technical memoranda for each specific field efforts, including groundwater sampling and injection events, and provide them to NMED following each activity. All field work will be documented through standardized field logs and inspection forms, which NMED will review and incorporate into the annual report. All reports and annual data collection activities are used to evaluate remedy effectiveness and inform decisions regarding annual/future O&M efforts.

8. Institutional Controls

NMED will annually coordinate with the New Mexico Office of the State Engineer (NMOSE) regarding the *State Engineer Order* (NMOSE, 2001) that restricts the permitting of new groundwater wells within the delineated boundaries of the Site. As part of this coordination, an annual review will be conducted to verify that the boundaries of the NMOSE Order remain appropriate based on the current extent of the contamination plume. This order established that no new appropriations of ground water, including new Section 72-12-1 (New Mexico Statutes Annotated (NMSA)) wells, and no transfers of either surface water or groundwater to existing wells will be allowed within the boundaries of NRAP specifically, Sections 3 and 10 of Township 20 North, Range 8 East. NMED requested the order to restrict permitting of wells until the Site meets remediation goals and groundwater concentrations are below MCLs which may take more than 30 years.

9. Community Involvement

NMED maintains access agreements with the City of Española and private residents. NMED annually requests a permit to enter Santa Clara Pueblo Tribal Lands prior to the annual groundwater monitoring event.

Public meetings or availability sessions will be held as deemed necessary by NMED to communicate with the public any updates to the effectiveness of the remediation. Contact information for NMED is communicated to residents with all official correspondence.

NMED will work with the City of Española, Santa Clara Pueblo, and Rio Arriba County to communicate ongoing field activities at the Site. NMED will work with the City of Española, Santa Clara Pueblo, or the New Mexico Department of Transportation on projects that may impact

activities at the Site, such as road resurfacing or underground utility work that could impact locations of existing monitoring or injection wells.

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TABLES

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Table 1. Summary of Selected Remedies and Implementation Status

Remedy Component	Description (per ROD / ESD)	Implementation Summary	Current Status	Monitoring / O&M Component	Next Steps / Notes
SVE	Designed to address adsorbed DNAPL and dissolved-phase contamination in the approximately 1,600 ft^2 dry cleaner release area, extract vapors, and control the accumulation of biogenic gases	Pulse mode from May 2011 to January 2013 ; SVE system was shut down in June 2017 and decommissioned in March 2020	**Decommissioned**	None	None
Biocurtain	Line of alternating extraction and injection wells oriented roughly perpendicular to the groundwater flow direction and parallel with US Highway 84/285	9 injection events from 2008 to 2013; decommissioned and demolished the Biocurtain injection wells, extraction wells, and associated remediation infrastructure in November 2019 and 2020	**Decommissioned**	Groundwater sampling; evaluate performance trends	Continue monitoring groundwater wells; decommission the Biocurtain building
ERD	Injection of EVO and enhanced treatment strategy to promote anaerobic dechlorination in Source Area, Hotspot, Intermediate and Deep zones	7 injection wells in Source Area with 9 events (2008-2024); 3 injection wells in Hotspot with 7 events (2008-2024); 5 injection wells in Intermediate Zone and 12 wells in Deep Zone with 9 events (2008-2025)	**Ongoing**	Groundwater sampling; evaluate performance trends and optimize injection schedule.	Most recent injection event - December 2025. Establish if injection events are needed in SFY2027
GW & VI Monitoring	Long-term monitoring of groundwater and VI media to evaluate remedy performance and maintain protectiveness	Annual and triennial groundwater sampling ongoing; VI monitoring at selected properties	**Ongoing**	Maintain monitoring network (108 monitoring and remediation wells, 3 buildings for VI)	Integrate new and redeveloped wells into O&M network. Continue to monitor VI at 3 buildings

Remedy Component	Description (per ROD / ESD)	Implementation Summary	Current Status	Monitoring / O&M Component	Next Steps / Notes
ICs	Restrict groundwater use within plume boundaries to prevent exposure and protect the remedy	At the request of EPA and NMED in 2001, NMOSE implemented no transfer of either surface water or groundwater to existing wells and restricts permitting of wells until site meets remediation goals and groundwater concentrations are below MCLs	**Implemented / Active**	Periodic review during FYR; coordinate with NMOSE on enforcement	Maintain coordination with NMOSE; lift upon attainment of remediation goals and groundwater concentrations are below MCLs
O&M Transition	Transfer of long-term responsibilities from EPA to NMED upon completion of active response	EPA transferred LTRA to NMED on June 30, 2019	**Ongoing State-Led O&M**	Annual GW & VI monitoring and reporting	Continue annual O&M and reporting

Acronyms:

DNAPL = dense non-aqueous phase liquid
EPA = Environmental Protection Agency
ERD = enhanced reductive dechlorination
ESD = Explanation of Significant Differences (EPA, 2008)
EVO = emulsified vegetable oil
GW= groundwater
ICs = Institutional Controls
LTRA = Long-term Response Action
MCLs = Maximum Contaminant Level
NMED = New Mexico Environment Department
NMOSE = New Mexico Office of the State Engineer
O&M = Operation and Maintenance
ROD = Record of Decision (EPA, 2001)
SFY = state fiscal year
SVE = soil vapor extraction system
VI = vapor intrusion

Table 2 - SITE CHRONOLOGY

Event	Date
Initial discovery - chlorinated solvent contamination was discovered in groundwater samples collected from two City of Española municipal supply wells	1989
Preliminary Assessment (PA) completed by New Mexico Environmental Improvement Division (predecessor to NMED)	July 1990
Screening Site Inspection (SSI) Report submitted by NMED to the EPA for additional site work performed September through November 1991	March 1992
Listing Site Inspection (LSI) Report submitted	April 1993
State-lead removal action to remove material from the Norge Town dry cleaner facility's sewer line lint trap. NMED performed an additional Source Area investigation adjacent to the dry cleaner facility	June 1997
Final NPL listing	January 1999
Remedial Investigation (RI) completed	January 2001
Feasibility Study (FS) completed	June 2001
ROD approved	September 2001
Enforcement documents (Consent Decree, Administrative Order on Consent, Unilateral Administrative Order)	Not applicable
Remedial Design (RD) completed	December 2003
Superfund State Contract, Cooperative Agreement, or Federal Facility Agreement signature	
Remedial Action (RA) on-site construction began	July 2005
Long-term groundwater monitoring events: February 2006, December 2006, October 2007, July 2008, March 2009, October 2009, June 2010, February 2011, August 2011, March 2012, April 2013, June 2014, June 2015, June 2016, June 2017, May 2018, and May 2019	February 2006 – May 2019
Explanation of Significant Differences signed – replace Surfactant Enhanced Aquifer Recovery system with ERD; soil vapor extraction replaced with soil removal, if needed	March 2008
Full-scale operation began - initial substrate injections to all four treatment systems	April 2008
Construction completion date - Preliminary Close Out Report issued	June 2008
Operational and Functional determination	June 2009
First Five-Year Review completed	June 2010
ERD substrate injections completed to different remediation zones: April/May 2008 – Source Area (SA), Hotspot (HS), Biocurtain (BC), Deep Zone (DZ); October 2008 – SA, HS, BC, DZ; April 2009 – SA, HS, BC; August 2009 – SA, HS, BC, DZ; March 2010 – BC; October 2010 – BC, DZ; July 2011 – BC; November 2012 – BC, DZ; April 2013 – SA, BC; April 2017 – SA, HS; September 2017 – SA, HS	April 2008 – September 2017

Event	Date
SVE implemented in SA/HS to address methane detected in well vaults February 2010. 13 soil vapor drive-point wells installed in existing vaults. SVE operated April 9, 2010 to May 28, 2010. Upgraded SVE and operated in pulse-mode late May 2011 to October 2011, June 2012 through July 2012, and November 2012 through January 2013	February 2010 – January 2013
Indoor Air Sampling Events: February and June 2011, September 2012, May 2013, June 2014, June 2015, September 2016, June 2017, May 2018, January 2020, January and April 2021, March 2022, April 2023, January 2024, January 2025, and February 2026	February 2011 – February 2026
EPA performed Optimization Review of Long-Term Response Action (LTRA)	February 2015
Second five-year review completed	July 14, 2015
CDM Smith completed SA/HS investigation and DZ data gap analysis	October 2015
SVE system shut down	2017
Federally-financed LTRA ended, and state-financed Operation and Maintenance (O&M) began	June 30, 2019
Additional investigation of DZ completed	August 11, 2019
Evaluation of carbon substrate injections at Source Area and Hotspot completed	September 11, 2019
Deep Zone Monitored Natural Attenuation Study completed	October 17, 2019
Enhanced Treatment Strategy (ETS) – downgradient DZ drilling and well installations (I1/I2 and D2 zones)	February 2020 – March 2020
ETS – Source Area and Hotspot directional injection well installations and injections; and D1/D2 zone injections completed	February 2020 – March 2020
SA and HS infrastructure D&D	March 2020
SVE system D&D	2020
O&M groundwater monitoring events: June 2020, June 2021, November 2022, November 2023, September 2024, September and October 2025	June 2020 – October 2025
Third five-year review completed	August 19, 2020
ETS – Injections completed in I1, I2, D1, and D2	February – March 2021
ETS – downgradient Deep Zone drilling and well installations (I1/I2 and D2 zones): March and December 2021, November 2022, June 2023, and February and October 2024, May 2026	March 2021 – May 2026
ETS – Injections completed in Deep Zone (I2, D1, and D2)	March 2023
ETS – Source Area and Hotspot directional injection well installations in Shallow Zone (S2)	June 2023
Ready for Reuse (RfR) soil study area determination issued	September 21, 2023
ETS – Injections completed in Source Area and Hotspot Shallow Zone (S2)	March 2024
Aquifer Test completed in Deep Zone (D2)	May 1, 2025
Fourth five-year review completed	August 31, 2025
ETS – Injections completed in Deep Zone (I2, D1, and D2)	December 2025

