National Aeronautics and
Space Administration

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

December 20, 2022

Reply to Attn of: RE-22-158

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

Subject: Abbreviated Drilling Work Plan in Response to the NMED Approval with Modification of the Report on Tracer Testing in the WSTF 200/600 Areas and Mid-plume Constriction Area

National Aeronautics and Space Administration (NASA) submitted a *Report on Tracer Testing in the 200/600 Areas and Mid-plume Constriction Area* at White Sands Test Facility (WSTF) to the New Mexico Environment Department (NMED) on August 31, 2020. Following a review of the report, NMED issued an approval with modification on April 5, 2022. The modification consisted of one comment with a two-part request for 1a) the installation of at least three additional groundwater monitoring wells immediately downgradient of the 200 Area and 1b) three additional proposed monitoring well locations further to the west between the area targeted by the 1a) request and the Mid-plume Constriction Area (MPCA). The wells were requested to support "vertical and horizonal refinement of the groundwater contaminant plume conceptual model." NASA submitted a letter to the NMED on November 9, 2022 that provided a recommended approach to address the new well installation requirements.

The enclosed Abbreviated Drilling Work Plan (ADWP) recommends the installation of three monitoring wells in accordance with NMED comment 1a). The ADWP includes proposed well locations and well construction diagrams that are designed to address the subsurface data gap immediately to the west of the 200 Area (area generally bounded by monitoring well BW-4 to the west, the 200 Area to the east, the 400 Area to the north, and monitoring well BW-3-180 to the south).

NASA recommends that the results obtained from installation and sampling for the three monitoring wells proposed in response to NMED comment 1a) first be evaluated relative to the locations, bedrock geology encountered, and groundwater geochemistry prior to any additional well installations in response to NMED Comment 1b). The requirement and proposed location for additional wells further to the west can be addressed following NMED review of the evaluation of information generated during installation and monitoring of the three new wells. This ADWP is intended to satisfy the NMED requirement of a work plan no later than December 30, 2022. Enclosure 1 includes a bound copy of the ADWP. An electronic copy of the ADWP is provided on a CD-ROM as Enclosure 2.

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 Michael Zigmond of my staff at 575–524–5484.

Sincerely,

ANTONETT
E Doherty
Digitally signed by
ANTONETTE Doherty
Date: 2022.12.20
09:52:40 -08'00'

For: Timothy J. Davis
Chief, Environmental Office

2 Enclosures

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

Abbreviated Drilling Work Plan for the Installation of Monitoring Wells Downgradient of the 200 and 400 Areas

Primary Purpose	This abbreviated drilling work plan (ADWP) is provided in accordance with a New Mexico Environment Department (NMED) direction that requires the submittal of a work plan in part for the installation of three new monitoring wells (NMED, 2022; comment 1a) at the National Aeronautics and Space Administration (NASA) at White Sands Test Facility (WSTF; Figure 1). The ADWP documents the strategy for installation of the three monitoring wells within the area downgradient (topographically and hydrologically) of the WSTF 200 and 400 Areas. The proposed monitoring well locations are bounded by well BW-4 to the west, the 200 Area to the east, the 400 Area to the north and well BW-3-180 to the south as requested by NMED (NMED, 2022; comment 1a). The three monitoring wells are planned as dual-zone installations within a single borehole to support an NMED requirement for vertical and horizontal refinement of the groundwater conceptual model. The hydrogeological conditions encountered during the installation of each borehole, along with the evaluation of downhole geophysical logs, will be used for the positioning of the monitoring zones, and to determine if two zones are feasible within each well. With respect to NMED comment 1b (NMED, 2022), NASA recommends that the results obtained from the installation of the three monitoring wells proposed in response to comment 1a) first be evaluated relative to the locations, bedrock geology encountered, and groundwater geochemistry prior to addressing additional well installations. The requirement and proposed location for wells further to the west in the area generally bounded by well BW-4 to the east, Mid-plume to the west, wells BLM-15-305, BLM-27-270, and MPE-2 to the north, and monitoring wells BLM-14-327 and BLM-21-400 to the south will be determined following NMED review of the NASA evaluation of groundwater monitoring data from the first three wells.
Hydrogeologic and Geochemical Objectives	The primary objective for each of the three proposed groundwater monitoring wells is to provide characterization of the groundwater geochemistry at specific locations down gradient of the WSTF 200 and 400 Areas. The selected locations fall within the area specified by NMED (NMED, 2022; comment 1a), and are positioned based on the existing well network, local hydrogeological conditions, and surface topographical features particularly with respect to significant drainages and surface runoff. The three locations will support characterization of the local aquifer and groundwater plume downgradient of the 200 and 400 Areas where the current well network coverage is limited.
Conceptual Model	The current conceptualization of the area west of the 200 Area is provided by the line of cross-section A – A’ identified on Figure 2. The corresponding cross-section extends from the 200 Area industrial complex (coincident with wells 200-F, 200-LV-150, 200-KV-150, and 200-H) in the east (A) to well BLM-14 in the west (A’) located in the Mid-plume area (Figure 3). The current subsurface conceptualization will be supplemented by information acquired from the new monitoring wells for this investigation that are proposed in the area between well 200-B-240 and well BW-4.

