National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

November 21, 2024

Reply to Attn of: RE-24-167

Mr. JohnDavid Nance, Bureau Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: Response to Disapproval of Reconfiguration Report for NASA Well BW-4

On June 29, 2021, NASA submitted the *Well Reconfiguration Work Plan for Well BW-4*. NMED approved the work plan with modifications on January 18, 2022, and NASA provided a revised work plan on March 8, 2022. NASA completed partial abandonment of the BW-4 borehole in accordance with the work plan and provided the *Reconfiguration Report for NASA Well BW-4* on March 21, 2023. NMED disapproved the report on February 6, 2024 and directed NASA to address a two-part comment and submit a revised report no later than July 31, 2024. To perform additional fieldwork at well BW-4, NASA requested an extension of time for submittal of the revised report on July 22, 2024. NMED approved the request on July 31, 2024, extending the due date for submittal of the revised report to November 30, 2024.

NASA performed additional well development at the BW-4 borehole using available on-site pumping equipment in September and October 2024. NASA then installed a PFAS-free dedicated bladder pump sampling system in the well on November 3, 2024, as indicated in the approved reconfiguration work plan.

This submittal includes a printed response table that cross-references NMED's comments as Enclosure 1, a bound paper copy of the revised report as Enclosure 2, and a CD-ROM with electronic copies of the final report, redline-strikeout report, and response table as Enclosure 3.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions or comments concerning this submittal, please contact Antonette Doherty of my staff at 575-202-5406.

Timothy Davis
Digitally signed by Timothy Davis
Date: 2024.11.21 09:55:51 -07'00'

Timothy J. Davis
Chief, Environmental Office

3 Enclosures

cc:
Mr. Gabriel Acevedo
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

National Aeronautics and Space Administration



Reconfiguration Report for Well BW-4

March 2023

Revised November 2024

NM8800019434

NASA Johnson Space Center White Sands Test Facility

Reconfiguration Report for Well BW-4

March 2023

Revised November 2024

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Timothy Davis Digitally signed by Timothy Davis
Date: 2024.11.21 09:56:09 -07'00'

Timothy J. Davis
Chief, NASA Environmental Office

See Electronic Signature
Date

National Aeronautics and Space Administration

Johnson Space Center
White Sands Test Facility
12600 NASA Road
Las Cruces, NM 88012
www.nasa.gov/centers/wstf

www.nasa.gov

Table of Contents

Table of Contents iii
List of Acronyms iv
1.0 Introduction 1
2.0 Facility Location and Description 1
3.0 Well BW-4 Summary 1
4.0 Reconfiguration Overview 2
5.0 Well Development and Sampling System Installation 2
6.0 Work Plan Deviations 3
7.0 Waste Management 3
8.0 References 4
Figures 5
Figure 2.1 WSTF Location Map 6
Figure 3.1 BW-4 Well Location Map 7
Figure 3.2 Well BW-4 Well Completion Diagram 8
Figure 4.1 Reconfigured BW-4 Well Completion Diagram 9
Appendix A Well Development Parameters A-1

List of Acronyms

°C	Degrees Celsius
bgs	Below ground surface
btoc	Below top of casing
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
Freon 11	Trichlorofluoromethane
Freon 113	1,1,2-trichloro-1,2,2-trifluoroethane
ft	Feet/Foot
NASA	National Aeronautics and Space Administration
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NTU	Nephelometric Turbidity Units
PCE	Tetrachloroethene
PPE	Personal protective equipment
RCRA	Resource and Recovery Act
TCE	Trichloroethene
YJD	Yellow Jacket Drilling Services, LLC
µS/cm	Microsiemens per centimeter

1.0 Introduction

This Well Reconfiguration Report summarizes activities associated with the plugging of the bottom 148 feet (ft) of the open borehole of National Aeronautics and Space Administration (NASA) White Sands Test Facility (WSTF) well BW-4. The partial plugging of BW-4 was part of a larger abandonment effort completed between January 4 and January 30, 2023. Yellow Jacket Drilling Services, LLC (YJD) was contracted to perform the abandonment activities. YJD is a licensed driller in the State of New Mexico (WD-1458) that is qualified to perform well abandonment in the state.

2.0 Facility Location and Description

WSTF is located approximately 16 miles northeast of Las Cruces in southern New Mexico (Figure 2.1). WSTF's primary activities in support of the United States space program are:

1. Development, qualification, refurbishment, and testing of spacecraft propulsion systems, subsystems, and ground support equipment.
2. Investigation of flight hardware anomalies.
3. Testing of materials and components.
4. Performance of hazard and failure analyses.

Following the completion of construction of WSTF in 1964, many wastes were historically managed in hazardous waste management units, including surface impoundments, within the WSTF industrial area. These hazardous waste management units contributed to groundwater contamination. As a result of the groundwater contamination, NASA operates a network of groundwater monitoring wells throughout the site.

3.0 Well BW-4 Summary

Well BW-4 was drilled in 1993 and is located in the WSTF 600 Area (Figure 3.1). The well was completed with nominal 5-inch carbon steel surface casing to a depth of 244 ft below ground surface (bgs) and a 4.5-inch open borehole from 244 ft to 482 ft bgs, which sloughed to 481 ft bgs (Figure 3.2). Andesite bedrock is at 230 ft bgs in this location. The well was fitted with a Westbay®[1] sampling system, which NASA attempted to remove in 2017 after a downhole pump became lodged in the casing. Attempts to recover the equipment were not successful and prevented further use of the well for groundwater sampling. In February 2018, NASA contracted with a drilling company to remove the Westbay sampling system from the well. The contractor recovered approximately 185 ft (of 475 ft total) of Westbay casing, but the remainder had to be drilled out of the borehole.

On July 17, 2019, a contractor geophysical service company logged the open portion of the borehole below the surface casing to identify fractures that could be potential pathways for groundwater flow. Multiple geophysical logging methods were utilized to determine the presence of four fracture zones in the borehole. Based on the results of the BW-4 geophysical evaluation, NASA proposed to reconfigure the well to target a relatively high-flowing fracture at approximately 330 ft below top of casing (btoc) for future groundwater monitoring. NASA submitted the *Well Reconfiguration Work Plan for Well BW-4* on June 29, 2021 (NASA, 2021). On January 18, 2022, the New Mexico Environment Department (NMED) approved the work plan (NMED, 2022). In the work plan, NASA proposed to install a single, dedicated low-flow bladder pump in the open portion of the borehole with the intake set at approximately 330 ft

[1] Westbay is a registered trademark of Nova Metrix Ground Monitoring (Canada) Ltd.

btoc and to abandon the lower portion of the borehole from current total depth up to roughly 340 ft btoc using a neat cement grout containing 5% bentonite. The upper portion of the borehole from top of cement grout (roughly 340 ft btoc) to the bottom of the casing at 244 ft btoc would remain open.

4.0 Reconfiguration Overview

NASA and the subcontract drilling company completed plugging activities in accordance with the NMED-approved work plan (NASA, 2021). Surface features including bollards and concrete well pad were removed during previous work. Prior to YJD's arrival at WSTF, NASA performed well site maintenance at BW-4 to provide a safe work environment.

Plugging activities were completed using a Boart Longyear®[2] BK-81 heavy-duty drill rig. Equipment used included a 1,500-gallon water tank, 20 ft sections of 2-inch steel tremie pipe, air compressor, diaphragm pump, grout tank, and a power drill fitted with a mixing attachment. Reconfiguration of the open borehole was completed at well BW-4 on January 5 and 6, 2023. Reconfiguration was completed by pumping cement grout downhole until the desired new borehole depth had been achieved.

Tremie pipe was lowered into the well to a depth of approximately 475 ft bgs. Cement grout was then hand mixed onsite using Phoenix Cement®[3], Portland Type II, mixed with 5% by weight Quick-Gel bentonite and approximately 4.52 gallons of water per 50-pound bag of cement. Approximately 60 gallons of grout was pumped downhole the first day. The following day, NASA measured the top of grout in the borehole at 421 ft bgs. Tremie was lowered to approximately 415 ft bgs and approximately 50 gallons of grout was mixed and pumped downhole. Tremie pipe was removed and decontaminated. On January 30, 2023, NASA measured the top of grout in the borehole at 332.65 ft bgs. A well completion diagram illustrating the well reconfiguration is provided in Figure 4.1.

5.0 Well Development and Sampling System Installation

Development of well BW-4 began on September 11, 2024 and was concluded on October 30, 2024. Development was completed via hand bailing using a stainless steel 3-inch by 3-foot bailer. During development activities, WSTF Environmental Contractor personnel monitored discharged development water for indicator parameters including pH, specific conductivity, temperature, and turbidity (Appendix A). Well development ideally is considered complete when measured water quality parameters are relatively stable (vary less than 10%) and turbidity is below 5 nephelometric turbidity units (NTUs). During development, levels of pH varied from 10.67 to 11.4, temperature varied from 18.6 to 22.3 degrees Celsius (°C), and specific conductivity ranged from 1194 to 1354 µS/cm.

A total of 310 gallons were removed during well development. Groundwater quality parameters final results were as follows: pH = 11.14; temperature = 18.6 °C; and specific conductivity = 1234 µS/cm. The final turbidity was reported at 79.4 NTUs.

On November 3, 2024, a low-flow bladder pump sampling system was installed in well BW-4. The dedicated pump and tubing are certified perfluoroalkyl and polyfluoroalkyl substance-free.

[2] Boart Longyear is a registered trademark of Longyear TM, Inc.
[3] Phoenix Cement is a registered trademark of Salt River Pima-Maricopa Indian Community.

6.0 Work Plan Deviations

The following are deviations from the NMED-approved well reconfiguration work plan (NASA, 2021) for the reconfiguration of well BW-4.

The target depth of the reconfigured borehole was 340 ft bgs. This depth was selected to plug the fracture zone identified at approximately 350 ft bgs, while leaving the fracture zone at 330 ft bgs as the primary producing fracture in the borehole. The final depth of the borehole after reconfiguration was tagged on January 30, 2022 at 332.65 ft bgs. The final depth of the reconfigured borehole is approximately 7.35 ft higher than the target depth. The cement grout rose higher in the borehole than expected after curing. In an effort not to over-plug the borehole, the grouting took place over two days, as discussed in Section 4.0. In the first lift, approximately 60 gallons of cement grout was added downhole. Calculations in the field indicated the additional grout should have plugged approximately 72 ft of the borehole, which would have brought the total depth to 415 ft bgs. The following day, the grout depth was measured at 421 ft bgs. It was assumed the difference was a result of formation loss. An additional 50 gallons of cement grout was added, which was calculated to bring the depth up to approximately 360.5 ft bgs. After placement of the second lift, the drill crew mobilized and completed activities at other wells, allowing the cement grout to cure fully before measuring the new borehole depth and adding a third lift if necessary. On January 30, 2024, the depth was measured at 332.65ft bgs.

It is believed that groundwater samples have the potential to be minimally affected by proximity of the cement grout. The fracture targeted in the reconfiguration is still accessible for sampling. With the bladder pump intake properly placed at 330 ft bgs, representative groundwater samples will be collected from the targeted fracture immediately following effective low-flow purging in accordance with established WSTF groundwater sampling procedures. Potential effects cannot be determined until multiple sampling events have been completed and chemical analytical data can be compared to historical data.

As the reconfigured BW-4 is included in the ongoing groundwater monitoring program at WSTF, results of subsequent annual samples will be included and evaluated in the quarterly monitoring reports. NASA is aware of the potential for sample quality effects due to the proximity of grout to the targeted fracture zone at 330 ft bgs and will closely monitor sample results to identify any impacts observed.

7.0 Waste Management

Well BW-4 is located within the extent of the known WSTF groundwater contaminant plume. Waste management and disposal were conducted in accordance with the NMED-approved *Well Reconfiguration Work Plan for Well BW-4* (NASA, 2021; NMED, 2022) and the then current WSTF Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit Environmental Protection Agency (EPA) ID No. NM8800019434 (NMED, 2009). Groundwater within the WSTF contaminant plume is characterized as hazardous waste when it is actively managed through application of the EPA's contained-in policy (EPA, 1998) and 40 Code of Federal Regulations (CFR) 261.31. The EPA "Contained-In" Policy states that groundwater, soil, and other environmental media is not solid waste but is subject to regulation as hazardous waste when it contains listed waste (EPA, 1996). The specific F001 and F002 contaminants of concern are trichloroethene (TCE), tetrachloroethene (PCE), trichlorofluoromethane (Freon®[4] 11), and 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113). Therefore, any environmental media and debris that has been contacted by the contaminated groundwater was characterized as hazardous waste and will only carry the F001 and F002 hazardous waste codes.

[4] Freon is a registered trademark of The Chemours Company FC, LLC.

Contaminated groundwater does not exhibit the characteristics of hazardous waste codified in 40 CFR 261, Subpart D.