Table 3
North Railroad Avenue Plume Superfund Site
Española, Rio Arriba County, NM

Annual Non-Labor Cost Projections NM FY 2027-2031
CERCLA Operations and Maintenance

FY[1]	Item	Estimated Annual Cost[2]	Assumptions	Approximate Dates
FY2027	Analytical Services for Annual Groundwater Sampling Event	$ 20,591.51	based on recent years	September/October
	Analytical Services for Annual Vapor Intrusion Sampling Event	$ 6,318.15	based on recent years	February
	Contractor Project Management and Tech Support	$ 70,083.68	based on recent years	August-June
	Workplans/SSHASP updates	$ 24,132.15	based on recent years	August/September
	Well installation, abandonment, and/or injections	$ 109,565.60	based on recent years	November-March
	Special Projects (Biocurtain Building D&D)	$ 203,478.98	based on recent years	February-May
	Annual Monitoring Support/Supplies	$ 87,866.09	based on recent years	September/October
	O&M Activities	$ 16,453.74	based on recent years	November
	Reporting and Database Updates	$ 39,123.69	based on recent years	February-June
	Contingency (5%) and NMGRT	$ 64,301.56	10% of Annual Cost	July-May
	Total	**$ 641,915.15**		
FY2028	Analytical Services for Annual Groundwater Sampling Event	$ 20,591.51	based on 2024	September/October
	Analytical Services for Annual Vapor Intrusion Sampling Event	$ 6,318.15	based on 2025	February
	Contractor Project Management and Tech Support	$ 70,083.68	based on recent years	August-June
	Workplans/SSHASP updates	$ 24,132.15	based on recent years	August/September
	Well installation, abandonment, and/or injections	$ 313,044.59	based on recent years	November-March
	Annual Monitoring Support	$ 87,866.09	based on recent years	September/October
	O&M Activities	$ 16,453.74	based on recent years	November
	Reporting and Database Updates	$ 39,123.69	based on recent years	February-June
	Contingency (5%) and NMGRT	$ 64,301.56	10% of Annual Cost	July-May
	Total	**$ 641,915.15**		
FY2029	Analytical Services for Annual Groundwater Sampling Event	$ 20,591.51	based on 2024	September/October
	Analytical Services for Annual Vapor Intrusion Sampling Event	$ 6,318.15	based on 2025	February
	Contractor Project Management and Tech Support	$ 70,083.68	based on recent years	August-June
	Workplans/SSHASP updates	$ 24,132.15	based on recent years	August/September

FY[1]	Item	Estimated Annual Cost[2]	Assumptions	Approximate Dates
	Well installation, abandonment, and/or injections	$ 313,044.59	based on recent years	November-March
	Annual Monitoring Support	$ 87,866.09	based on recent years	September/October
	O&M Activities	$ 16,453.74	based on recent years	November
	Reporting and Database Updates	$ 39,123.69	based on recent years	February-June
	Contingency (5%) and NMGRT	$ 64,301.56	10% of Annual Cost	July-May
	Total	**$ 641,915.15**		
FY2030	Analytical Services for Annual Groundwater Sampling Event	$ 20,591.51	based on 2024	September/October
	Analytical Services for Annual Vapor Intrusion Sampling Event	$ 6,318.15	based on 2025	February
	Contractor Project Management and Tech Support	$ 70,083.68	based on recent years	August-June
	Workplans/SSHASP updates	$ 24,132.15	based on recent years	August/September
	Well installation, abandonment, and/or injections	$ 313,044.59	based on recent years	November-March
	Annual Monitoring Support	$ 87,866.09	based on recent years	September/October
	O&M Activities	$ 16,453.74	based on recent years	November
	Reporting and Database Updates	$ 39,123.69	based on recent years	February-June
	Contingency (5%) and NMGRT	$ 64,301.56	10% of Annual Cost	July-May
	Total	**$ 641,915.15**		
FY2031	Analytical Services for Annual Groundwater Sampling Event	$ 20,591.51	based on 2024	September/October
	Analytical Services for Annual Vapor Intrusion Sampling Event	$ 6,318.15	based on 2025	February
	Contractor Project Management and Tech Support	$ 70,083.68	based on recent years	August-June
	Workplans/SSHASP updates	$ 24,132.15	based on recent years	August/September
	Well installation, abandonment, and/or injections	$ 313,044.59	based on recent years	November-March
	Annual Monitoring Support	$ 87,866.09	based on recent years	September/October
	O&M Activities	$ 16,453.74	based on recent years	November
	Reporting and Database Updates	$ 39,123.69	based on recent years	February-June
	Contingency (5%) and NMGRT	$ 64,301.56	10% of Annual Cost	July-May
	Total	**$ 641,915.15**		
	FINAL TOTAL	**$ 3,209,575.76**		

Notes:

1. New Mexico State fiscal year.
2. FY26 Inflation adj of 2.3% per April 2024 to April 2025 CPI applied to each Fiscal Year
3. Costs include Environmental Service Contracts and Analytical Lab Costs

Acronyms:

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

D&D - decommissioning and demolition

O&M - operations and maintenance

SSHASP - site specific health and safety plan

Table 4 - Groundwater Monitor Well Information

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
Shallow and Intermediate Background Wells										
R-01(S1)	2	14	4 - 14	5	HydraSleeve	no				shallow aquifer upgradient background well
R-01(S2)	2	23.3	13.3 - 23.3	4	HydraSleeve	no	x			monitors shallow aquifer background water quality conditions
R-01(I2)	2	110	95 - 110	24	HydraSleeve	no	x			intermediate aquifer upgradient background well
Shallow Aquifer - Source Area										
EWMW-4B	4	28.5	18 - 28	35	Low Flow	no	x	x		monitors remediation progress at Source Area - Historic rapid changes observed
R-28(S2)	4	33	8 - 33	50	HydraSleeve	no				monitors plume boundary downgradient of Source Area treatment
SAI-8	4	37	NA	-	-	-				injection well, not sampled
SAI-9	4	36.85	NA	-	-	-				injection well, only sampled for biogenic gas monitoring
SAI-10	4	40.5	NA	-	-	-				injection well, not sampled
SAI-11	4	32	NA	-	-	no				injection well, only sampled for biogenic gas monitoring
SAI-12	4	2	NA	-	-	yes				injection well, only sampled for biogenic gas monitoring
SAI-13	4	32	NA	-	-	no				injection well, only sampled for biogenic gas monitoring
SAI-14	4	42	NA	-	-	-				injection well, only sampled for biogenic gas monitoring
SAI-15	4	30.26	NA	-	-	-				injection well, only sampled for biogenic gas monitoring
SMW-1S	2	22.5	7.5 - 22.5	7.5	-	no				last sampled in 2013, not sampled due to non-detect results
SMW-1D	2	31	26 - 31	5.75	Low Flow	yes	x	x		monitors source area remediation progress
SMW-2S	2	17	7 - 17	-	Low Flow	yes				monitors source area remediation progress
SMW-2D	2	25	20 - 25		Low Flow	yes	x	x	x	monitors source area remediation progress
SMW-3S	2	21	6 - 21	7.5	Low Flow	yes	x	x		monitors source area remediation progress
SMW-3D	2	29	24 - 29	5.25	Low Flow	yes	x	x	x	monitors source area remediation progress
SMW-4S	2	16.5	6.5 - 16.5	5	Low Flow	no				monitors source area remediation progress
SMW-4D	2	25	20 - 25	4.5	Low Flow	yes	x	x		monitors source area remediation progress
SMW-5S	2	18	8 - 18	5.5	Low Flow	yes		x		last sampled in 2013, Needs to be resampled due to VC = 3.4 ppb in 2013. Blockage at 6.91 ft btoc observed in 2025

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
SMW-5D	2	25.5	20.5 - 25.5	4.75	Low Flow	yes	x	x		monitors source area remediation progress
SMW-6S	2	16.9	6.9 - 16.9	5	Low Flow	no		x		monitors source area remediation progress, non-detect results in 2025
SMW-6D	2	26	21 - 26	5	Low Flow	yes	x	x		monitors source area remediation progress
SMW-7D	2	26	21 - 26	5	Low Flow	no	x	x		monitors source area remediation progress
SMW-8D	2	33	23 - 33	5	Low Flow	yes	x	x	x	monitors source area remediation progress
SMW-9D	2	32.4	22 - 32	5	Low Flow	no	x	x		monitors source area remediation progress
Shallow Aquifer - Hotspot										
EWMW-2	4	28	17.5 - 27.5	41	HydraSleeve	no	x			monitors side gradient plume expansion associated w/ Hotspot treatment - increasing metals concentrations
EWMW-3	4	22	11.5 – 21.5	32	HydraSleeve	no				monitors side gradient plume associated w/ Hotspot treatment- historic COC variability
HSE-6	4	33	8 - 33	-	-	no				extraction well, last sampled in 2014, not sampled due to non-detect results
HSE-7	4	27.5	7.5 - 27.5	-	-	no				extraction well, last sampled in 2009, not sampled due to below detection limits
HSE-9	4	24.5	7 - 24.5	-	-	-				extraction well, last sampled in 2009, not sampled due to results below detection limits
HSI-21	2	35	30 - 35	-	-	-				injection well, not sampled
HSI-22	2	35	30 - 35	-	-	no	x			injection well, last sampled in 2023 with VOCs below ARARs and metals above ARARs, High methane levels
Shallow Aquifer - between Hotspot & Biocurtain										
EX-09	2	13.68	5 - 13.68	3	HydraSleeve	no				shallow aquifer boundary definition well
EX-11	2	13.6	5 - 13.6	-	Low Flow	yes	x			associated with El Centro Exxon PSTB site, not sampled, last sampled in 2002 with VOCs below ARARs and metals above ARARs
EX-13	2	13.25	5 - 13.25	3	HydraSleeve	no	x			associated with El Centro Exxon PSTB site, monitors remediation progress downgradient of Hotspot ; significant increase in daughter products since remediation began; increasing metals observed
EX-15	2	13.45	5 - 13.45	-	Low Flow	no				associated with El Centro Exxon PSTB site, not sampled, last sampled in 1999 with BTEX above NMWQCC standards