Conceptual Model (cont.)	Figure 3 includes conventional monitoring well 200-B-240 (installed 1988), and multiport monitoring wells 200-F and 200-H (both installed in 1994) that were used to define an elevated horst-block in the Paleozoic limestone bedrock located directly below the 200 Area industrial complex. Variable thicknesses of the Quaternary Camp Rice Formation alluvial fan deposits overlie the Permian Hueco limestone bedrock surface with thickening to the east and west. Well-defined bedding in the limestone dips at approximately 22 degrees to the northwest and strikes northeast-southwest. The alluvial fan deposits are derived from erosion of the San Andres Mountains located 1 mile east of the 200 Area. The 200 Area buildings are coincident with the most elevated section of the horst block where depths to bedrock are as shallow as 20 feet (ft) below ground surface (bgs). Bedrock is faulted to depth along half-graben bounding faults on both the east (Gardner Spring Arroyo [GSA]) and west (well 200-B-240 Arroyo) sides of the horst block, where the depth to bedrock increases to greater than 100 ft bgs on both sides. Dilute volatile organic compounds (VOCs) discharged to the shallow subsurface from the Chemistry Laboratory tanks hazardous waste management unit (HWMU) on the east side of the 200 Area infiltrated porous alluvial soils to shallow limestone bedrock at 50 ft bgs. These contaminants are interpreted to have migrated southeast down the alluvial-bedrock surface toward GSA and, while following this path, infiltrated bedrock porosity pathways formed by the northeast-southwest trending faults and fractures in the GSA area. Subsequent migration was toward the west under the influence of the regional aquifer gradient and, potentially, the southwest under the influence of the northeast-southwest bedding plane solution channels. These pathways are inferred to have added a downgradient flow component within the fractured bedrock groundwater aquifer to the southwest, which is tangential to the primary site-wide westward flow direction under the influence of a steep hydraulic gradient in the area of 0.05 ft/ft. From the Clean Room Tank HWMU on the west side of the 200 Area, dilute VOCs migrated downward through the thin veneer of alluvium to the bedrock surface and subsequently west along the alluvial-bedrock surface toward wells 200-F and 200-B-240. Fractured limestone bedrock porosity pathways again include faults and bedding planes that form solution channels striking northeast-southwest. Camera logs of open boreholes performed prior to the installation of groundwater monitoring wells 200-F and 200-H in the 200 Area demonstrate the strong relationship between high porosity bedding plane solution channels and elevated groundwater flow. Migration rates for the groundwater plume within the fractured limestone bedrock aquifer from the 200 Area east toward well BW-4 is high compared to the volcanic aquifer bedrock lithologies at WSTF based on observation of relatively high effective porosity of the limestones (NASA, 2015), high flow velocity calculations in annual Post-Closure Care Reports (NASA, 2009), and the significant declines in groundwater contaminant concentrations over time for the 200 Area (NASA, 2022).
Proposed Monitoring Well Locations	The three proposed monitoring wells for this ADWP are located within areas designated adjacent to target surface drainages (Figure 4). The infiltration of surface recharge in these areas is expected to experience enhanced flow and,