Waste that was not contacted by contaminated groundwater was characterized as non-hazardous solid waste. Nonhazardous waste consisted primarily of spent disposable personal protective equipment (PPE), concrete debris, and empty commercial packaging from the cement and bentonite products used during the plugging and abandonment activities. The non-hazardous waste was managed in accordance with New Mexico Solid Waste Regulations in 20.9 New Mexico Administrative Code (NMAC). Following completion of plugging and abandonment activities, non-hazardous solid waste was disposed of at the Corralitos Regional Landfill. Metal determined to be recyclable, such as cut steel well casing, was decontaminated and will be recycled under the scrap metal exemption described at 20.4.1.200 NMAC incorporating 40 CFR 261.4(a)(13).

Environmental media and debris suspected of contact with contaminated groundwater was characterized as a hazardous solid waste. Hazardous waste generated included contaminated debris (e.g., plastic drop sheet, concrete debris, and PPE), environmental media (e.g., soil), and decontamination fluids. Similarly, hydrocarbon contaminated debris (e.g., plastic sheeting and wipes) that may have come into contact with petroleum-based lubricants, coolants, and/ or fuels were accumulated separately, and managed as hazardous waste. Hazardous wastes were accumulated in appropriately sized, Department of Transportation-compliant containers. The containers were managed in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.17. Within permissible accumulation time limits, the aqueous-phase decontamination fluids were transferred to the Mid-plume Interception and Treatment System for treatment and discharge in accordance with then current Discharge Permit-1255 (NMED, 2017). Land disposal restriction notifications and disposal facility profiles were completed as required for the solid-phase environmental media and debris characterized as hazardous waste. Within 90 days from the initial accumulation, the solid phase-hazardous waste will be manifested off-site and transported for treatment and disposal at a permitted RCRA Treatment Storage and Disposal Facility.

8.0 References

Adoption of 40 CFR Part 262, Environmental Improvement Board, 20.4.1.300 NMAC (12-01-18).

Adoption of 40 CFR Part 263, Environmental Improvement Board, 20.4.1.400 NMAC (12-01-18).

NASA Johnson Space Center White Sands Test Facility. (2021, June 29). *NASA WSTF Well Reconfiguration Work Plan for Well BW-4*. Las Cruces, NM.

NMED Hazardous Waste Bureau. (2009, November 3). *Hazardous Waste Permit No. NM8800019434* (modified December 2019). Santa Fe, NM.

NMED Ground Water Quality Bureau. (2017, July 14). *Discharge Permit Renewal and Modification, DP-1255, NASA White Sands Testing Facility*. Santa Fe, NM.

NMED Hazardous Waste Bureau. (2022, January 18). *Approval with Modifications Well Reconfiguration Work Plan for BW-4*. Santa Fe, NM.

Solid Waste, New Mexico Environmental Improvement Board, 20.9 NMAC (08-02-07).

Figures

Figure 2.1 **WSTF Location Map**

(SEE NEXT PAGE)

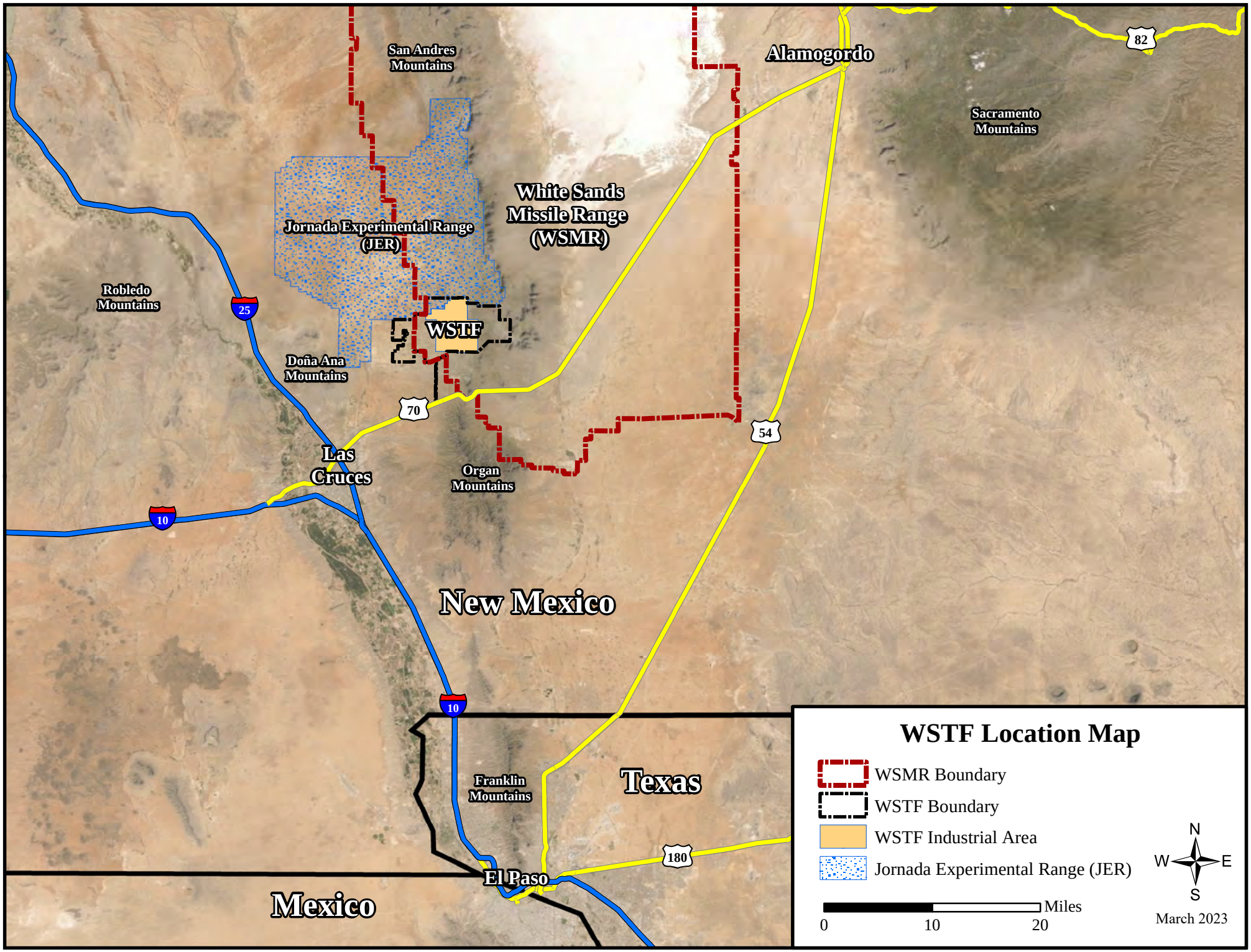

San Andres Mountains
Alamogordo
82
Sacramento Mountains
White Sands Missile Range (WSMR)
Jornada Experimental Range (JER)
Robledo Mountains
25
WSTF
Doña Ana Mountains
70
54
Las Cruces
Organ Mountains
10
New Mexico
10
Franklin Mountains
Texas
180
El Paso
Mexico
WSTF Location Map
WSMR Boundary
WSTF Boundary
WSTF Industrial Area
Jornada Experimental Range (JER)
Miles
0
10
20
N
W
E
S
March 2023

Figure 3.1 **BW-4 Well Location Map**

(SEE NEXT PAGE)

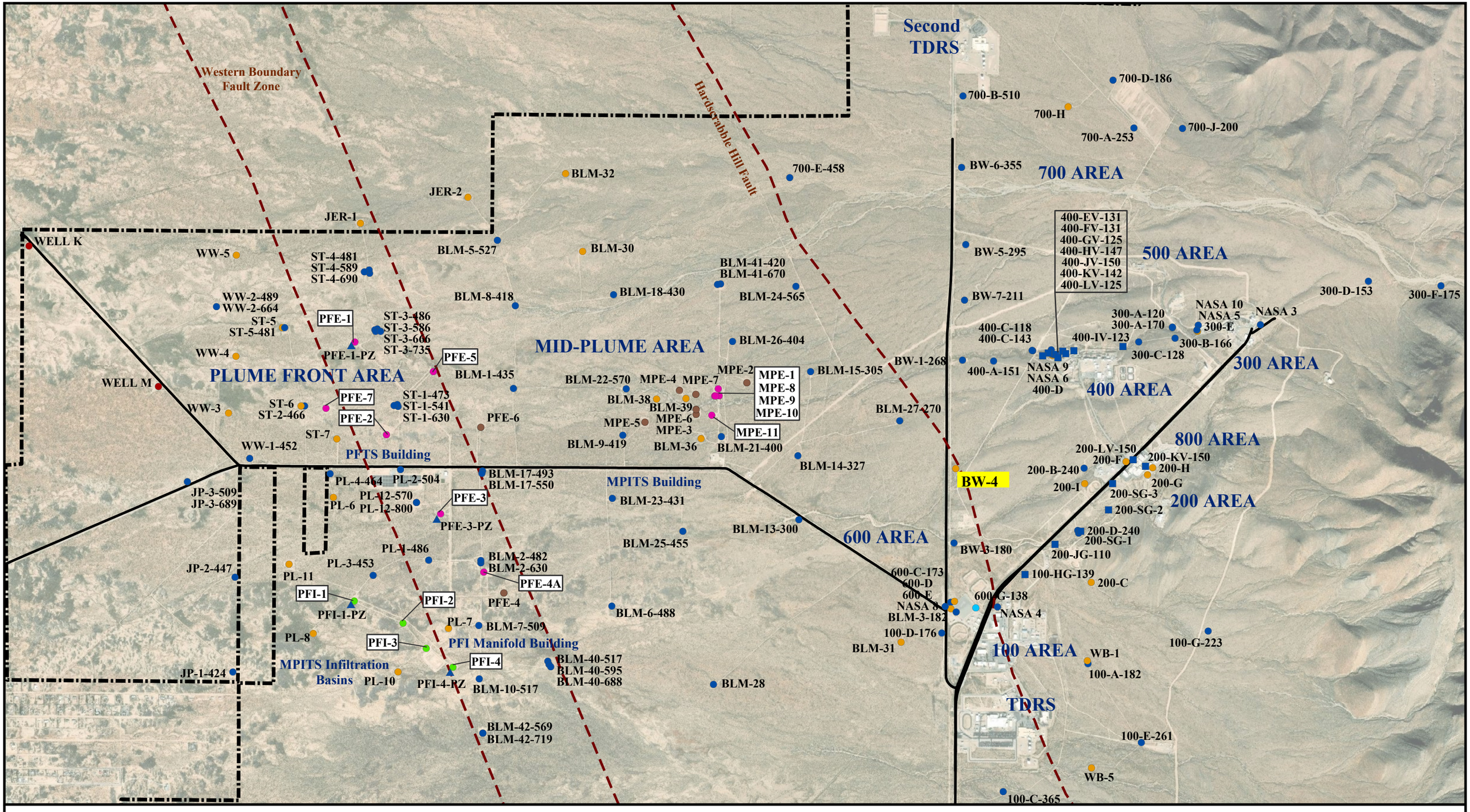

Western Boundary Fault Zone
Hardscrabble Hill Fault
Second TDRS
700-D-186
700-B-510
700-H
700-A-253
700-J-200
BW-6-355
700 AREA
700-E-458
BLM-32
JER-2
JER-1
WELL K
WW-5
BLM-5-527
BLM-30
ST-4-481
ST-4-589
ST-4-690
400-EV-131
400-FV-131
400-GV-125
400-HV-147
400-JV-150
400-KV-142
400-LV-125
BW-5-295
500 AREA
BLM-41-420
BLM-41-670
WW-2-489
WW-2-664
ST-5
ST-5-481
BLM-8-418
BLM-18-430
BLM-24-565
BW-7-211
300-D-153
300-F-175
NASA 10
NASA 5
NASA 3
300-A-120
300-A-170
300-E
PFE-1
ST-3-486
ST-3-586
ST-3-606
ST-3-735
400-C-118
400-C-143
400-IV-123
300-B-166
300-C-128
WW-4
PFE-1-PZ
PFE-5
BLM-26-404
MID-PLUME AREA
BLM-15-305
BW-1-268
300 AREA
400-A-151
NASA 9
NASA 6
400-D
400 AREA
PLUME FRONT AREA
BLM-1-435
BLM-22-570
MPE-4
MPE-7
MPE-2
MPE-1
MPE-8
MPE-9
MPE-10
WELL M
PFE-7
ST-1-473
ST-1-541
ST-1-630
BLM-38
BLM-39
WW-3
ST-6
ST-2-466
PFE-2
PFE-6
MPE-5
MPE-6
MPE-3
MPE-11
BLM-27-270
ST-7
BLM-9-419
BLM-36
BLM-21-400
800 AREA
WW-1-452
PFTS Building
BLM-14-327
200-LV-150
200-F
200-KV-150
200-H
200-B-240
200-I
200-G
BW-4
BLM-17-493
BLM-17-550
MPITS Building
PL-4-464
PL-2-504
200-SG-3
200-SG-2
200 AREA
JP-3-509
JP-3-689
PL-12-570
PL-12-800
PL-6
PFE-3
BLM-23-431
200-D-240
200-SG-1
PFE-3-PZ
BLM-13-300
BLM-25-455
600 AREA
BW-3-180
200-JG-110
PL-1-486
JP-2-447
PL-3-453
BLM-2-482
BLM-2-630
PL-11
PFE-4A
100-HG-139
200-C
600-C-173
600-D
600-E
600-G-138
PFI-1
PFI-2
PFE-4
NASA 8
NASA 4
BLM-3-182
PFI-1-PZ
BLM-6-488
PL-7
BLM-7-509
100-D-176
BLM-31
PL-8
PFI-3
PFI Manifold Building
100-G-223
100 AREA
WB-1
PFI-4
BLM-40-517
BLM-40-595
BLM-40-688
100-A-182
JP-1-424
MPITS Infiltration Basins
PL-10
PFI-4-PZ
BLM-10-517
BLM-28
TDRS
BLM-42-569
BLM-42-719
100-E-261
WB-5
100-C-365
Monitoring Well BLM-28 Location
Multiport
MSVGM Well
Piezometer
Main Road
WSTF Boundary
Conventional Well
Extraction Well
Exploration Well
Faults
Perched Well
Injection Well
Production Well
0
2,000
4,000
6,000
Feet
N
W
E
S
March 2023