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
EX-16	2	17.04	7.7 - 17.7	6	HydraSleeve	no				associated with El Centro Exxon PSTB site; monitors remediation progress downgradient of Hotspot, monitoring residual daughter products since remediation began; well filled in at bottom
EX-17	-	11.67	-	2	Low Flow	yes				associated with El Centro Exxon PSTB site, lost well, last sampled in 2010 with VC = 2.7 ppb in 2010
PASMW-01	2	23.3	8 - 23	-	-	-				possible alternate source monitoring well, last monitored in 2021, attributed to off-site source
PASMW-02	2	28.3	8 - 28	-	-	-				possible alternate source monitoring well, last monitored in 2021, attributed to off-site source
PASMW-03	2	23.3	8 - 23	-	-	-				possible alternate source monitoring well, last monitored in 2021, attributed to off-site source
R-03(S2)	2	23.9	14 - 24	9	HydraSleeve	no				shallow aquifer boundary definition well
R-09(S1)	2	16	6 - 16	5	HydraSleeve	no				shallow aquifer boundary definition well
R-12(S1)	2	19.34	9 - 19	6	HydraSleeve	yes				monitors central portion of shallow plume upgradient of Biocurtain
R-24(S2)	2	24.7	10.8 - 24.7	10	HydraSleeve	no	x			monitors remediation progress and metals downgradient of Hotspot - fluctuating VOC and increasing metals conc. observed
R-25(S2)	2	25.2	10 - 25	10	HydraSleeve	no	x			monitors remediation progress downgradient of Hotspot ; monitoring residual daughter products since remediation began; increasing metals conc. observed
SMW-29D	2	35	30 - 35	-	Low Flow	yes	x	x	x	monitors southeastern portion of Source Area
Shallow Aquifer - Biocurtain										
BC-5	2	28.1	9 - 29		HydraSleeve	no	x			monitors remediation within Biocurtain
BC-6	2	28.4	9 - 29	12	HydraSleeve	no	x			monitors remediation progress within Biocurtain - recent increase in concentrations due to Mountain Air Cleaners plume
BC-7S	2	17	7 - 17	5	HydraSleeve	no				upgradient of biocurtain system
BC-7D	2	25.5	20.5 - 25.5	4.75	HydraSleeve	no				upgradient of biocurtain system
R-04(S2)	2	28	17.8 - 27.8	10	HydraSleeve	no	x			monitors remediation within biocurtain
R-08(S2)	2	23	13 - 23	6	HydraSleeve	no				monitors side gradient impacts from biocurtain
R-08A(S2)	1.5	43.2	32.5 - 42.5	12	HydraSleeve	no				assess contaminant extent and concentrations within the shallow Tesuque formation in the southern portion of the plume

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
R-26(S2)	2	40	20 - 40	16	HydraSleeve	no				monitors remediation at edge biocurtain
R-27(S2)	2	39.3	20 - 35 (5' sump)	16	HydraSleeve	yes				monitors remediation within biocurtain
Shallow Aquifer - Downgradient of Biocurtain										
R-05(S2)	2	28	18 - 28	8	HydraSleeve	no	x			monitors remediation progress and plume migration downgradient of biocurtain - recent increase in VC & metals
R-06(S1)	2	15	5 - 15	-	-	no				lost well, last sampled in 1999 with COCs below detection limits
R-06(S2)	2	25	15 - 25	3	HydraSleeve	no				monitors downgradient plume boundary
R-07(S2)	2	23.43	14 - 24	8	-	no				shallow aquifer boundary definition well, lost well, last sampled in 2009 with COCs below detection limits
R-14(S2)	2	25	15 - 25	9	HydraSleeve	no				monitors remediation progress and plume migration downgradient of biocurtain
R-16(S2)	2	30	20 - 30	9	HydraSleeve	no				monitors plume boundary along Rio Grande for potential surface water impacts
RDP-1	2	12.4	5.3 - 9.3	0.4	bailer	no				monitors plume migration downgradient of biocurtain
RDP-2	2	7	2.2 - 6.2	0.3	bailer	no				monitors plume downgradient of biocurtain
RDP-3	1.25	7.8	2.9 - 6.9	0.5	bailer	no				monitors plume boundary and potential surface water impacts along Rio Grande
RDP-4	2	10.2	3.8 - 7.8	0.5	bailer	no				monitors plume boundary and potential surface water impacts along Rio Grande, lost well, last sampled in 2019 with COCs below detection limits
Intermediate Zone Aquifer Wells										
DI-1(I1)	2	75	45 - 75	-	-	no		x		injection well, last sampled in 2010 with COCs below detection limits, not sampled
DI-2(I1)	2	72	58 - 73	-	HydraSleeve/ Low Flow	no				injection well, last sampled in 2025 with COCs below detection limits
DM-1(I1)	2	71.5	51.5 - 71.5	-	HydraSleeve	no	x			monitors intermediate aquifer near former injection location
DM-2(I1)	2	71	51.5 - 71.5	-	HydraSleeve	no				monitors intermediate aquifer near former injection location
EWMW-1	4	59	48.5 – 58.5	108	HydraSleeve	no				monitors potential migration/impacts to intermediate zone below Source Area
EWMW-4A	4	58	47.5 - 57.5	56	HydraSleeve	no	x			monitors potential migration/impacts to intermediate zone below Source Area
R-03(I1)	2	85	70 - 85	21	HydraSleeve	no				intermediate aquifer boundary definition well
R-03(I2)	2	108	93 - 108	25	HydraSleeve	no				intermediate aquifer boundary definition well

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
R-04(I2)	2	95	80 - 95	23	HydraSleeve	no	x			monitors potential migration/impacts on intermediate zone from Biocurtain treatment
R-08(I2)	2	95	80 - 95	23	HydraSleeve	yes	x			monitors southern portion of intermediate plume
R-08A(I1)	2	60.3	50 - 60	15	HydraSleeve/Low Flow	yes	x			assess contaminant extent and concentrations within the shallow Tesuque formation in the southern portion of the plume
R-09(I1)	2	69.5	54.5 - 69.5	19	Low Flow	no		x		injection well as of 2021 – monitors intermediate remediation zone progress
R-09(I2)	2	100	85-95 (5' sump)	24	-	yes				injection well damaged as of 2021, P&A on 11/11/2022
R-10(I1)	2	88	73 - 88	22	HydraSleeve	no				intermediate aquifer boundary definition well
R-10(I2)	2	133	118 - 133	27	HydraSleeve	no				intermediate aquifer boundary definition well
R-11(I1)	2	70	55 - 70	17	HydraSleeve	no				intermediate aquifer boundary definition well
R-11(I2)	2	98	83 - 98	22	HydraSleeve	no				intermediate aquifer boundary definition well
R-12(I1)	2	71.2	56 - ? (10' sump)	18	HydraSleeve	no				intermediate aquifer boundary definition well
R-12(I2)	2	95	80 - 90 (5' sump)	-	HydraSleeve	no				intermediate aquifer boundary definition well, last sampled in 2009 with COCs below ARARs, well fixed in May 2025
R-13(I2)	2	98	83 - 98	-	HydraSleeve	yes				monitors leading edge of intermediate plume - increasing PCE concentrations observed
R-23(I1)	2	65	50 - 65	-	HydraSleeve	no				intermediate aquifer boundary definition well
R-29(I1)	7.5	-	53 - 58	-	FLUTe	no				FLUTe well port monitors northern intermediate zone
R-29(I2)	7.5	-	90 - 95	-	FLUTe	yes				FLUTe well port monitors northern intermediate zone
R-29A(I1)	2	60.3	40 - 60	-	HydraSleeve	no	x			Installed adjacent to R-29 due to complications with FLUTe well installation
R-30(I1)	3	255.4	55.8 - 60.7	-	FLUTe	no				FLUTe well port monitors western intermediate zone
R-30(I2)	3	255.4	80.7 - 85.6	-	FLUTe	no				FLUTe well port monitors western intermediate zone
R-31(I1)	2	95.3	75 - 95	-	HydraSleeve	no				monitors western intermediate zone plume
R-31(I2)	2	131.3	111 - 131	-	HydraSleeve	yes				monitors western intermediate zone plume
R-32(I1)	2	80.3	65 - 80	-	HydraSleeve	no				monitors southern intermediate zone plume

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
R-32(I2)	2	98.8	88.5 - 98.5	-	HydraSleeve	no				monitors southern intermediate zone plume
R-33(I1)	2	60.35	45 - 60	-	HydraSleeve	no				intermediate aquifer boundary definition well
R-33(I2)	2	97.85	87.5 - 97.5	-	HydraSleeve	no				intermediate aquifer boundary definition well
R-34(I1)	4	58.9	43.5 - 58.5	-	Low Flow	yes	x			monitors intermediate zone plume core
R-34(I2)	4	84.9	64.5 - 84.5	-	Low Flow	no		x		monitors intermediate zone plume core
Deep Zone Aquifer Wells										
DI-1(D1)	3	190	170 - 190	84	Low Flow	no		x		deep zone injection well, last sampled in 2021 with COCs below detection limits, injections in March 2020, dropped from sampling program
DI-1(D2)	3	266	226 - 266	112	-	-		x		deep zone injection well, injections in March 2020, not sampled
DI-2(D1)	3	191	156 - 191	83	-	-		x		deep zone injection well, injections in February 2021, not sampled
DI-2(D2)	3	260	235 - 260	110	HydraSleeve	yes		x		monitors deep zone remediation progress within the ERD injection well
DM-1(D1)	3	194	175 - 195	-	HydraSleeve	yes	x			monitors deep zone remediation progress at nearby monitor well
DM-1(D2)	3	262	230 - 265	-	HydraSleeve	yes				monitors deep zone remediation progress at nearby monitor well
DM-2(D1)	3	184	155.5 - 185.5	-	HydraSleeve	no	x	x		monitors deep zone remediation progress at nearby monitor well
DM-2(D2)	3	258	230 - 260	-	HydraSleeve	yes				monitors deep zone remediation progress at nearby monitor well
M-09(D1)	3	191	166 - 191	91	Low Flow	no	x	x	x	monitors deep zone remediation progress at nearby monitor well
M-12	3	195	165 - 195	-	HydraSleeve	yes	x	x		monitors SE portion of deep zone plume outside of treatment well influence
M-15	3	205	185 - 205	91	HydraSleeve/ Low Flow	yes	x	x		monitors deep zone remediation progress at nearby monitor well
M-20	3	227	202 - 227	-	HydraSleeve	yes	x			monitors potential source area remediation effects on the deep zone
M-21	3	229.5	215 - 230	91	Low Flow	R-21				last sampled in 2013, well not representative of COC conc. in surrounding aquifer, dropped from sampling program
R-08(D1)	2	190	175 - 190	-	HydraSleeve	no				deep aquifer boundary definition well
R-09(D1)	2	190	175 - 190	36	Low Flow	no	x	x	x	deep zone injection well, last sampled in September 2025, injections in February 2021
R-09(D2)	4	262 mud 254	242.4 - 257.4	178	Low Flow	no		x		injection well as of 2021 – monitors deep zone remediation progress
R-09(D3)	4	357	342 - 357	244	HydraSleeve	no				vertical definition well in D3 of deep zone
R-10(D2)	4	259	244 - 259	180	HydraSleeve	no				deep aquifer boundary definition well

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
R-12(D1)	2	185	170 - 185	-	HydraSleeve	no				monitors eastern downgradient edge of deep zone
R-12(D2)	4	258	243 - 258	180	HydraSleeve	no				deep aquifer boundary definition well
R-15(D1)	2	205	185 - 205	-	Low Flow	no	x	x	x	deep zone injection well, last sampled in 2025, injections in March 2023
R-17(D1)	2	220	200 - 220	42	HydraSleeve	no				deep aquifer boundary definition well
R-18(D1)	2	231	216 - 231	41	HydraSleeve	no				deep aquifer boundary definition well
R-19(D1)	2	223	208 - 223	40	HydraSleeve	no				deep aquifer boundary definition well
R-20(D2)	2	230	210 - 225	-	HydraSleeve	yes				monitors potential source area remediation effects on the deep zone
R-21(D2)	2	238	213 - 228	43	HydraSleeve	no				monitors deep zone remediation progress within the ERD injection well
R-22(D2)	2	230	205 - 220 (10' sump)	42	HydraSleeve	no				deep aquifer boundary definition well
R-29(D2U)	7.5	-	229 - 234	-	FLUTe	yes				FLUTe well port monitors northern deep zone
R-29A(D1)	2	165.3	150 - 165	27	Low Flow	no	x	x	x	installed adjacent to R-29 due to complications with FLUTe well installation
R-30(D1L)	3	255.4	130.4 - 135.3	-	FLUTe	no				FLUTe well port monitors western deep zone
R-30(D1U)	3	255.4	105.6 - 110.4	-	FLUTe	yes				FLUTe well port monitors western deep zone
R-30(D2L)	3	255.4	240.1 - 245	-	FLUTe	no				FLUTe well port monitors western deep zone
R-30(D2U)	3	255.4	193.3 - 200.2	-	FLUTe	yes				FLUTe well port monitors western deep zone
R-31(D2)	4	255	244.65 - 254.65	-	HydraSleeve/ Low Flow	yes	x	x		deep aquifer boundary definition well, well keeps silting in, rehabilitated in 2025
R-32(D2)	4	252.4	237 - 252	-	HydraSleeve	no				deep aquifer boundary definition well
R-33(D2)	4				HydraSleeve / Low Flow					monitors southeastern deep zone plume
R-34(D1)	4	191	185.5 - 190.5	-	HydraSleeve	yes	x	x		monitors core of deep zone plume
R-34(D2)	4	265.35	245 - 265	174	HydraSleeve/ Low Flow	yes	x	x		monitors core of deep zone plume
R-35(D1)	4	163.3	148 - 163	-	Low Flow	no	x	x		deep zone injection well, last sampled in 2025, injections in March 2023
R-35(D2)	4	241.4	221 - 241	-	Low Flow	yes	x	x		deep zone injection well, last sampled in 2022, injections in March 2023, blockage removed in April 2026
R-36(D2)	4	202.35	192 - 202	590	HydraSleeve/ Low Flow	yes		x		monitors western deep zone
R-37(D2)	4	207.85	192.5 - 207.5	940	HydraSleeve/ Low Flow	yes		x		monitors western deep zone

Well ID	Well Diameter (inches)	Total Depth (ft. BTOC)	Screen Interval	Est. Purge volume (gal)	Sampling Method	Exceeds MCLs	Dissolved Metals	TOC and/or dissolved gases*	Bio parameters (DNA/q-PCR)*	Notes/Data quality objective
Private / Public Supply Wells										
SCTW-2	2	-	-	-	Tap	no				well no longer in use, last sampled in 2009 with COCs below lab detection limits, dropped from sampling program
Cook Estate	-	125	95 - 125	-	Outside Tap	no				well used for irrigation - fluctuating PCE/TCE concentrations observed

Notes:

	Wells sampled annually by NMED
	Wells sampled by NMED's contractor (INTERA) for additional ERD performance monitoring parameters
	Wells sampled on a triennial schedule (next scheduled to be sampled in 2027)
	Wells not sampled
	Wells sampled by NMED and INTERA

* - Parameters collected by NMED's contractor

Acronyms:

ARAR - Applicable or Relevant and Appropriate Requirement	NMED - New Mexico Environment Department
BTEX - Benzene, Toluene, Ethylbenzene, and Xylene	NMWQCC - New Mexico Water Quality Control Commission
BTOC - Below Top of Casing	P&A - Plug and Abandon
COC - Contaminant of Concern	PCE - Tetrachloroethylene
DNA - Deoxyribonucleic Acid	ppb - Parts Per Billion
ERD - Enhanced Reductive Dechlorination	PSTB - Petroleum Storage Tank Bureau
FLUTe - Flexible Line Underground Technologies	q-PCR - Quantitative polymerase chain reaction
ft - Feet	TCE -Trichloroethylene
gal - Gallon	TOC - Top of Casing
INTERA - INTERA Incorporated	VC - Vinyl Chloride
MCL - Maximum Contaminant Level	VOC -Volatile Organic Compound
NA - Not Applicable	

Table 5 - Sample Containers, Preservatives, and Holding Times

Analysis	Method	Container	Preservation/ Storage	Maximum Hold Time
pH	YSI Model Professional Plus*	—	—	—
Conductivity	YSI Model Professional Plus*	—	—	—
Dissolved Oxygen	YSI Model Professional Plus*	—	—	—
Temperature	YSI Model Professional Plus*	—	—	—
Oxidation-Reduction Potential	YSI Model Professional Plus*	—	—	—
VOCs	EPA Method 8260C or SOM02.3	(3) 40-mL VOA vial	pH < 2 (HCl), Cool 4°C	21 days
Dissolved Metals (TAL or As, Fe and Mn only)	ISM02.3 ICP-MS or SW-846 6020A or SW-846 6010B	(1) 125-mLHDPE bottle	pH < 2 (HNO_3), Cool 4°C, Field filtered	180 days
TOC	EPA 9060	(2) 40-mL amber VOA vial	pH < 2 (HCl), Cool 4°C	28 days
Dissolved Gases (CH4, Ethane, Ethene)	RSK 175	(2) 40-mL VOA vials	pH < 2 (HCl), Cool 4°C	14 days
DNA based CENSUS® (q-PCR for DHC and DHC functional genes)	Proprietary	(1) 1-liter poly bottle or Bio-Filter	Cool 4°C	2 days
QuantArray®-Chlor (advanced q-PCR for several contaminant-degrading microorganisms)	Proprietary	(1) 1-liter poly bottle	Cool 4°C	2 days
CSIA ($\delta^{13}C$ ($^{13}C/^{12}C$))	GC-C-IRMS	(12) 40-mL VOA vials	pH < 2 (HCl), Cool 4°C	28 days
Cation/Anion Balance and Alkalinity	EPA Method 6010, EPA Method 300.0, and Standard Method 2320B	Packs with (1) 500-mL, (1) 500-mL, and (1) 250-mL bottle	None, pH < 2 (H_2SO_4), pH £ 2 (HNO_3), Cool 4°C, Filtered for HNO_3	14 days