Figure 3.2 **Well BW-4 Well Completion Diagram**

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

WESTBAY® MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **168325.61N 465802.60E**
Elevation (Brass Cap): **1448.64 m AMSL**
Elevation (Top of Casing): **1449.04 m AMSL**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Total Depth of Borehole (bgs): **482' (146.9 m)**
Borehole Diameter: **8 3/4" 0-244'; 4 1/2" 244-482'**
Depth to Bedrock (bgs): **230' (70.1 m); Andesite**
Depth to Groundwater: **194.26' (59.2 m) TOSC (2/18/93)**
Total Depth Surface Casing (bgs): **244' (74.4 m)**
Diameter and Type Surface Casing: **Nominal 5" Steel**
Date(s) Well Installed: **2/19/93 - 2/23/93**

Date(s) Well Developed: **BH = 2/17/93 (air-lift); WB = unknown**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **475' (144.8 m)**
Type of Casing: **Westbay® MP 38 PVC (SCD 80)**
Diameter Well Casing: **1.5" ID; 1.9" OD**
WB Sampling Zone(s)(bgs): **270' (82.79 m); 355' (108.71 m); and 455' (139.20 m)**
WB Packer Zone(s)(bgs): **260-285' (79.74-87.36 m); 345-365' (105.66 m-111.76 m); and 455-475' (TD) (139.20-144.8 m)**
Comments: **Depths (meters) for Westbay components and zones are a calculated value based on piezometric levels at Meas. Ports. TOSC = Top of Surface Casing AMSL = Above Mean Sea Level BH = borehole WB = Westbay®**

Surface Casing
Nominal 5" Steel

1.5" ID Westbay® MP38 Casing

Casing Explanation:

1.5" ID Westbay® MP38 End Cap

Packer

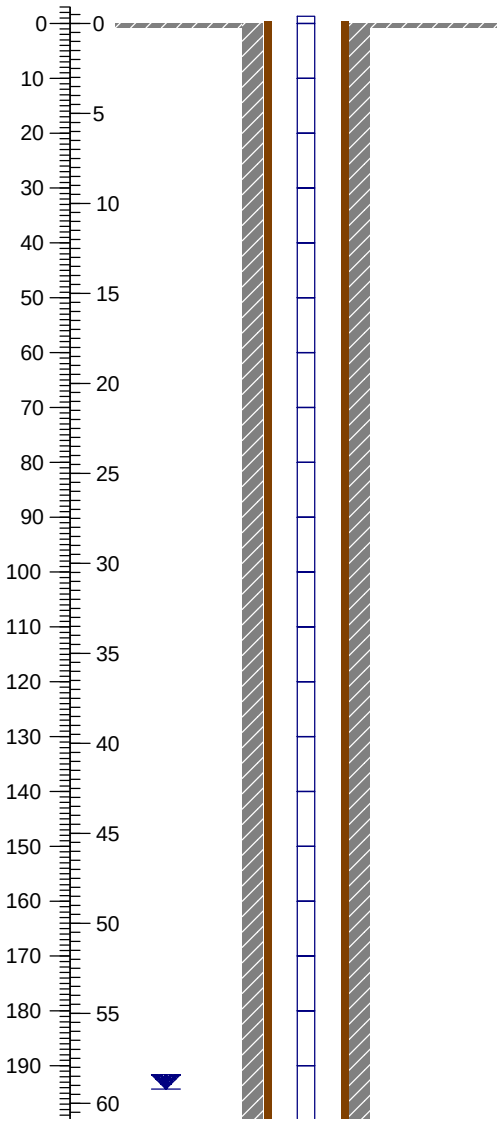
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)

Magnetic Collar
Water Table

Cement
Slough

Feet/Meters

Well Descriptions All depths listed are bgs (unless noted)	**Annular/Borehole Descriptions** All depths listed are bgs



Westbay® Well Stick-Up = 1.3' (0.394 m)
Surface Casing Stick-Up = ~0.42' (0.1 m)
Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casing at ground surface.

Depth to Water = 194.26' (59.2 m)(Borehole; measured

Surface Casing
Nominal 5" Steel

1.5" ID Westbay® MP38 Casing

Casing Explanation:

1.5" ID Westbay® MP38 End Cap

Packer

Measurement Port (MP)

MP with Filter Sock

Mechanical Pumping Port (PP)

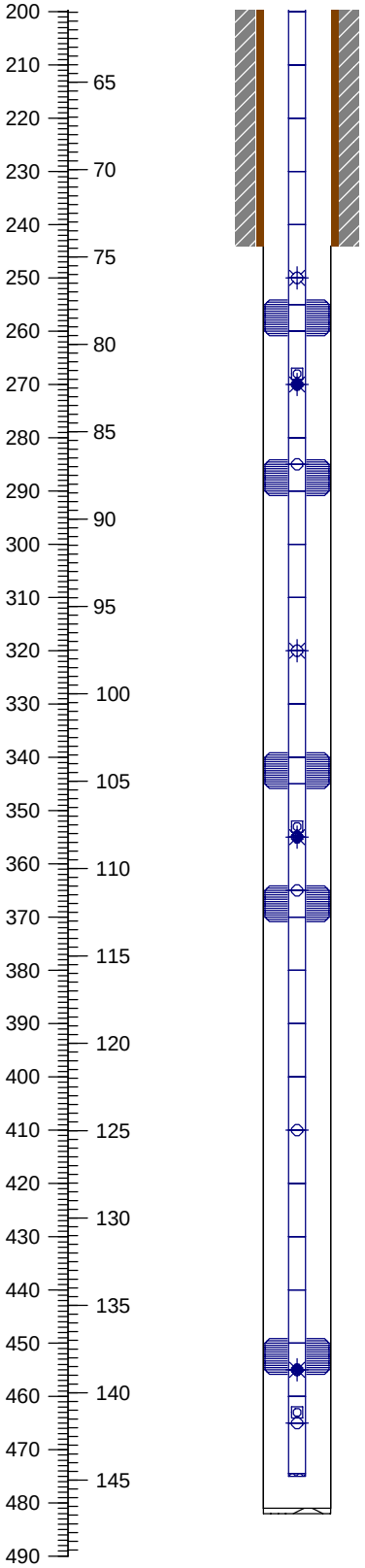
Magnetic Collar

Water Table

Cement

Slough

Feet/Meters



Well Descriptions All depths listed are bgs (unless noted)	**Annular/Borehole Descriptions** All depths listed are bgs
2/18/93 (TOSC) just before Westbay® well casing installation)	
	Andesite (Orejon Andesite) Bedrock Depth = 230' (70.1 m)
Nominal 5" Steel Surface Casing Depth = 244' (74.4 m)	8 3/4" Borehole cemented to 244' (74.4 m)
MP Depth = 250' (76.69 m) Packer Depth = 255'-260' (78.21-79.74 m)	
Magnetic Collar Depth = 269.6' (82.67 m) Sampling MP Depth (with Filter Sock) = 270' (82.79 m)	
PP Depth = 285' (87.36 m) Packer Depth = 285'-290' (87.36-88.87 m)	
MP Depth = 320' (98.04 m)	
Packer Depth = 340'-345' (104.14-105.66 m)	
Magnetic Collar Depth = 354.6' (108.59 m) Sampling MP Depth (with Filter Sock) = 355' (108.71 m)	
PP Depth = 365' (111.76 m) Packer Depth = 365'-370' (111.76-113.28 m)	
PP Depth = 410' (125.0 m)	
Packer Depth = 450'-455' (137.68-139.20 m) Sampling MP Depth (with Filter Sock) = 455' (139.20 m) Magnetic Collar Depth = 464.6' (142.13 m) PP Depth = 465' (142.25 m)	
Westbay® MP 38 Casing TD = 475' (144.8 m)	
4 1/2" Borehole TD = 482' (146.9 m)	Top of Slough = ~481' (146.6 m). Borehole total depth with slough per

Figure 4.1 Reconfigured BW-4 Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation

Surface Casing
5-in. Nominal Steel

Completion Casing
N/A

Well Screen
N/A

Annular Materials Explanation

Neat Cement

Slough

Cement w/ 5% Bentonite

Elevation (ft amsl) / Depth (ft bgs)	**Borehole/Well Casing Descriptions** All depths are below ground surface	**Annular Materials Descriptions** All depths are below ground surface
4750 / 0	Surface Casing Stick-Up = 0.83 ft. ags	
4740 / 10		Alluvium formation is Santa Fe Group from surface to 230 ft.
4730 / 20	8 3/4-in. Borehole 0 - 244 ft	8 3/4-in. Borehole cemented to 244 ft
4720 / 30		
4710 / 40		
4700 / 50		
4690 / 60		
4680 / 70		
4670 / 80		
4660 / 90		
4650 / 100		
4640 / 110		
4630 / 120		

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft.; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation

Surface Casing
5-in. Nominal Steel

Completion Casing
N/A

Well Screen
N/A

Annular Materials Explanation

Neat Cement

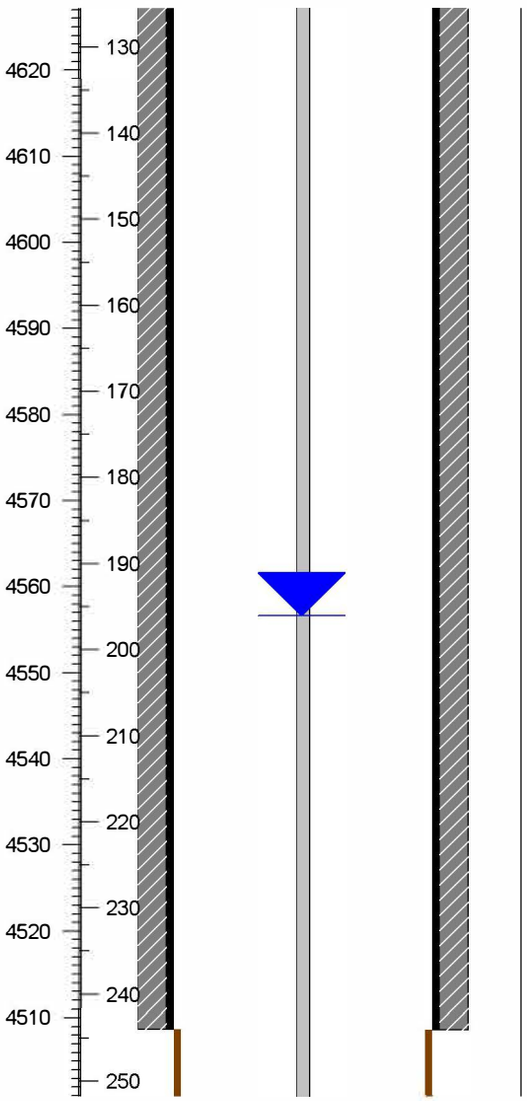
Slough

Cement w/ 5% Bentonite

Elevation (ft amsl) / Depth (ft bgs)

Borehole/Well Casing Descriptions
All depths are below ground surface

Annular Materials Descriptions
All depths are below ground surface



Water Table Depth = 197.5 ft. (measured post re-development 10/30/24)

Nominal 5-in. Steel Surface Casing Depth = 244 ft.