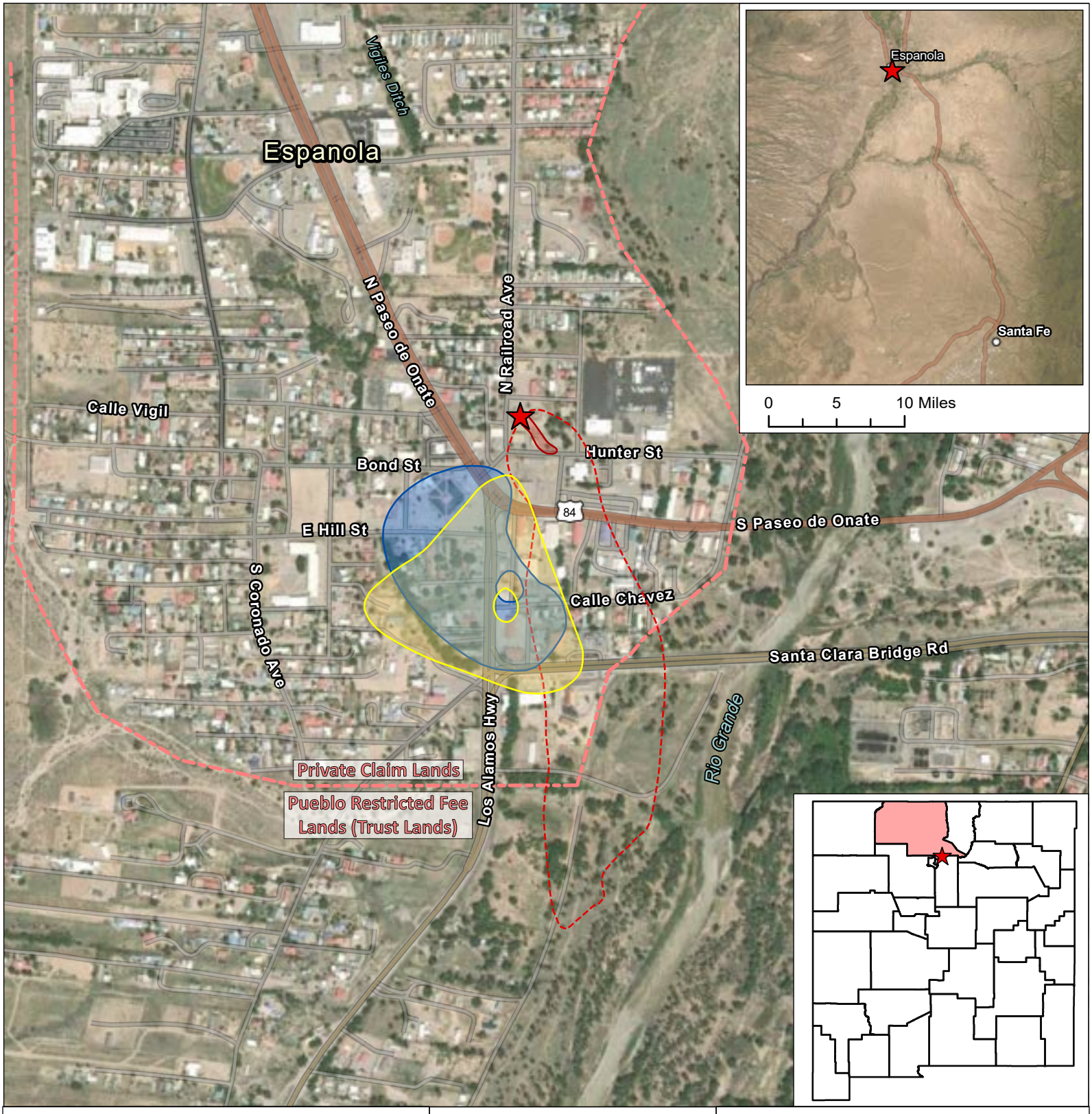
Acronyms:

* = or equivalent
°C = degrees Celsius
CSIA = Compound Specific Isotope Analysis
DHC = *Dehalococcoides*
GC-C-IRMS = Gas chromatography-combustion-isotope ratio mass spectrometry
HCl = hydrochloric acid
HDPE = High-density polyethylene
HNO_3 = Nitric acid
q-PCR = Quantitative polymerase chain reaction
TAL = Target analyte list
TOC = Total organic carbon
VOA = Volatile organic analysis
VOCs = Volatile organic compounds

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FIGURES

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Figure 1. Site Location

North Railroad Avenue Plume
Española, New Mexico
EPA ID #NMD986670156

Legend

- Source Area
- Former Shallow Zone Plume
- Shallow Zone Plumes
- Intermediate Zone Plumes
- Deep Zone Plumes

N

0 375 750 1,500 Feet



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Figure 2. Source Area and Hotspot Bioremediation Wells and System Layout

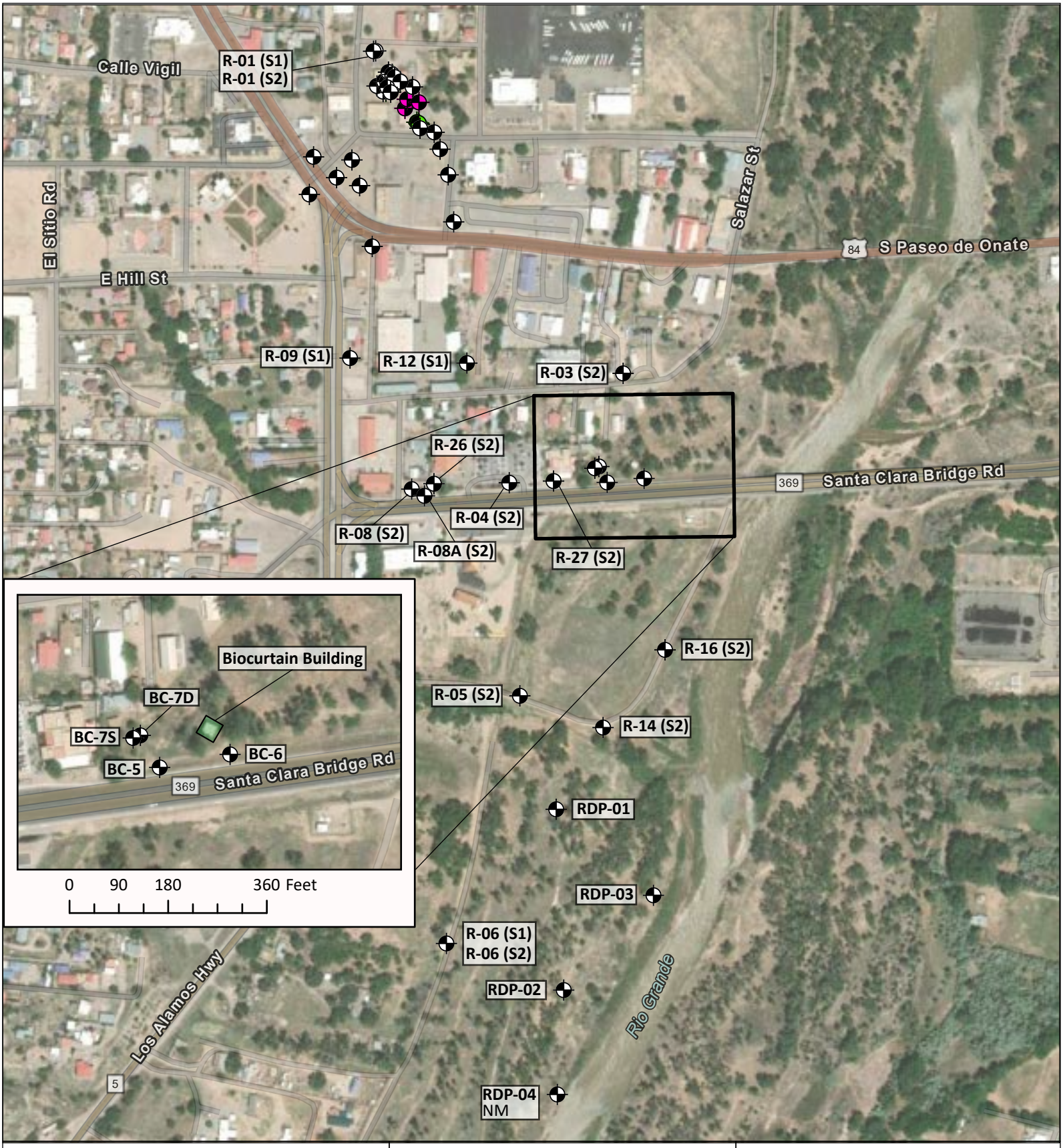
North Railroad Avenue Plume
EPA ID No. NMD986670156
Española, New Mexico

Legend

- Monitor Well
- Injection Well
- Extraction Well

N

0 75 150 Feet



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Figure 3. Biocurtain and Shallow Aquifer Wells

North Railroad Avenue Plume
Española, New Mexico
EPA ID #NMD986670156

Legend

- Monitor Well
- Injection Well
- Extraction Well
- Biocurtain Building

Note: See Figure 2 for Source Area Well detail

N

0 200 400 800 Feet

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Figure 4. Intermediate Zone Bioremediation Wells Layout

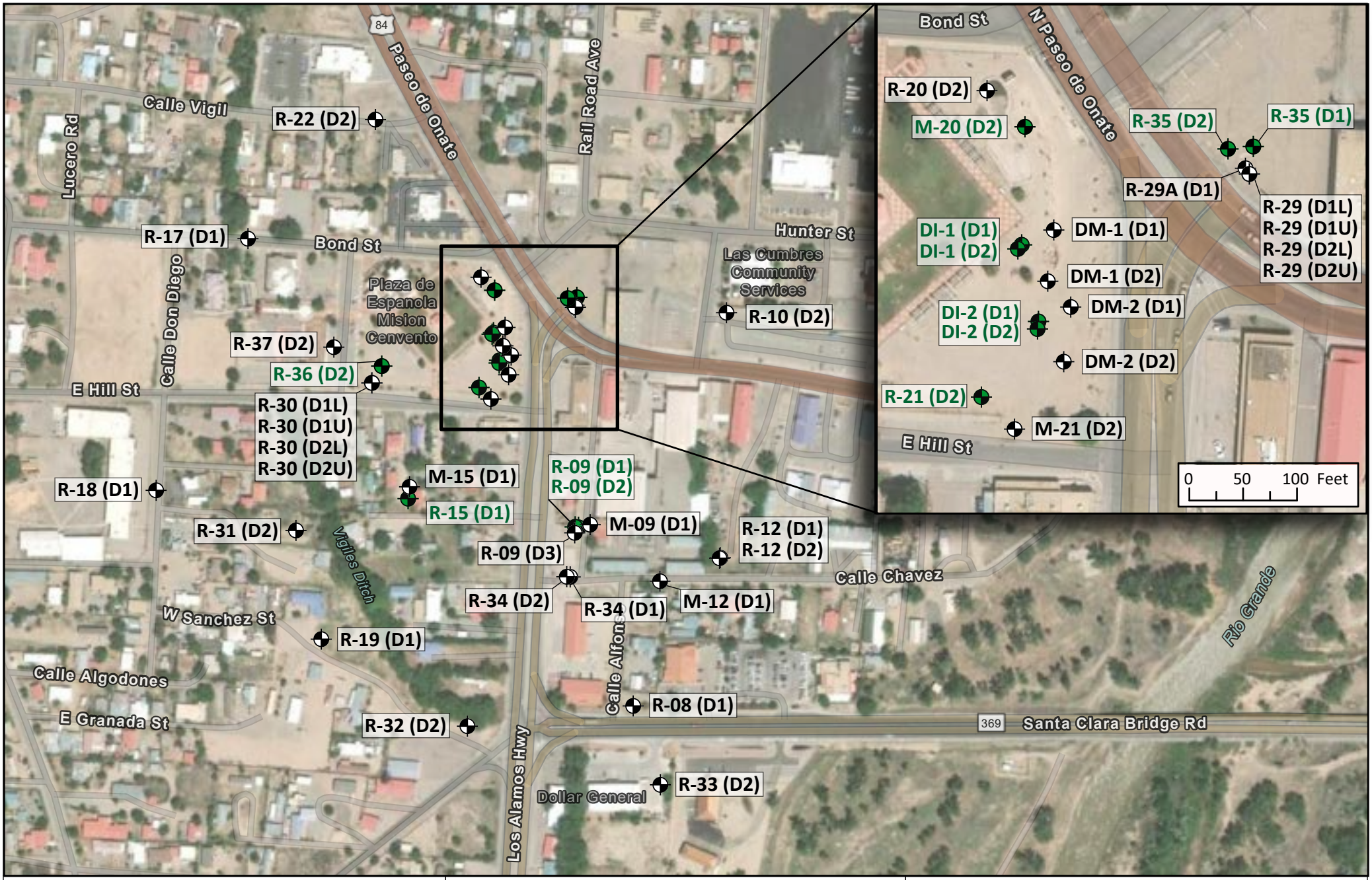
North Railroad Avenue Plume
EPA ID No. NMD986670156
Española, New Mexico

Legend

- Injection Well
- Monitor Well

N

0 150 300 600 Feet



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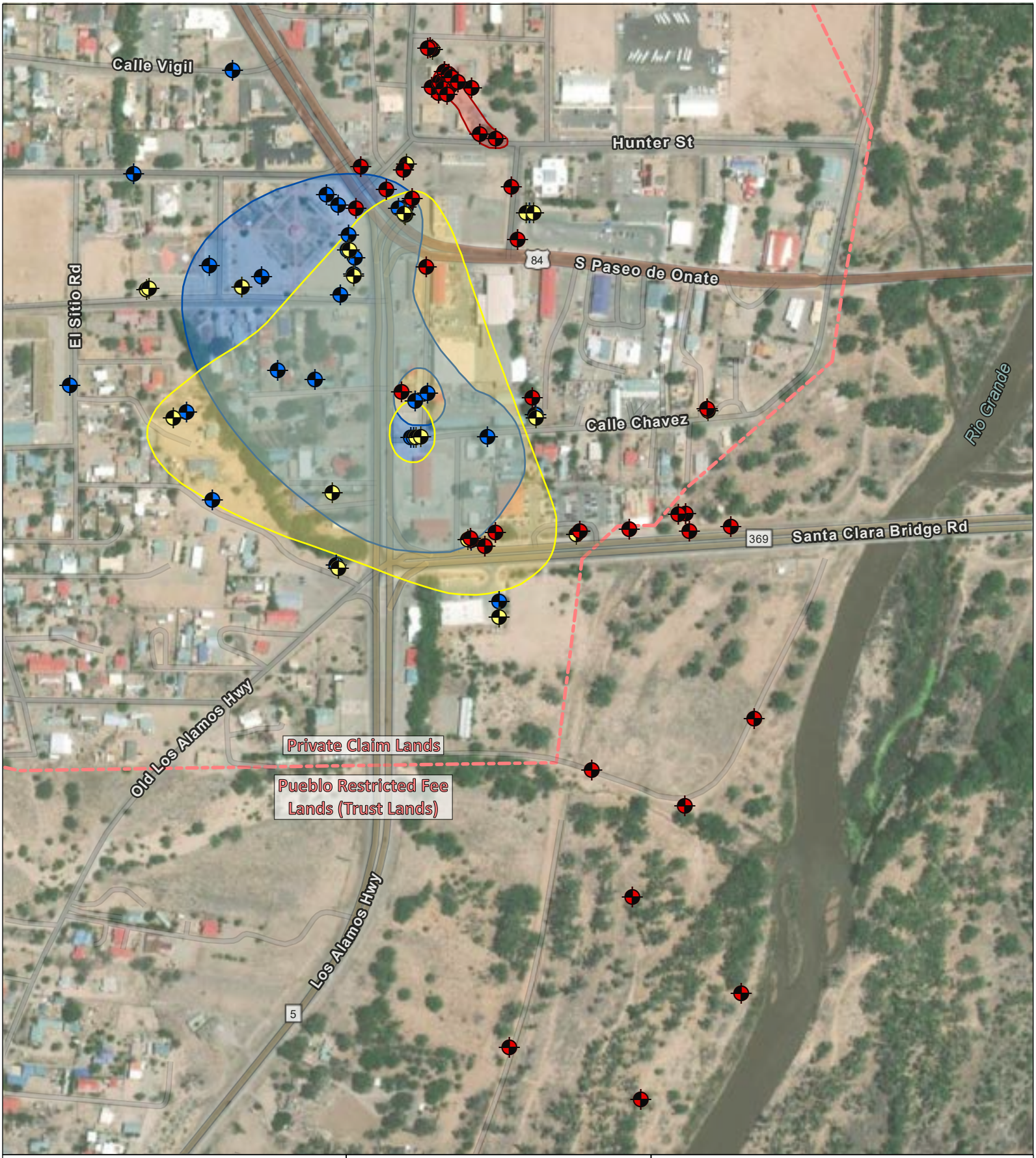
Figure 5. Deep Zone Bioremediation Wells Layout

North Railroad Avenue Plume
EPA ID No. NMD986670156
Española, New Mexico

Legend
- Monitor Well
- Injection Well

N

0 150 300 600 Feet



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Figure 6.
Site Wide Monitor Wells