Andesite (Orejon Andesite) Bedrock Depth = 230 ft

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft.; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation

Surface Casing
5-in. Nominal Steel

Completion Casing
N/A

Well Screen
N/A

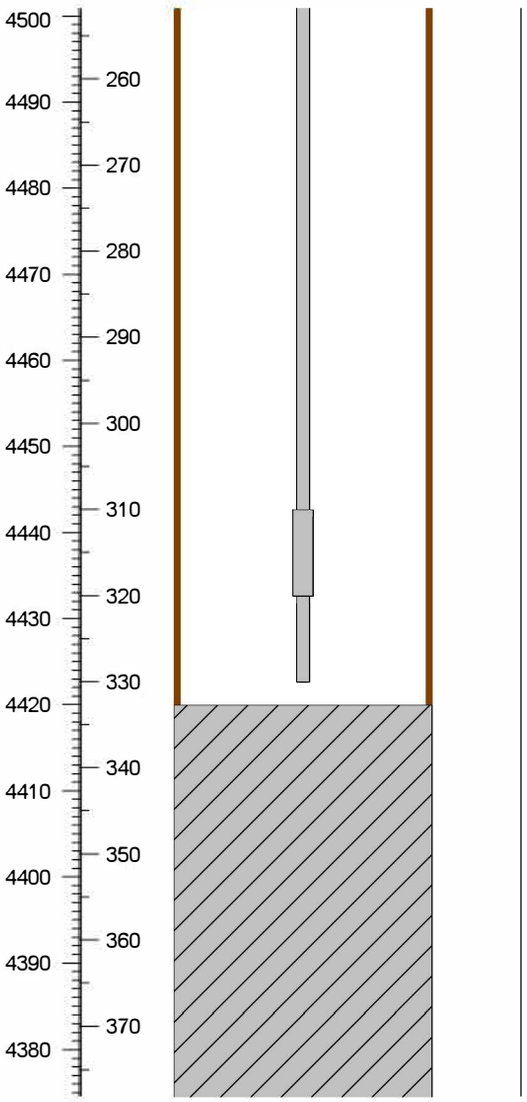
Annular Materials Explanation

Neat Cement

Slough

Cement w/ 5% Bentonite

Elevation (ft amsl) / Depth (ft bgs)	**Borehole/Well Casing Descriptions** All depths are below ground surface	**Annular Materials Descriptions** All depths are below ground surface



Sampling System Inlet = 330 ft btoc

Cement w/ 5% Bentonite
(Re-completion) = 332.65 - 481 ft

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

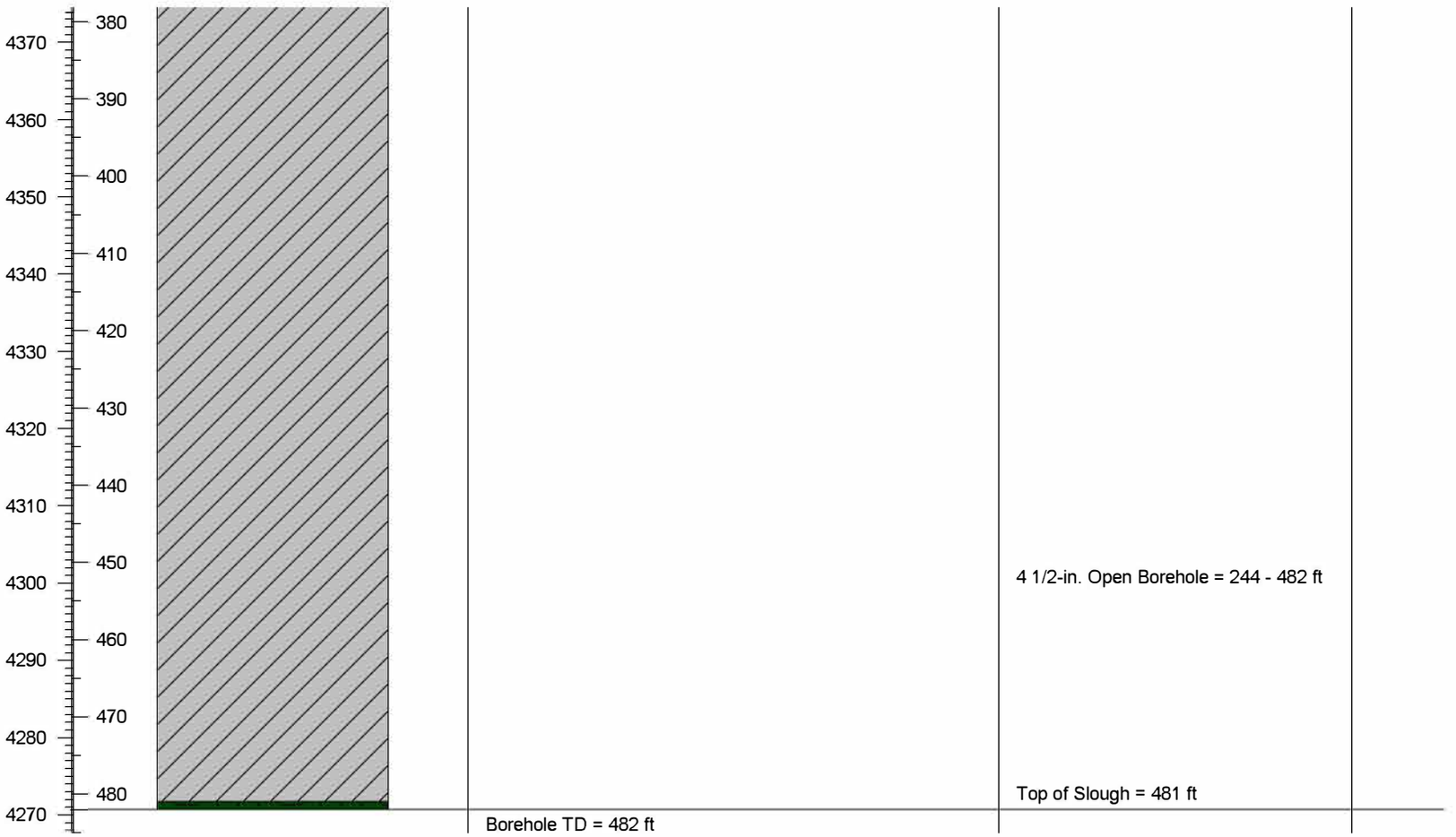
Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft.; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation
Surface Casing: **5-in. Nominal Steel**
Completion Casing: **N/A**
Well Screen: **N/A**

Annular Materials Explanation
Neat Cement
Slough
Cement w/ 5% Bentonite



Appendix A Well Development Parameters

BOREHOLE / WELL DEVELOPMENT

Cover Page

Provide all depth measurements with respect to ground surface

Site/Screen Name:	BW-4	Project No.:	
Location:	WSTF	Field Personnel:	T.Kondy (Field Lead)
Lead Company:	Navarro	Document Reviewer:	S. Rees
Supporting Company:		Review Complete:	

FINAL DEVELOPMENT PARAMETERS

Borehole / Well Total Depth: 332.65 ft bgs

Screened Intervals: Open Borehole and ft bgs

Total Volume Withdrawn: (Airlifting/Swabbing/Jetting) n/a gals

Total Volume Withdrawn: (Development Pumping) 280 gals

DEVELOPMENT TOOLS

Tool: Bailer Description: 3-inch X 36-inch Used from: to

Tool: Description: Used from: to

DEVELOPMENT DATA

METER CALIBRATION / VERIFICATION:

Water level pre-development = 197.00 ft btoc

Date	Time	Meter Type	Withdrawn (gal)	Cumulative Withdrawn (gal)	Drawdown (ft bgs)	Pumping Rate (gpm)	pH	Temp (°C)	SC (µS/cm)	Turbidity (NTU)	Pump Intake (ft bgs)
9/11/24	1005		20	20			11.4	21.9	1226	359	
9/12/24	1440		30	50	208.6		-	-	-	-	
9/13/24			30	80	209.24		-	-	-	-	
9/30/24	0955		-	-			11.05	20.5	1328	1.93	
10/7/24	0910		10	90			10.76	20.1	1208	61.7	
10/7/24	1030		10	100			10.71	20.4	1324	60.5	
10/8/24	0910		10	110			11.05	20.8	1195	70.9	
10/8/24	1030		10	120			10.91	20.9	1321	68.7	

BOREHOLE / WELL DEVELOPMENT (Continued)

Provide all depth measurements with respect to ground surface

Site/Screen Name: BW-4 Project No.:

Location: WSTF Field Personnel: T.Kondy

DEVELOPMENT DATA (Continued)

Date	Time	Meter Type	Withdrawn (gal)	Cumulative Withdrawn (gal)	Drawdown (ft bgs)	Pumping Rate (gpm)	pH	Temp (°C)	SC (µS/cm)	Turbidity (NTU)	Pump Intake (ft bgs)
10/8/24	1410		10	130			10.84	21.3	1354	61.4	
10/10/24	0915		10	140			11.05	20.9	1240	59.7	
10/10/24	1040		10	150			11.10	21.3	1231	58.4	
10/15/24	0930		10	160			10.67	20.6	1235	47.4	
10/15/24	1345		10	170			11.10	22.1	1194	82.5	
10/15/24	1430		10	180			11.15	22.3	1205	81.4	
10/16/24	0945		10	190			11.02	21.9	1245	45.4	
10/16/24	1345		10	200			11.21	21.8	1251	81.0	
10/16/24	1435		10	210			11.40	22.3	1250	82.5	
10/24/24	0930		10	220			10.9	20.2	1237	60.4	
10/24/24	1055		10	230			11.07	20.8	1220	90.8	
10/24/24	1455		10	240			11.34	21.0	1229	85.4	
10/25/24	0925		10	250			11.21	20.5	1231	65.4	
10/25/24	1050		10	260			11.11	20.9	1221	79.8	
10/28/24	0930		10	270			11.26	20.5	1235	62.5	

BOREHOLE / WELL DEVELOPMENT (Continued)

Provide all depth measurements with respect to ground surface

Site/Screen Name: BW-4 Project No.:

Location: WSTF Field Personnel: T.Kondy

DEVELOPMENT DATA (Continued)

Date	Time	Meter Type	Withdrawn (gal)	Cumulative Withdrawn (gal)	Drawdown (ft bgs)	Pumping Rate (gpm)	pH	Temp (°C)	SC (µS/cm)	Turbidity (NTU)	Pump Intake (ft bgs)
10/28/24	1055		10	280			11.19	20.7	1242	79.38	
10/28/24	1455		10	290			10.95	20.4	1236	81.5	
10/30/24	0920		10	300	203.6		10.80	18.6	1241	97.3	
10/30/24	1050		10	310	208.00		11.14	18.6	1234	79.4	

Comments for Disapproval of the Well BW-4 Reconfiguration Report

NMED Comment Number	NMED Comments	NASA Revisions/Responses/Discussion
1. Section 4.0, Reconfiguration Overview	**NMED Comment:** The following issues must be addressed: a. The NMED Approved March 2022 *Well Reconfiguration Work Plan for Well BW-4* proposed the installation of a bladder-pump sampling system at 330 feet below the top of casing at an identified high transmissivity fracture zone, and a reconfigured total well depth of 340 feet below ground surface (bgs). The well completion information reported on Figure 4.1 Reconfigured BW-4 Well Completion Diagram, indicates a work scope deviation for the final total well depth (reported at 332.65 feet bgs) that must be discussed in the revised Report as this well termination depth only allows for two-feet of borehole below the proposed sampling zone. Additionally, clarify if the final well depth could potentially affect representative groundwater sampling at the monitoring well location. The Permittee is reminded that any deviation from the approved work plan must be discussed in the appropriate sections of the Report. b. The revised Report must include discussion of well development and the installation of the proposed bladder pump sampling system, including all supporting data and information, and must also include a final well completion diagram.	In response to NMED comments, NASA added new sections to the report. Original report Section 5.0 is now Section 7.0. A new Section 5.0 was added in response to NMED comment 1b and Section 6.0 was added in response to NMED comment 1a. See below for more detail. a. The work scope deviation of the borehole depth is detailed in new Section 6.0, Work Plan Deviations. Section 6.0 details the final total depth of the borehole and includes a discussion related to the potential representativeness of groundwater samples collected from the 330 ft fracture. It is believed that because the 330 ft fracture is the primary producing fracture, the sample may be representative of groundwater from that fracture if the pump intake is located at the 330 depth and groundwater samples are collected immediately after purging in accordance with established sampling procedures. More information is provided in Section 6.0 of the report. b. NASA added new Section 5.0 to the report to discuss well development and sampling system installation. Appendix A, Well Development Parameters was also added to the report to provide groundwater indicator parameters measured during well development activities. The well completion diagram was updated and included in the revised report.
2. Additional changes		Additional report revisions were completed in Section 3.0 regarding the removal of the Westbay sampling system.

National Aeronautics and Space Administration



Reconfiguration Report for Well BW-4

March 2023

Revised November 2024

NM8800019434

NASA Johnson Space Center White Sands Test Facility

Reconfiguration Report for Well BW-4

March 2023

Revised November 2024

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____ _____

Timothy J. Davis
Chief, NASA Environmental Office

Date

National Aeronautics and Space Administration

Johnson Space Center
White Sands Test Facility
12600 NASA Road
Las Cruces, NM 88012
www.nasa.gov/centers/wstf

www.nasa.gov

Table of Contents

Table of Contents iii
List of Acronyms v
1.0 Introduction 1
2.0 Facility Location and Description 1
3.0 Well BW-4 Summary 1
4.0 Reconfiguration Overview 2
5.0 Well Development and Sampling System Installation 2
6.0 Work Plan Deviations 3
7.0 Waste Management 3
8.0 References 4
Figures 6
Figure 2.1 WSTF Location Map 7
Figure 3.1 BW-4 Well Location Map 8
Figure 3.2 Well BW-4 Well Completion Diagram 9
Figure 4.1 Reconfigured BW-4 Well Completion Diagram 10
Appendix A Well Development Parameters A-1
~~Table of Contents ..... iii~~
~~List of Acronyms ..... iv~~
~~1.0 Introduction ..... 1~~
~~2.0 Facility Location and Description ..... 1~~
~~3.0 Well BW-4 Summary ..... 1~~
~~4.0 Reconfiguration Overview ..... 2~~
~~5.0 Well Development and Sampling System Installation ..... 2~~
~~6.0 Work Plan Deviations ..... 2~~
~~7.0 Waste Management ..... 3~~
~~8.0 References ..... 4~~
~~Figures ..... 5~~
~~Figure 2.1 WSTF Location Map ..... 6~~
~~Figure 3.1 BW-4 Well Location Map ..... 7~~
~~Figure 3.2 Well BW-4 Well Completion Diagram ..... 8~~
~~Figure 4.1 Reconfigured BW-4 Well Completion Diagram ..... 9~~
~~Appendix A Well Development Parameters ..... A-1~~
~~Table of Contents ..... iii~~
~~List of Acronyms ..... iv~~
~~1.0 Introduction ..... 1~~
~~2.0 Facility Location and Description ..... 1~~

3.0 Well BW-4 Summary 1
4.0 Reconfiguration Overview 2
5.0 Waste Management 2
6.0 References 3
Figures 4
Figure 2.1 WSTF Location Map. 5
Figure 3.1 BW-4 Well Location Map 6
Figure 3.2 Well BW-4 Well Completion Diagram 7
Figure 4.1 Reconfigured BW-4 Well Completion Diagram 8

List of Acronyms

°C	Degrees Celsius
bgs	Below ground surface
btoc	Below top of casing
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
Freon 11	Trichlorofluoromethane
Freon 113	1,1,2-trichloro-1,2,2-trifluoroethane
ft	Feet/Foot
NASA	National Aeronautics and Space Administration
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NTU	Nephelometric Turbidity Units
PCE	Tetrachloroethene
PPE	Personal protective equipment
RCRA	Resource and Recovery Act
TCE	Trichloroethene
YJD	Yellow Jacket Drilling Services, LLC
µS/cm	Microsiemens per centimeter

1.0 Introduction

This Well Reconfiguration Report summarizes activities associated with the plugging of the bottom 148 feet (ft) of the open borehole of National Aeronautics and Space Administration (NASA) White Sands Test Facility (WSTF) well BW-4. ~~The well is located at the NASA White Sands Test Facility (WSTF).~~ The partial plugging of BW-4 was part of a larger abandonment effort completed between January 4 and January 30, 2023. Yellow Jacket Drilling Services, LLC (YJD) was contracted to perform the abandonment activities. YJD is a licensed driller in the State of New Mexico (WD-1458) that is qualified to perform well abandonment in the state.

2.0 Facility Location and Description

WSTF is located approximately 16 miles northeast of Las Cruces in southern New Mexico (Figure 2.1). WSTF's primary activities in support of the United States space program are:

1. Development, qualification, refurbishment, and testing of spacecraft propulsion systems, subsystems, and ground support equipment.
2. Investigation of flight hardware anomalies.
3. Testing of materials and components.
4. Performance of hazard and failure analyses.

Following the completion of construction of WSTF in 1964, many wastes were historically managed in hazardous waste management units, including surface impoundments, within the WSTF industrial area. These hazardous waste management units contributed to groundwater contamination. As a result of the groundwater contamination, NASA operates a network of groundwater monitoring wells throughout the site.

3.0 Well BW-4 Summary

Well BW-4 was drilled in 1993 and is located in the WSTF 600 Area (Figure 3.1). The well was completed with nominal 5-inch carbon steel surface casing to a depth of 244 ft below ground surface (bgs) and a 4.5-inch open borehole from 244 ft to 482 ft bgs, which sloughed to 481 ft bgs (Figure 3.2). Andesite bedrock is at 230 ft bgs in this location. The well was fitted with a Westbay®[1] sampling system, which ~~was~~ NASA attempted to remov~~ced~~ in ~~2019~~ 2017 after a downhole pump became lodged in the casing. Attempts to recover the equipment were not successful and prevented further use of the well for groundwater sampling. In February 2018, NASA contracted with a drilling company to remove the Westbay sampling system from the well. The contractor recovered approximately 185 ft (of 475 ft total) of Westbay casing, but the remainder had to be drilled out of the borehole.

On July 17, 2019, a contractor geophysical service company logged the open portion of the borehole below the surface casing to identify fractures that could be potential pathways for groundwater flow. Multiple geophysical logging methods were utilized to determine the presence of four fracture zones in the borehole. Based on the results of the BW-4 geophysical evaluation, NASA proposed to reconfigure the well to target a relatively high-flowing fracture at approximately 330 ft below top of casing (btoc) for future groundwater monitoring. NASA submitted the *Well Reconfiguration Work Plan for Well BW-4* on June 29, 2021 (NASA, 2021). On January 18, 2022, the New Mexico Environment Department (NMED) approved the work plan (NMED, 2022). In the work plan, NASA proposed to install a single, dedicated

[1] Westbay is a registered trademark of Nova Metrix Ground Monitoring (Canada) Ltd.

low-flow bladder pump in the open portion of the borehole with the intake set at approximately 330 ft btoc and to abandon the lower portion of the borehole from current total depth up to roughly 340 ft btoc using ~~with~~ a neat cement grout containing 5% bentonite. The upper portion of the borehole from top of cement grout (roughly 340 ft btoc) to the bottom of the casing at 244 ft btoc would remain open.

4.0 Reconfiguration Overview

NASA and the subcontract drilling company completed plugging activities in accordance with the NMED-approved work plan (NASA, 2021). Surface features including bollards and concrete well pad were removed during previous work. Prior to YJD's arrival at WSTF, NASA performed well site maintenance at BW-4 to provide a safe work environment.

Plugging activities were completed using a Boart Longyear®[2] BK-81 heavy-duty drill rig. Equipment used included a 1,500-gallon water tank, 20 ft sections of 2-inch steel tremie pipe, air compressor, diaphragm pump, grout tank, and a power drill fitted with a mixing attachment. Reconfiguration of the open borehole was completed at well BW-4 on January 5 and 6, 2023. Reconfiguration was completed by pumping cement grout~~s~~ downhole until the desired new borehole depth had been achieved.

Tremie pipe was lowered into the well to a depth of approximately 475 ft bgs. Cement grout was then hand mixed onsite using Phoenix Cement®[3], Portland Type II, mixed with 5% by weight Quick-Gel bentonite and approximately 4.52 gallons of water per 50-pound bag of cement. Approximately 60 gallons of grout was pumped downhole the first day. The following day, NASA measured the top of grout in the borehole at 421 ft bgs. Tremie was lowered to approximately 415 ft bgs and approximately 50 gallons of grout was mixed and pumped downhole. Tremie pipe was removed and decontaminated. On January 30, 2023, NASA measured the top of grout in the borehole at 332.65 ft bgs. A well completion diagram illustrating the well reconfiguration is provided in Figure 4.1.

5.0 Well Development and Sampling System Installation

~~NASA expects to coordinate additional well development at well BW-4 before a new sampling system is installed. After redevelopment, well BW-4 will be fitted with a dedicated groundwater sampling system certified free of per- and polyfluorinated substances and WSTF groundwater contaminants. The pump intake will be positioned at approximately 330 ft bgs to collect representative groundwater samples from the targeted fracture.~~ Development of well BW-4 began on September 11, 2024 and was concluded on October 30, 2024. Development was completed via hand bailing using a stainless steel 3-inch by 3-foot bailer. During development activities, WSTF Environmental Contractor personnel monitored discharged development water for indicator parameters including pH, specific conductivity, temperature, and turbidity (Appendix A). Well development ideally is considered complete when measured water quality parameters are relatively stable (vary less than 10%) and turbidity is below 5 nephelometric turbidity units (NTUs). During development, levels of pH varied from 10.67 to 11.4, temperature varied from 18.6 to 22.3 degrees Celsius (°C), and specific conductivity ranged from 1194 to 1354 µS/cm.

A total of 310 gallons were removed during well development. Groundwater quality parameters final results were as follows: pH = 11.14; temperature = 18.6 °C; and specific conductivity = 1234 µS/cm. The final turbidity was reported at 79.4 NTUs.

[2] Boart Longyear is a registered trademark of Longyear TM, Inc.
[3] Phoenix Cement is a registered trademark of Salt River Pima-Maricopa Indian Community.

On November 3, 2024, a low-flow bladder pump sampling system was installed in well BW-4. The dedicated pump and tubing are certified perfluoroalkyl and polyfluoroalkyl substance-free.

6.0 Work Plan Deviations

The following are deviations from the NMED-approved well reconfiguration work plan (NASA, 2021) for the reconfiguration of well BW-4.

The target depth of the reconfigured borehole was 340 ft bgs. This depth was selected to plug the fracture zone identified at approximately 350 ft bgs, while leaving the fracture zone at 330 ft bgs as the primary producing fracture in the borehole. The final depth of the borehole after reconfiguration was tagged on January 30, 2022 at 332.65 ft bgs. The final depth of the reconfigured borehole is approximately 7.35 ft higher than the target depth. The cement grout rose higher in the borehole than expected after curing. In an effort not to over-plug the borehole, the grouting took place over two days, as discussed in Section 4.0. In the first lift, approximately 60 gallons of cement grout was added downhole. Calculations in the field indicated the additional grout should have plugged approximately 72 ft of the borehole, which would have brought the total depth to 415 ft bgs. The following day, the grout depth was measured at 421 ft bgs. It was assumed the difference was a result of formation loss. An additional 50 gallons of cement grout was added, which was calculated to bring the depth up to approximately 360.5 ft bgs. After placement of the second lift, the drill crew mobilized and completed activities at other wells, allowing the cement grout to cure fully before measuring the new borehole depth and adding a third lift if necessary. On January 30, 2024, the depth was measured at 332.65ft bgs.

It is believed that groundwater samples have the potential to be minimally affected by proximity of the cement grout. The fracture targeted in the reconfiguration is still accessible for sampling. With the bladder pump intake properly placed at 330 ft bgs, representative groundwater samples will be collected from the targeted fracture immediately following effective low-flow purging in accordance with established WSTF groundwater sampling procedures. Potential effects cannot be determined until multiple sampling events have been completed and chemical analytical data can be compared to historical data.

As the reconfigured BW-4 is included in the ongoing groundwater monitoring program at WSTF, results of subsequent annual samples will be included and evaluated in the quarterly monitoring reports. NASA is aware of the potential for sample quality effects due to the proximity of grout to the targeted fracture zone at 330 ft bgs and will closely monitor sample results to identify any impacts observed.

~~5.0~~7.0 Waste Management

Well BW-4 is located within the extent of the known WSTF groundwater contaminant plume. Waste management and disposal were conducted in accordance with the NMED-approved *Well Reconfiguration Work Plan for Well BW-4* (NASA, 2021; NMED, 2022) and the then current WSTF Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit Environmental Protection Agency (EPA) ID No. NM8800019434 (NMED, 2009). Groundwater within the WSTF contaminant plume is characterized as hazardous waste when it is actively managed through application of the EPA's contained-in policy (EPA, 1998) and 40 Code of Federal Regulations (CFR) 261.31. The EPA "Contained-In" Policy states that groundwater, soil, and other environmental media is not solid waste but is subject to regulation as hazardous waste when it contains listed waste (EPA, 1996). The specific F001 and F002 contaminants of concern are trichloroethene (TCE), tetrachloroethene (PCE),

trichlorofluoromethane (Freon®[4] 11), and 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113). Therefore, any environmental media and debris that has been contacted by the contaminated groundwater was characterized as hazardous waste and will only carry the F001 and F002 hazardous waste codes. Contaminated groundwater does not exhibit the characteristics of hazardous waste codified in 40 CFR 261, Subpart D.