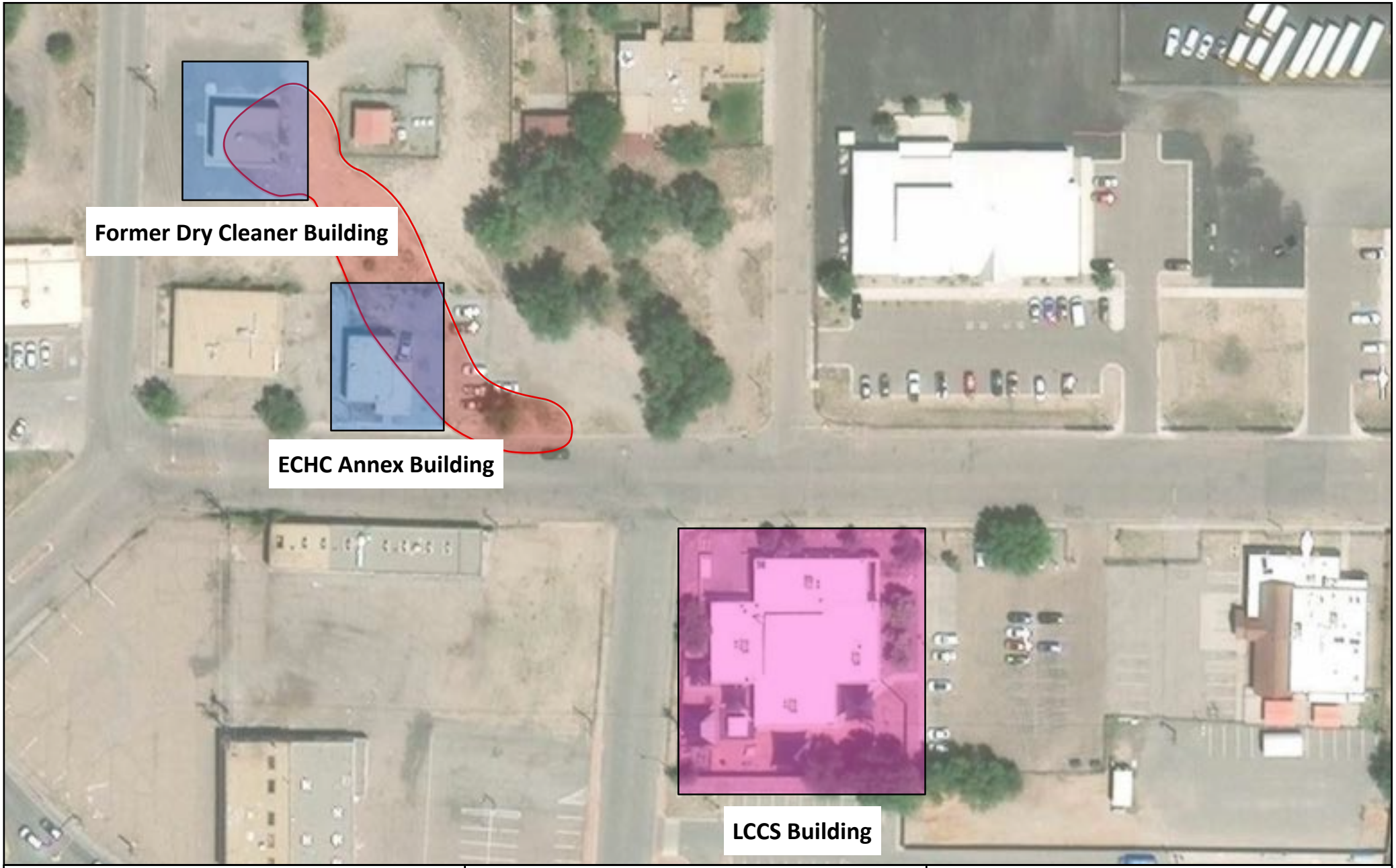
North Railroad Avenue Plume
Española, New Mexico
EPA ID #NMD986670156

Legend

- Shallow Monitor Well
- Intermediate Monitor Well
- Deep Monitor Well
- Shallow Plumes
- Intermediate Plumes
- Deep Plumes

0 400 800 Feet

N



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Figure 7. Source Area Target Buildings for Indoor Air and Sub-Slab Soil Vapor Sampling

North Railroad Avenue Plume
EPA ID No. NMD986670156
Española, New Mexico

Legend

- Indoor Air, Commercial, 8-hr
- Indoor Air, Residential, 24-hr
- Sub-slab Soil Vapor, 5-minute
- Shallow Plumes

0 50 100 200 Feet

N

ATTACHMENT A

HydraSleeve Manufacturer Manual

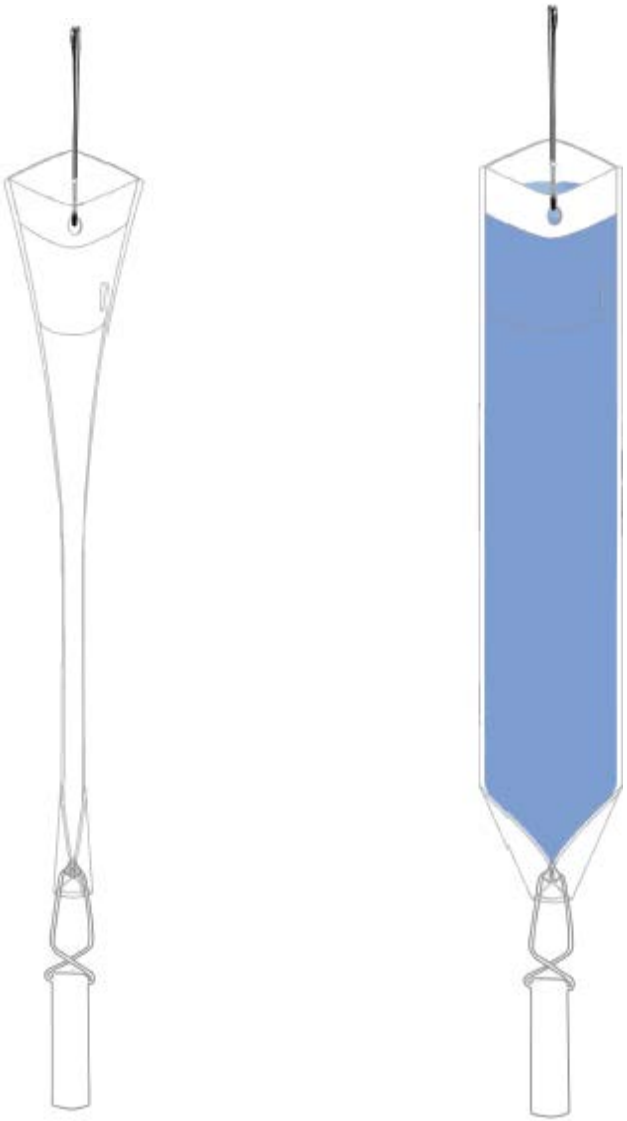
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HYDRASleeve™

Simple by Design

US Patent No. 6,481,300; No. 6,837,120; No. 9,726,013; others pending

Standard Operating Procedure: Sampling Groundwater with a HydraSleeve



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This guide should be used in addition to field manuals and instructions appropriate to the chosen sampling device (i.e., HydraSleeve, SpeedBag or Super/Skinny Sleeve and W3 HybridSleeve).

Find the appropriate field manual and instructions on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, P.O. Box 1266, Mesilla Park, NM 88047
800-996-2225, info@hydrasleeve.com.

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Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect groundwater samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only. It excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative groundwater samples depends on the natural movement of groundwater (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of groundwater for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term groundwater monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

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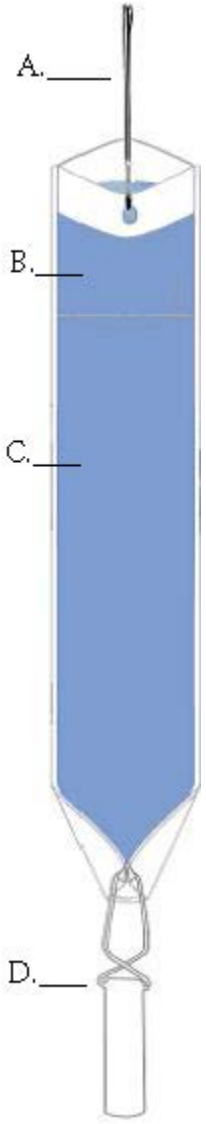
As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

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Description of the HydraSleeve

The basic HydraSleeve (Figure 1) consists of the following components*:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75" OD and are available in a variety of sizes. An optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.



*Other configurations such as top weighted assemblies, Super/SkinnySleeves, Speedbags, and W3 Hybrids are available.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

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Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

Table 1. Dimensions and Volumes of HydraSleeve Models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 600 mls HydraSleeve	~600mls	30”	2.5”	1.4”
Standard 1-liter HydraSleeve	~1 Liter	38”	3”	1.9”
Super/SkinnySleeve 1-liter	~1 Liter	38”	2.5"	1.5”*
Super/SkinnySleeve 1.5-liter	~1.5 Liters	52”	2.5”	1.5”*
Super/SkinnySleeve 2-liter	*~2 Liters*	*66"*	*2.5"*	*1.5"**
4-Inch HydraSleeves				
Standard 2.5 liter	~2 Liters	38”	4”	2.7”

* outside diameter on the Heavy Duty Universal Super/SkinnySleeves is 1.5" however when using with schedule 40 hardware the O.D. of the assembly will be 1.9"

It's also recommended that you size the diameter of the HydraSleeve according to the diameter of the well (i.e. use 2-inch HydraSleeves in 2-inch wells). Using smaller sleeves in larger diameter wells (i.e. 2-inch HydraSleeves in 4-inch wells) will result in a longer fill rate and will require special retrieval instructions (explained later).

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

HydraSleeves can be custom-fabricated by GeoInsight in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied using a HydraSleeve.