Waste that was not contacted by contaminated groundwater was characterized as non-hazardous solid waste. Nonhazardous waste consisted primarily of spent disposable personal protective equipment (PPE), concrete debris, and empty commercial packaging from the cement and bentonite products used during the plugging and abandonment activities. The non-hazardous waste was managed in accordance with New Mexico Solid Waste Regulations in 20.9 New Mexico Administrative Code (NMAC). Following completion of plugging and abandonment activities, non-hazardous solid waste was disposed of at the Corralitos Regional Landfill. Metal determined to be recyclable, such as cut steel well casing, was decontaminated and will be recycled under the scrap metal exemption described at 20.4.1.200 NMAC incorporating 40 CFR 261.4(a)(13).

Environmental media and debris suspected of contact with contaminated groundwater was characterized as a hazardous solid waste. Hazardous waste generated included contaminated debris (e.g., plastic drop sheet, concrete debris, and PPE), environmental media (e.g., soil), and decontamination fluids. Similarly, hydrocarbon contaminated debris (e.g., plastic sheeting and wipes) that may have come into contact with petroleum-based lubricants, coolants, and/ or fuels were accumulated separately, and managed as hazardous waste. Hazardous wastes were accumulated in appropriately sized, Department of Transportation-compliant containers. The containers were managed in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.17. Within permissible accumulation time limits, the aqueous-phase decontamination fluids were transferred to the Mid-plume Interception and Treatment System for treatment and discharge in accordance with then current Discharge Permit-1255 (NMED, 2017). Land disposal restriction notifications and disposal facility profiles were completed as required for the solid-phase environmental media and debris characterized as hazardous waste. Within 90 days from the initial accumulation, the solid phase-hazardous waste will be manifested off-site and transported for treatment and disposal at a permitted RCRA Treatment Storage and Disposal Facility.

~~6.0~~8.0 References

Adoption of 40 CFR Part 262, Environmental Improvement Board, 20.4.1.300 NMAC (12-01-18).

Adoption of 40 CFR Part 263, Environmental Improvement Board, 20.4.1.400 NMAC (12-01-18).

NASA Johnson Space Center White Sands Test Facility. (2021, June 29). *NASA WSTF Well Reconfiguration Work Plan for Well BW-4*. Las Cruces, NM.

NMED Hazardous Waste Bureau. (2009, November 3). *Hazardous Waste Permit No. NM8800019434* (modified December 2019). Santa Fe, NM.

NMED Ground Water Quality Bureau. (2017, July 14). *Discharge Permit Renewal and Modification, DP-1255, NASA White Sands Testing Facility*. Santa Fe, NM.

[4] Freon is a registered trademark of The Chemours Company FC, LLC.

NMED Hazardous Waste Bureau. (2022, January 18). *Approval with Modifications Well Reconfiguration Work Plan for BW-4*. Santa Fe, NM.

Solid Waste, New Mexico Environmental Improvement Board, 20.9 NMAC (08-02-07).

Figures

Figure 2.1 **WSTF Location Map**

(SEE NEXT PAGE)

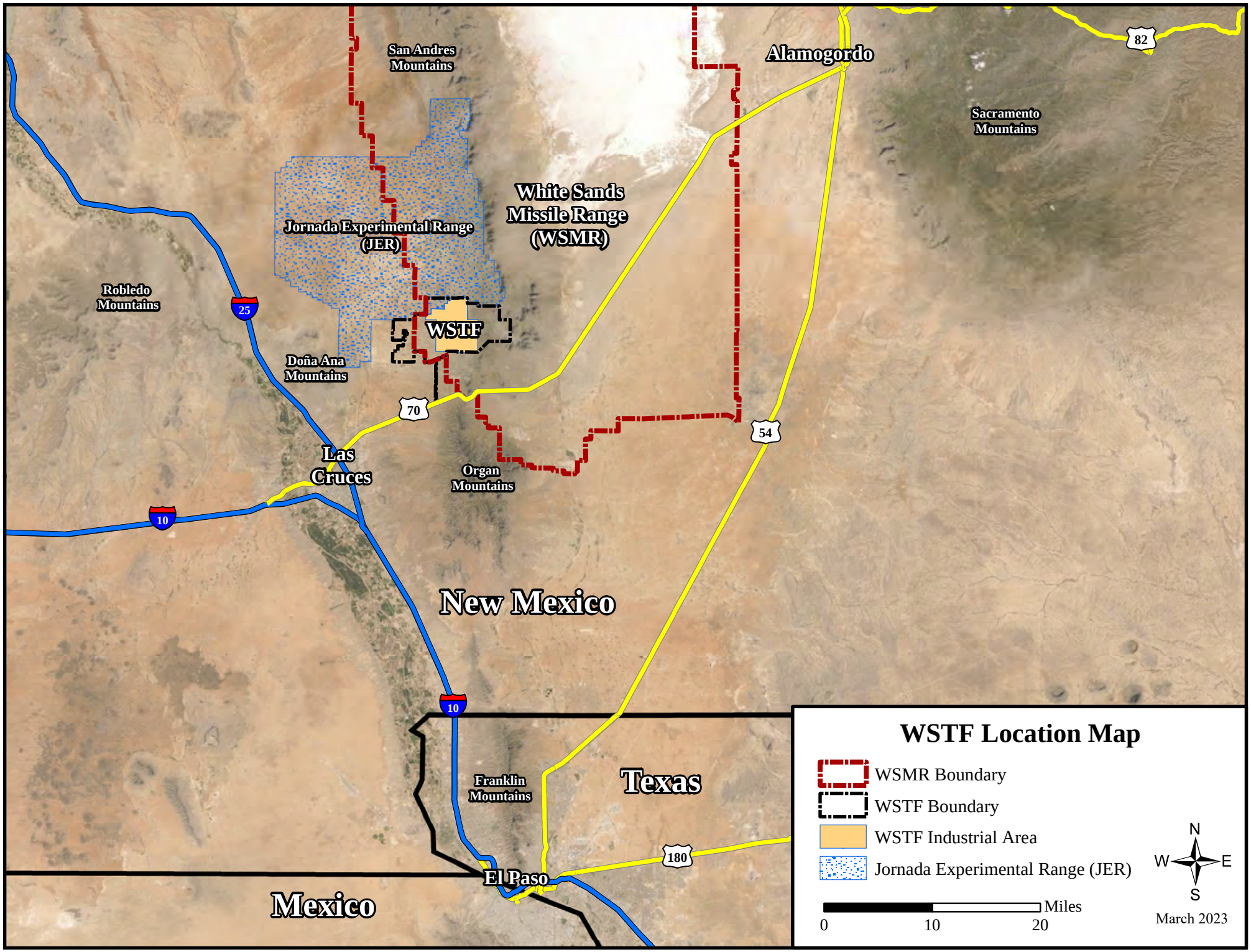

San Andres Mountains
Alamogordo
82
Sacramento Mountains
White Sands Missile Range (WSMR)
Jornada Experimental Range (JER)
Robledo Mountains
25
WSTF
Doña Ana Mountains
70
54
Las Cruces
Organ Mountains
10
New Mexico
10
Franklin Mountains
Texas
180
El Paso
Mexico
WSTF Location Map
WSMR Boundary
WSTF Boundary
WSTF Industrial Area
Jornada Experimental Range (JER)
Miles
0
10
20
N
W
E
S
March 2023

Figure 3.1 **BW-4 Well Location Map**

(SEE NEXT PAGE)