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HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

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HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen. It fills by pulling it up through the screen a distance equivalent to the length of the sampler when correctly sized to the well diameter. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2" ID PVC well, 50' total depth, 10' screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2" well (2.5" flat width/1.5" filled OD x 30" long, 600 ml volume), deploy the sampler so the weight (a 5 oz., 2.5" long weight with a 2" long clip) rests at the bottom of the well. The top of the sleeve is thus set at ~34" above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30" before it is filled; therefore, it is full (and the top check valve closes) at approximately 64" (5.3 feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

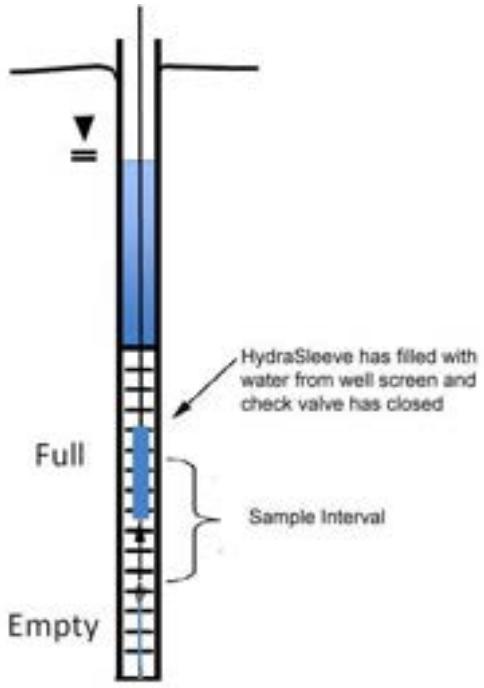


Figure 2. Correct Placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 36" (3 feet) from the bottom of the well, or 2-feet before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

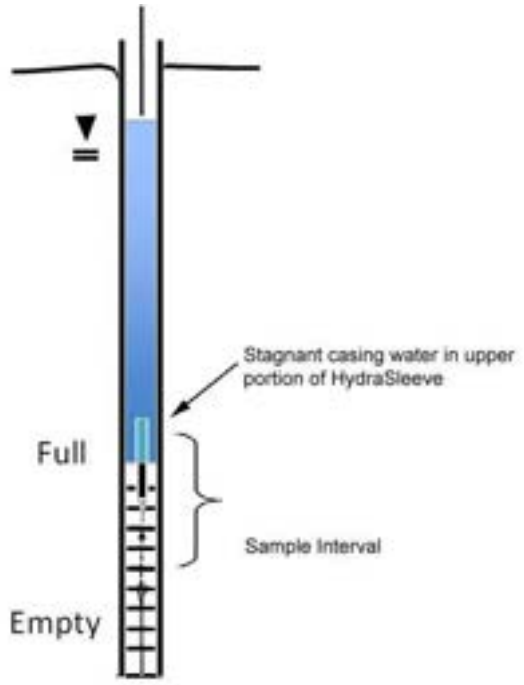


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

NOTE: Using smaller diameter HydraSleeves (2-inch) in larger diameter wells (4-inch) causes a slower fill rate. Special retrieval methods are necessary if this is your set up (shown later in this document).

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Procedures for Sampling with the HydraSleeve

Collecting a groundwater sample with a HydraSleeve is usually a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a groundwater contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the Basic HydraSleeve*

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, if spring clips are not being utilized, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together to align the holes and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

*See Super/SkinnySleeve assembly manual and HydraSleeve Field Manual for other assembly instructions.

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II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The basic HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In some cases, like when useing the SpeedBags, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

  NOTE: If using top weights additional equilibration time is needed to allow the top weight time to compress the HydraSleeve into the bottom of the well.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event.

  In periodic (i.e., quarterly, semi-annual, or annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

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Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.
2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)
3. Measure the water level in the well.
4. Use one of the following 3 retrieval methods. In all 3 scenarios, when the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

   a. In one smooth motion, pull the tether up 30"-60" (the length of the sampler) at a rate of about 1 foot per second (or faster). The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1:1 ratio or the length of the HydraSleeve if the sleeve is sized to fit the well). This is analogous to coring the water column in the well from the bottom up.

   b. There are times it is recommended that the HydraSleeve be oscillated in the screen zone to ensure it is full before leaving the screen area. Pull up 1-3 feet, let the sleeve assembly drop back down and repeat 3-5 times before pulling the sleeve to the surface. The collection zone will be the oscillation zone. ***When in doubt use this retrieval method.***

   c. SpeedBags require check valve activation and oscillation during recovery: When retrieving the SpeedBag, pull up hard 1-2 feet to open the check valve; let the assembly drop back down to the starting point; REPEAT THIS PROCESS 4 TIMES; and then quickly recover the SpeedBag through the well sceen to the surface.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.
6. Discard the small volume of water trapped in the Hydrasleeve above the check valve by pinching it off at the top under the stiffeners (above the check valve).

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v. Sample Discharge

NOTE: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

Be sure you have discarded the water sitting above the check valve – see step #6 above.

1. Remove the discharge tube from its sleeve.
2. Hold the HydraSleeve at the check valve
3. Puncture the HydraSleeve at least 3-4 inches below the reinforcement strips with the pointed end of the discharge tube. NOTE: For some contaminants (VOC's/sinkers) the best location for discharge is the middle to bottom of the sampler. This would be representative of the deeper portion of the well screen.
4. Discharge water from the HydraSleeve into your sample containers. Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.
5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column needs to be sampled, the HydraSleeve can be deployed with an optional top weight in addition to a bottom weight. The top weight will collapse the HydraSleeve to a very short (approximately 6" to 24") length, depending on the length and volume of the sampler. This allows the HydraSleeve to fill in a water column only 3' to 10' in height (again) depending on the sampler size. Note the SuperSleeves accomplish the same thing but provide greater sample volume at a lower per sample cost.

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Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

1. It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
2. It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

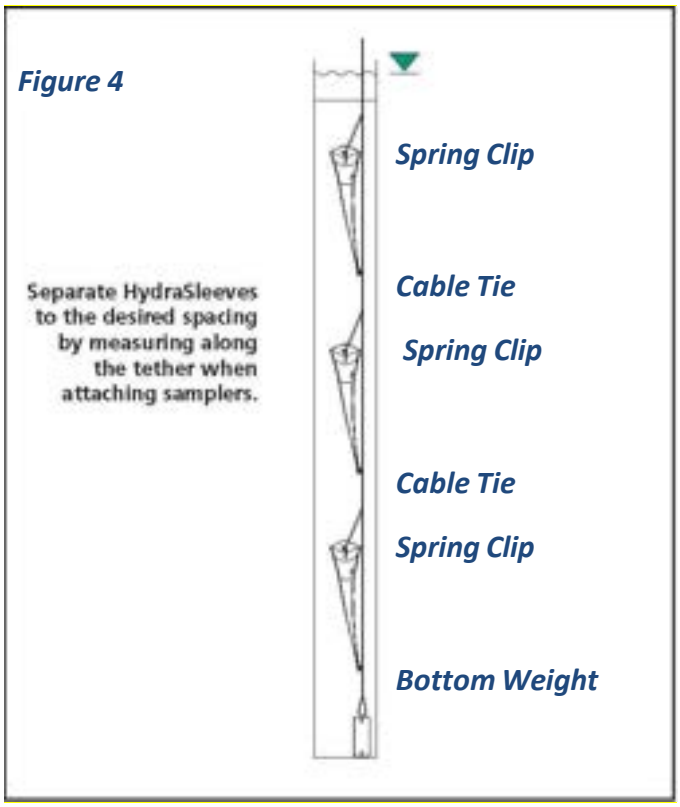


Figure 5. Multiple HydraSleeve deployment

If there is a need for only 2 samplers, they can be installed as follows. The first sampler can be attached to the tether as described above, a second attached to the bottom of the first using your desired length of tether between the two and the weight attached to the bottom of the second sampler (figure 6). This method can only be used with 2 samplers; 3 or more HydraSleeves in tandem need to be attached as described above.

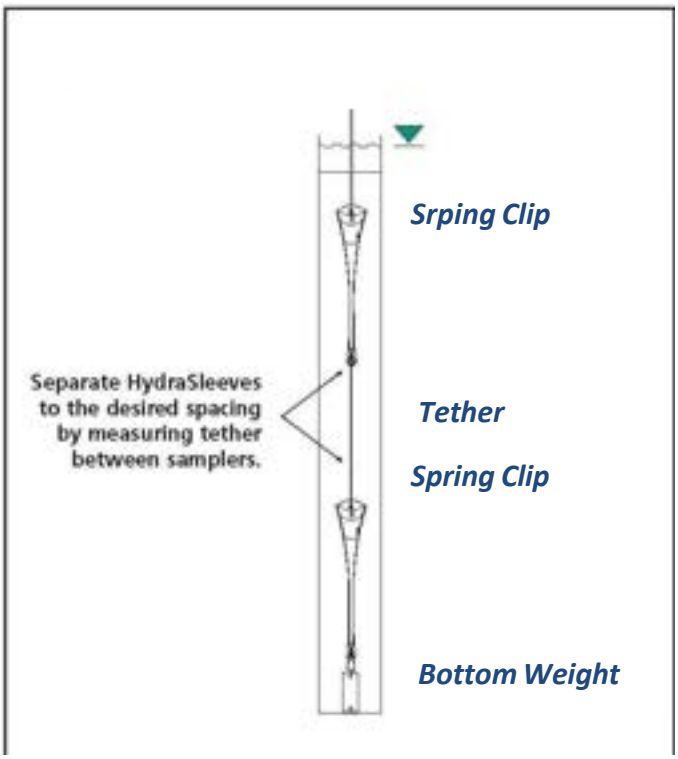


Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight will be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

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Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

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