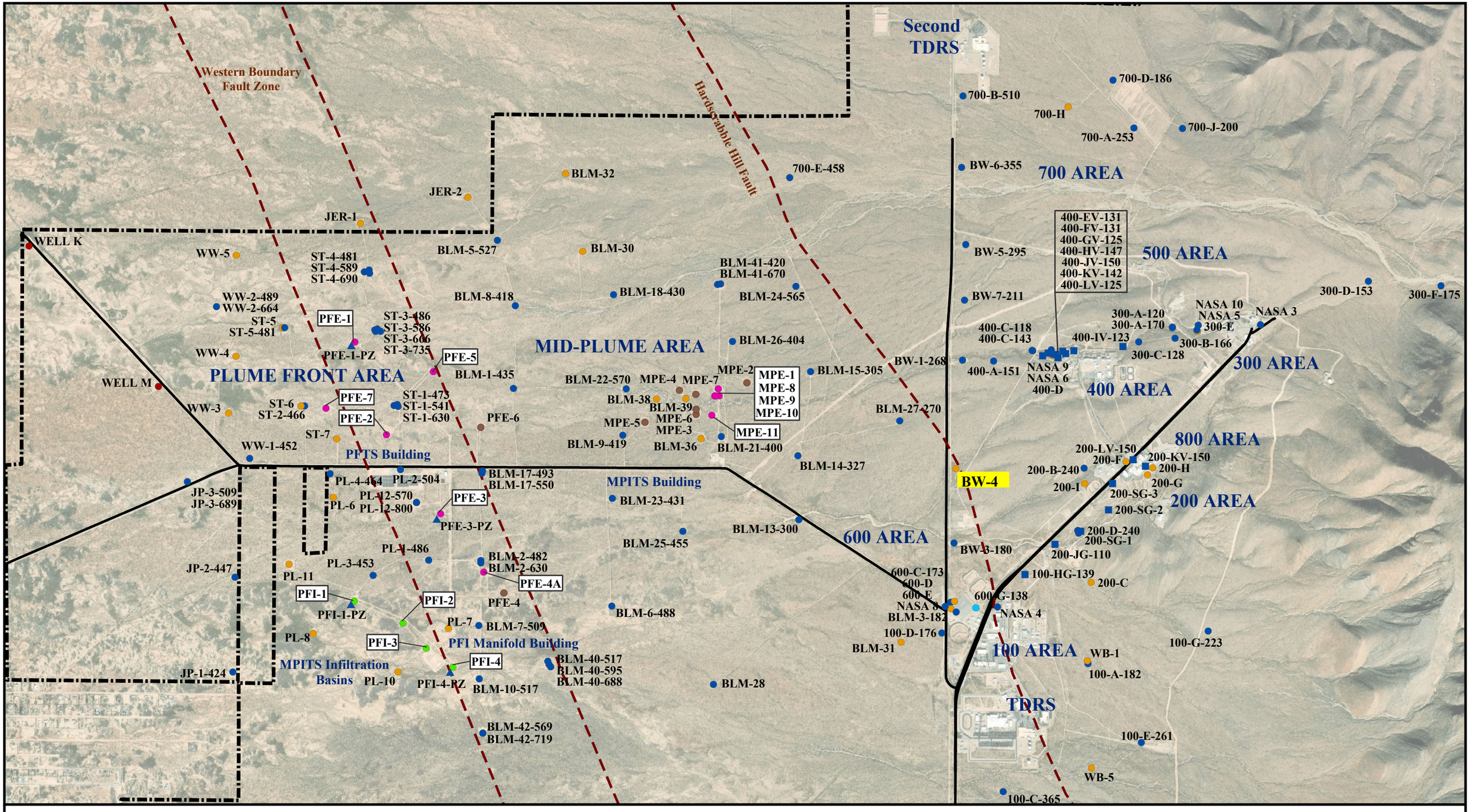

Western Boundary Fault Zone
Hardscrabble Hill Fault
Second TDRS
700-D-186
700-B-510
700-H
700-A-253
700-J-200
BW-6-355
700 AREA
700-E-458
BLM-32
JER-2
JER-1
WELL K
WW-5
BLM-5-527
BLM-30
ST-4-481
ST-4-589
ST-4-690
400-EV-131
400-FV-131
400-GV-125
400-HV-147
400-JV-150
400-KV-142
400-LV-125
BW-5-295
500 AREA
BLM-41-420
BLM-41-670
WW-2-489
WW-2-664
ST-5
ST-5-481
BLM-8-418
BLM-18-430
BLM-24-565
BW-7-211
300-D-153
300-F-175
NASA 10
NASA 5
NASA 3
300-A-120
300-A-170
300-E
PFE-1
ST-3-486
ST-3-586
ST-3-606
ST-3-735
400-C-118
400-C-143
400-IV-123
300-B-166
300-C-128
WW-4
PFE-1-PZ
PFE-5
BLM-26-404
MID-PLUME AREA
BLM-15-305
BW-1-268
300 AREA
400-A-151
NASA 9
NASA 6
400-D
400 AREA
PLUME FRONT AREA
BLM-1-435
BLM-22-570
MPE-4
MPE-7
MPE-2
MPE-1
MPE-8
MPE-9
MPE-10
WELL M
PFE-7
ST-1-473
ST-1-541
ST-1-630
BLM-38
BLM-39
WW-3
ST-6
ST-2-466
PFE-2
PFE-6
MPE-5
MPE-6
MPE-3
MPE-11
BLM-27-270
ST-7
BLM-9-419
BLM-36
BLM-21-400
800 AREA
WW-1-452
PFTS Building
BLM-14-327
200-LV-150
200-F
200-KV-150
200-H
200-B-240
200-I
200-G
BW-4
BLM-17-493
BLM-17-550
MPITS Building
PL-4-464
PL-2-504
200-SG-3
200-SG-2
200 AREA
JP-3-509
JP-3-689
PL-12-570
PL-12-800
PL-6
PFE-3
BLM-23-431
200-D-240
200-SG-1
PFE-3-PZ
BLM-13-300
BLM-25-455
600 AREA
BW-3-180
200-JG-110
PL-1-486
JP-2-447
PL-3-453
BLM-2-482
BLM-2-630
PL-11
PFE-4A
100-HG-139
200-C
600-C-173
600-D
600-E
600-G-138
PFI-1
PFI-2
PFE-4
NASA 8
NASA 4
BLM-3-182
PFI-1-PZ
BLM-6-488
PL-7
BLM-7-509
100-D-176
BLM-31
PL-8
PFI-3
PFI Manifold Building
100-G-223
100 AREA
WB-1
PFI-4
BLM-40-517
BLM-40-595
BLM-40-688
100-A-182
JP-1-424
MPITS Infiltration Basins
PL-10
PFI-4-PZ
BLM-10-517
BLM-28
TDRS
BLM-42-569
BLM-42-719
100-E-261
WB-5
100-C-365
Monitoring Well BLM-28 Location
Multiport
MSVGM Well
Piezometer
Main Road
WSTF Boundary
Conventional Well
Extraction Well
Exploration Well
Faults
Perched Well
Injection Well
Production Well
0
2,000
4,000
6,000
Feet
N
W
E
S
March 2023

Figure 3.2 **Well BW-4 Well Completion Diagram**

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

WESTBAY® MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **168325.61N 465802.60E**
Elevation (Brass Cap): **1448.64 m AMSL**
Elevation (Top of Casing): **1449.04 m AMSL**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Total Depth of Borehole (bgs): **482' (146.9 m)**
Borehole Diameter: **8 3/4" 0-244'; 4 1/2" 244-482'**
Depth to Bedrock (bgs): **230' (70.1 m); Andesite**
Depth to Groundwater: **194.26' (59.2 m) TOSC (2/18/93)**
Total Depth Surface Casing (bgs): **244' (74.4 m)**
Diameter and Type Surface Casing: **Nominal 5" Steel**
Date(s) Well Installed: **2/19/93 - 2/23/93**

Date(s) Well Developed: **BH = 2/17/93 (air-lift); WB = unknown**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **475' (144.8 m)**
Type of Casing: **Westbay® MP 38 PVC (SCD 80)**
Diameter Well Casing: **1.5" ID; 1.9" OD**
WB Sampling Zone(s)(bgs): **270' (82.79 m); 355' (108.71 m); and 455' (139.20 m)**
WB Packer Zone(s)(bgs): **260-285' (79.74-87.36 m); 345-365' (105.66 m-111.76 m); and 455-475' (TD) (139.20-144.8 m)**
Comments: **Depths (meters) for Westbay components and zones are a calculated value based on piezometric levels at Meas. Ports. TOSC = Top of Surface Casing AMSL = Above Mean Sea Level BH = borehole WB = Westbay®**

Surface Casing
Nominal 5" Steel

1.5" ID Westbay® MP38 Casing

Casing Explanation:

1.5" ID Westbay® MP38 End Cap

Packer

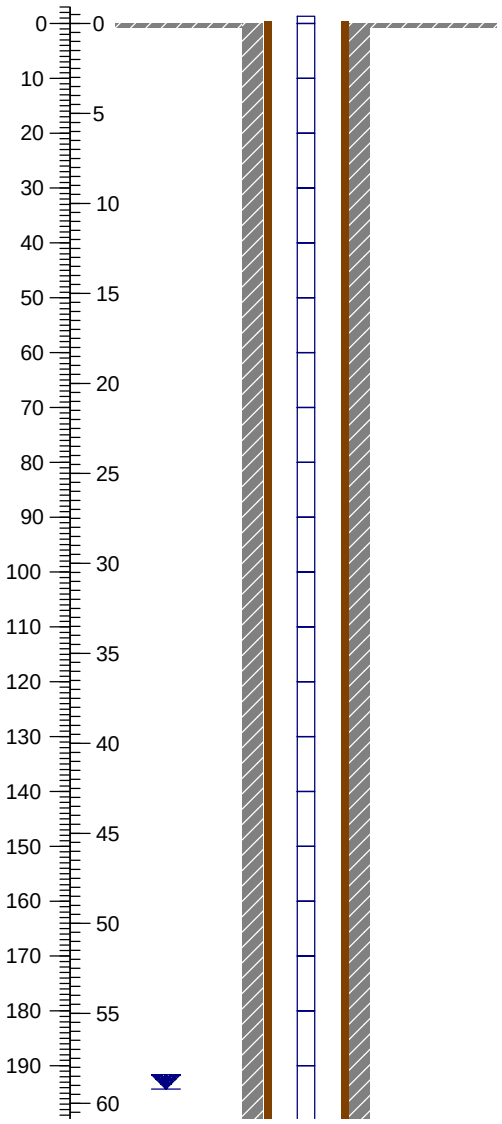
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)

Magnetic Collar
Water Table

Cement
Slough

Feet/Meters

Well Descriptions All depths listed are bgs (unless noted)	**Annular/Borehole Descriptions** All depths listed are bgs



Westbay® Well Stick-Up = 1.3' (0.394 m)
Surface Casing Stick-Up = ~0.42' (0.1 m)
Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casing at ground surface.

Depth to Water = 194.26' (59.2 m)(Borehole; measured

Surface Casing
Nominal 5" Steel

1.5" ID Westbay® MP38 Casing

Casing Explanation:

1.5" ID Westbay® MP38 End Cap

Packer

Measurement Port (MP)

MP with Filter Sock

Mechanical Pumping Port (PP)

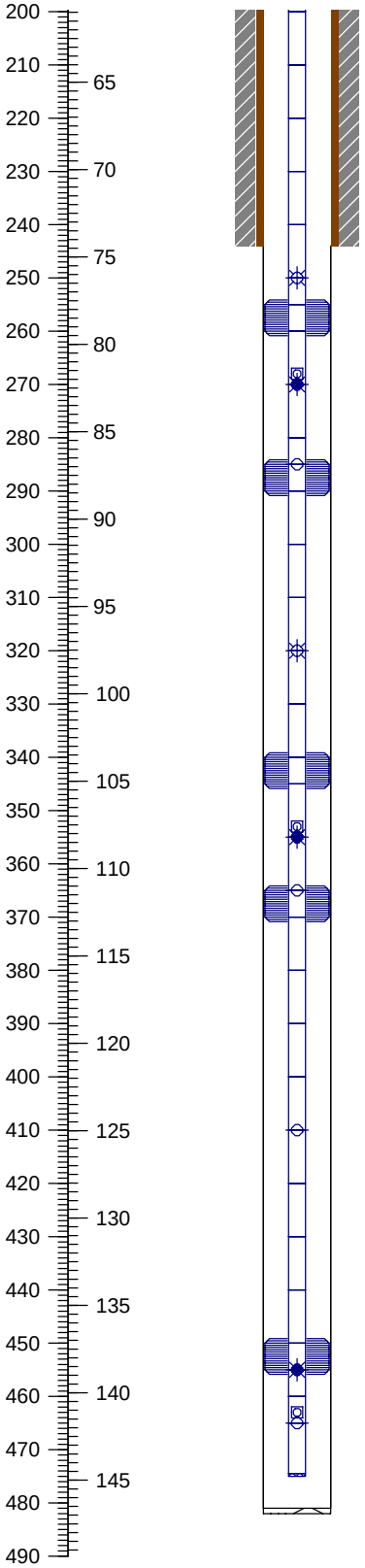
Magnetic Collar

Water Table

Cement

Slough

Feet/Meters



Well Descriptions All depths listed are bgs (unless noted)	**Annular/Borehole Descriptions** All depths listed are bgs
2/18/93 (TOSC) just before Westbay® well casing installation)	
	Andesite (Orejon Andesite) Bedrock Depth = 230' (70.1 m)
Nominal 5" Steel Surface Casing Depth = 244' (74.4 m)	8 3/4" Borehole cemented to 244' (74.4 m)
MP Depth = 250' (76.69 m) Packer Depth = 255'-260' (78.21-79.74 m)	
Magnetic Collar Depth = 269.6' (82.67 m) Sampling MP Depth (with Filter Sock) = 270' (82.79 m)	
PP Depth = 285' (87.36 m) Packer Depth = 285'-290' (87.36-88.87 m)	
MP Depth = 320' (98.04 m)	
Packer Depth = 340'-345' (104.14-105.66 m)	
Magnetic Collar Depth = 354.6' (108.59 m) Sampling MP Depth (with Filter Sock) = 355' (108.71 m)	
PP Depth = 365' (111.76 m) Packer Depth = 365'-370' (111.76-113.28 m)	
PP Depth = 410' (125.0 m)	
Packer Depth = 450'-455' (137.68-139.20 m) Sampling MP Depth (with Filter Sock) = 455' (139.20 m) Magnetic Collar Depth = 464.6' (142.13 m) PP Depth = 465' (142.25 m)	
Westbay® MP 38 Casing TD = 475' (144.8 m)	
4 1/2" Borehole TD = 482' (146.9 m)	Top of Slough = ~481' (146.6 m). Borehole total depth with slough per

Figure 4.1 Reconfigured BW-4 Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation

Surface Casing
5-in. Nominal Steel

Completion Casing
N/A

Well Screen
N/A

Annular Materials Explanation

Neat Cement

Slough

Cement w/ 5% Bentonite

Elevation (ft amsl) / Depth (ft bgs)	**Borehole/Well Casing Descriptions** All depths are below ground surface	**Annular Materials Descriptions** All depths are below ground surface
4750 / 0	Surface Casing Stick-Up = 0.83 ft. ags	
4740 / 10		Alluvium formation is Santa Fe Group from surface to 230 ft.
4730 / 20	8 3/4-in. Borehole 0 - 244 ft	8 3/4-in. Borehole cemented to 244 ft
4720 / 30		
4710 / 40		
4700 / 50		
4690 / 60		
4680 / 70		
4670 / 80		
4660 / 90		
4650 / 100		
4640 / 110		
4630 / 120		

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft.; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation

Surface Casing
5-in. Nominal Steel

Completion Casing
N/A

Well Screen
N/A

Annular Materials Explanation

Neat Cement

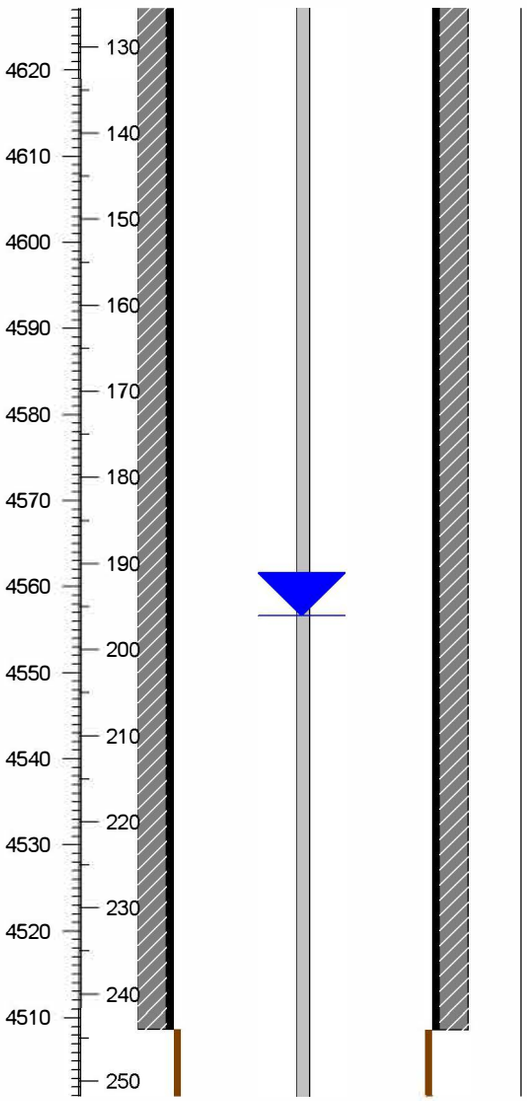
Slough

Cement w/ 5% Bentonite

Elevation (ft amsl) / Depth (ft bgs)

Borehole/Well Casing Descriptions
All depths are below ground surface

Annular Materials Descriptions
All depths are below ground surface



Water Table Depth = 197.5 ft. (measured post re-development 10/30/24)

Nominal 5-in. Steel Surface Casing Depth = 244 ft.

Andesite (Orejon Andesite) Bedrock Depth = 230 ft

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft.; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation

Surface Casing
5-in. Nominal Steel

Completion Casing
N/A

Well Screen
N/A

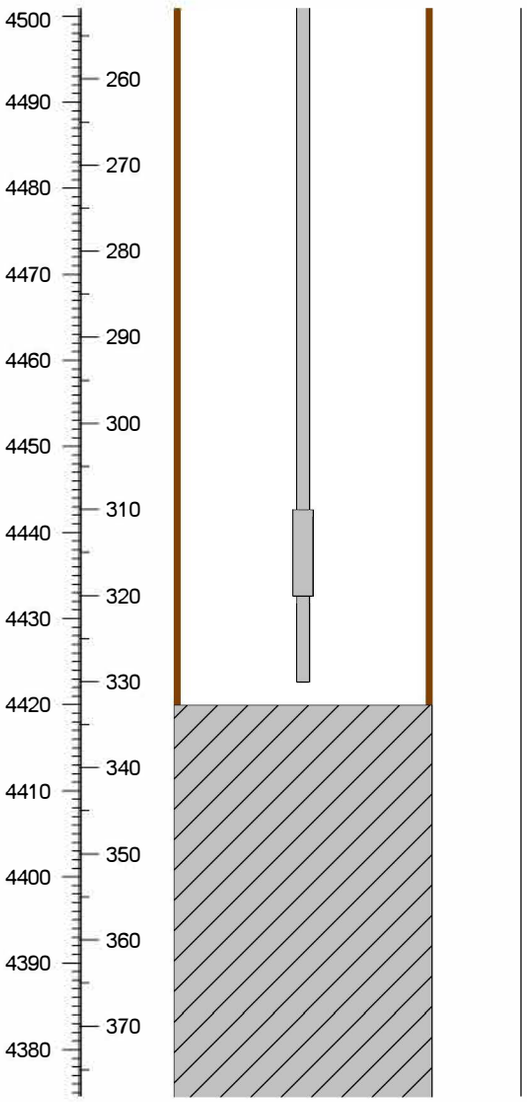
Annular Materials Explanation

Neat Cement

Slough

Cement w/ 5% Bentonite

Elevation (ft amsl) / Depth (ft bgs)	**Borehole/Well Casing Descriptions** All depths are below ground surface	**Annular Materials Descriptions** All depths are below ground surface



Sampling System Inlet = 330 ft btoc

Cement w/ 5% Bentonite
(Re-completion) = 332.65 - 481 ft

WELL COMPLETION DIAGRAM
MONITORING WELL

Location ID: **BW-4** Site ID: **NASA-WSTF, Doña Ana County, NM**

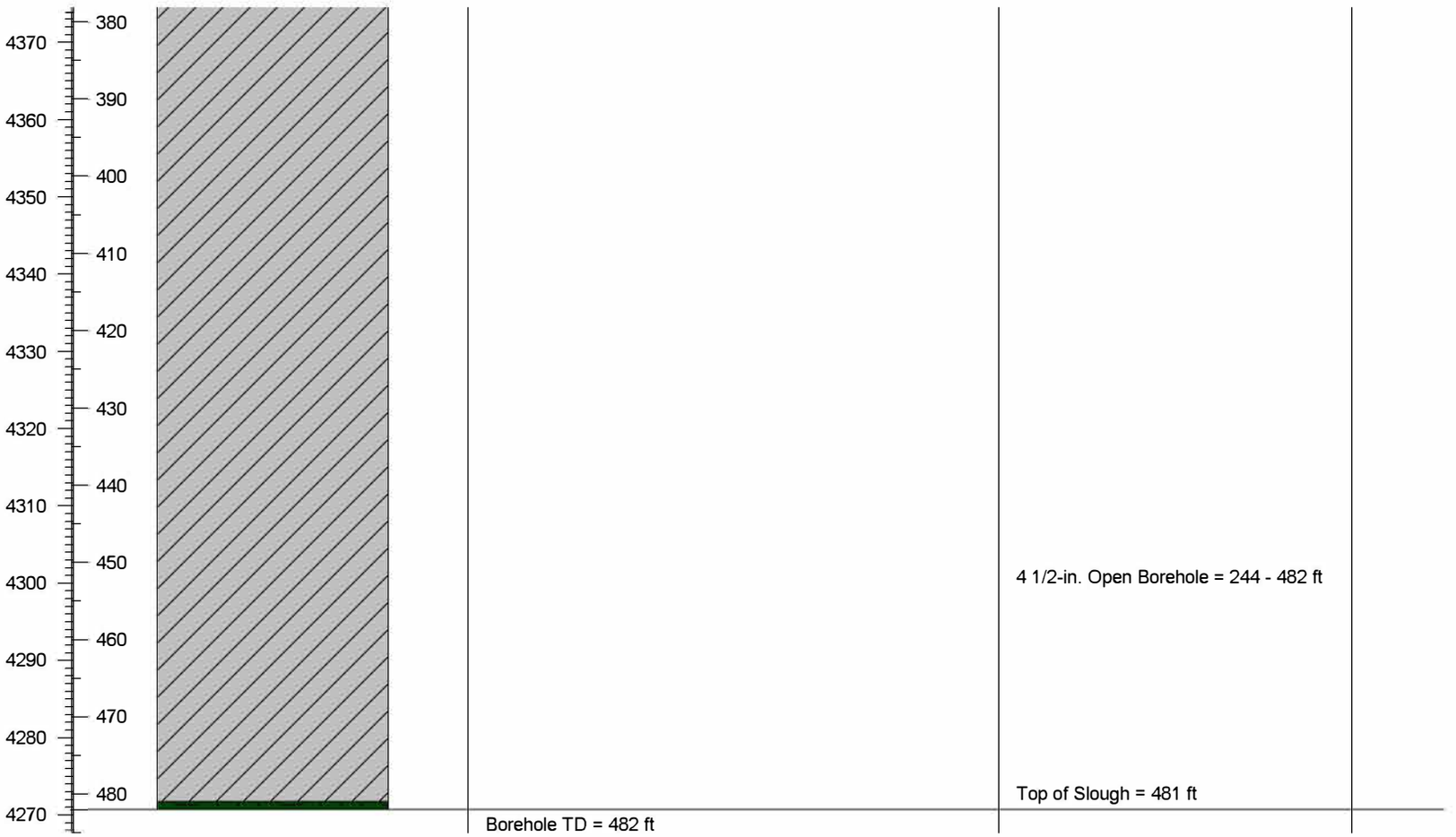
Township and Range: **SE 1/4 SE 1/4 SE 1/4 Sec. 34, T20S, R3E**
NM State Plane Coordinates (NAD 83)(ft): **552248.31 N, 1528220.58 E**
Elevation (Brass Cap): **4752.68 ft.**
Elevation (Top of Casing): **4753.51 ft.**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Method of Drilling: **Mud Rotary**
Total Depth of Borehole (bgs): **482 ft.; Reconfigured: 332.65 ft**
Borehole Diameter: **8 3/4-in. 0-244 ft; 4 1/2-in. 244-482 ft**
Depth to Bedrock (bgs): **230 ft; Andesite**
Depth to Groundwater: **197.5 ft. btoc (10/30/2024)**
Diameter and Type Surface Casing: **Nominal 5-in. Steel**

Dates Borehole Drilled: **2/2/93 - 2/18/93**
Date(s) Well Installed: **2/19/93 - 2/23/93 (Westbay; Open Borehole)**
Date(s) Well Developed: **2/17/93 (air-lift); 9/11 - 10/30/24 (Bailing)**
Field Representative(s): **P. Egan, D. Menzie, K. Summers**
Total Depth Well Casing (bgs): **244 ft (Surface Casing only)**
Type of Casing: **Steel**
Diameter Well Casing: **N/A (Open Borehole)**
Screened Zone (bgs): **N/A (Open Borehole)**

Comments: **WestBay pulled (2/4 - 2/16/18), Re-completed to 332.65 ft (1/6/23)**
bgs = below ground surface btoc= below top of casing
ags= above ground surface
ID = Inner Diameter OD= Outer Diameter

Casing Explanation
Surface Casing: **5-in. Nominal Steel**
Completion Casing: **N/A**
Well Screen: **N/A**

Annular Materials Explanation
Neat Cement
Slough
Cement w/ 5% Bentonite



Appendix A Well Development Parameters

BOREHOLE / WELL DEVELOPMENT

Cover Page

Provide all depth measurements with respect to ground surface

Site/Screen Name:	BW-4	Project No.:	
Location:	WSTF	Field Personnel:	T.Kondy (Field Lead)
Lead Company:	Navarro	Document Reviewer:	S. Rees
Supporting Company:		Review Complete:	

FINAL DEVELOPMENT PARAMETERS

Borehole / Well Total Depth: 332.65 ft bgs

Screened Intervals: Open Borehole and ft bgs

Total Volume Withdrawn: (Airlifting/Swabbing/Jetting) n/a gals

Total Volume Withdrawn: (Development Pumping) 280 gals

DEVELOPMENT TOOLS

Tool: Bailer Description: 3-inch X 36-inch Used from: to

Tool: Description: Used from: to

DEVELOPMENT DATA

METER CALIBRATION / VERIFICATION:

Water level pre-development = 197.00 ft btoc

Date	Time	Meter Type	Withdrawn (gal)	Cumulative Withdrawn (gal)	Drawdown (ft bgs)	Pumping Rate (gpm)	pH	Temp (°C)	SC (µS/cm)	Turbidity (NTU)	Pump Intake (ft bgs)
9/11/24	1005		20	20			11.4	21.9	1226	359	
9/12/24	1440		30	50	208.6		-	-	-	-	
9/13/24			30	80	209.24		-	-	-	-	
9/30/24	0955		-	-			11.05	20.5	1328	1.93	
10/7/24	0910		10	90			10.76	20.1	1208	61.7	
10/7/24	1030		10	100			10.71	20.4	1324	60.5	
10/8/24	0910		10	110			11.05	20.8	1195	70.9	
10/8/24	1030		10	120			10.91	20.9	1321	68.7	

BOREHOLE / WELL DEVELOPMENT (Continued)

Provide all depth measurements with respect to ground surface

Site/Screen Name: BW-4 Project No.:

Location: WSTF Field Personnel: T.Kondy

DEVELOPMENT DATA (Continued)

Date	Time	Meter Type	Withdrawn (gal)	Cumulative Withdrawn (gal)	Drawdown (ft bgs)	Pumping Rate (gpm)	pH	Temp (°C)	SC (µS/cm)	Turbidity (NTU)	Pump Intake (ft bgs)
10/8/24	1410		10	130			10.84	21.3	1354	61.4	
10/10/24	0915		10	140			11.05	20.9	1240	59.7	
10/10/24	1040		10	150			11.10	21.3	1231	58.4	
10/15/24	0930		10	160			10.67	20.6	1235	47.4	
10/15/24	1345		10	170			11.10	22.1	1194	82.5	
10/15/24	1430		10	180			11.15	22.3	1205	81.4	
10/16/24	0945		10	190			11.02	21.9	1245	45.4	
10/16/24	1345		10	200			11.21	21.8	1251	81.0	
10/16/24	1435		10	210			11.40	22.3	1250	82.5	
10/24/24	0930		10	220			10.9	20.2	1237	60.4	
10/24/24	1055		10	230			11.07	20.8	1220	90.8	
10/24/24	1455		10	240			11.34	21.0	1229	85.4	
10/25/24	0925		10	250			11.21	20.5	1231	65.4	
10/25/24	1050		10	260			11.11	20.9	1221	79.8	
10/28/24	0930		10	270			11.26	20.5	1235	62.5	

BOREHOLE / WELL DEVELOPMENT (Continued)

Provide all depth measurements with respect to ground surface

Site/Screen Name: BW-4 Project No.:

Location: WSTF Field Personnel: T.Kondy

DEVELOPMENT DATA (Continued)

Date	Time	Meter Type	Withdrawn (gal)	Cumulative Withdrawn (gal)	Drawdown (ft bgs)	Pumping Rate (gpm)	pH	Temp (°C)	SC (µS/cm)	Turbidity (NTU)	Pump Intake (ft bgs)
10/28/24	1055		10	280			11.19	20.7	1242	79.38	
10/28/24	1455		10	290			10.95	20.4	1236	81.5	
10/30/24	0920		10	300	203.6		10.80	18.6	1241	97.3	
10/30/24	1050		10	310	208.00		11.14	18.6	1234	79.4	