Proposed Monitoring Well Locations (cont.)	therefore, potentially enhanced contaminant mass transport along the alluvial-bedrock interface with some additional infiltration into the underlying fractured bedrock. Each designated area allows some flexibility in the placement of the wells to accommodate relatively steeper topography and well-site access. The wells are designed to support conceptualization of the groundwater plume as follows. • The well 400-001-GW area is located northwest of the 200 Area and adjacent to a significant topographic low along a drainage that runs south of the 300 and 400 Areas. This location is important relative to the evaluation of the southern extent of the 300 and 400 Area N-nitrosodimethylamine (NDMA) plume, northern extent of the 200 Area VOC plume, and a potential overlap of the two plumes in this area. • The well 200-001-GW area is located west of the 200 Area and adjacent to a significant topographic low along the drainage that represents a continuation of the same drainage adjacent to well 200-B-240. This area is considered important in evaluating continuation of the VOC plume that has been identified on the west side of the 200 industrialized area. • The well 200-002-GW area is located southwest of the 200 Area and adjacent to the west continuation of GSA, the prominent drainage feature that is coincident with the distribution of subsurface groundwater contamination on the east side of the 200 industrial area. This location is considered important in evaluating the continuation of the plume coincident with GSA and downgradient of known contaminated wells associated with the drainage (e.g., 200-D-240). The location also allows the evaluation of VOC contaminant migration along the southern boundary of the groundwater contaminant plume and the potential flow of contaminated groundwater between the 200 Area and easternmost 600 Area.
Drilling Methodology	NASA will drill the three monitoring well boreholes (400-001-GW, 200-001-GW, and 200-002-GW) in accordance with the requirements of Attachment 19 in the WSTF Hazardous Waste Permit (Permit; NMED, 2009). The boreholes will be installed using the air rotary casing advance (ARCA) or dual rotary drilling methods, which have been frequently used for the installation of source area boreholes at WSTF. The ARCA drilling uses the same methodology as air rotary drilling but also drives a temporary steel casing downhole as the drilling bit advances. This casing keeps the borehole open without the use of drilling fluid. The dual rotary drilling method is similar to the ARCA method, but the drive casing is rotated, instead of hammered, while drilling advances. Casing is removed during the well installation process. When using air supplied by an air compressor as the drilling fluid, the air compressor will have an in-line filter system to prevent potential introduction of contaminants, such as entrained residual oils, into the borehole. The filter system will be inspected regularly by the drilling contractor to ensure that the system is functioning properly. Drilling fluids will be limited to air with potable water if required to provide circulation within the borehole. Minimization of the drilling fluids is essential due to the nature of the fractured bedrock aquifer in this area that can be difficult to

Drilling Methodology (cont.)	develop due to potentially low groundwater flow rates encountered in the boreholes. A cyclone separator or similar air containment/dust-suppression system will be used to funnel the cuttings to one location instead of allowing the cuttings to discharge uncontrolled from the borehole. Particular attention will be paid to the management of cuttings and dust will be minimized as much as possible with a clean water mist at the cyclone, if necessary. The final determination of drilling method will be made following consultation with the drilling subcontractors during the competitive procurement process required by the Federal Acquisition Regulations (48 Code of Federal Regulations [CFR] Part 6). NASA expects to advance a 10-inch (in.) cased borehole to the depth of bedrock at each of the three locations (Table 1). Difficulties are not anticipated in achieving the target depth of the boreholes that are relatively shallow and estimated at between 160 to 165 ft bgs. Advancement of the boreholes will continue into fractured bedrock using downhole air rotary equipment. This will allow groundwater monitoring zones to be located within the fractured bedrock aquifer. The water table is anticipated at depths of between approximately 170 and 190 ft bgs (Table 1). The total depth of the boreholes is up to 350 ft bgs to allow for the installation of a monitoring well with a minimum of one, and up to two zones. The final number of zones will depend upon the results of field observations and downhole geophysical logging.
Potential Groundwater Occurrence and Detection	**Perched Groundwater** The presence of perched groundwater (PGW) is not anticipated at any of the three proposed well areas. If PGW is encountered, drilling will be suspended at the depth in the vadose zone where potential saturation is indicated. The screening of lithological samples from damp soil zones will be conducted with a photoionization detector equipped with the appropriate detection lamp to evaluate the presence of VOCs in the field. Groundwater samples will be collected using a decontaminated non-dedicated bailer if sufficient groundwater is present in the borehole. **Groundwater Aquifer** The top of the groundwater aquifer (water table) is expected to occur at a depth of approximately 170 to 190 ft bgs (Table 1). The exact depth to groundwater is uncertain as a result of the local topographic elevation of the drilling site, properties of variable fractured bedrock lithologies, and the hydrogeologic conditions within the borehole. Methods for groundwater detection may include drilling observations, water level measurements in the borehole, downhole camera logs, and borehole geophysical logs.
Lithological Sampling	Alluvial and bedrock lithological samples will be collected as the borehole advances within the cyclone discharge at the drilling rig at 10-ft intervals to the total depth of drilling. Chip samples will be archived in chip trays and stored at WSTF for future reference.
Groundwater Screening and Characterization Sampling	Based on the results from the surrounding groundwater monitoring well network, the three proposed monitoring wells are expected to be located within the footprint of the WSTF groundwater contaminant plume. For verification and

Groundwater Screening and Characterization Sampling (cont.)	waste characterization purposes, groundwater screening samples will be attempted during drilling as soon as practical upon intercepting the water table. Chemical analytical results from screening samples collected will be used to support the identification of potential monitoring zones, as applicable, and waste characterization activities. Screening samples will be analyzed for VOCs by the current revision of SW-846 Method 8260, semi-volatile organic compounds (SVOC) by the current revision of SW-846 Method 8270C, and NDMA by Modified EPA Method 607M or an acceptable low-level analytical method. If feasible, groundwater samples will be collected utilizing a decontaminated nondedicated bailer. If use of a bailer is not feasible, grab samples may be attempted at an accessible surface discharge point. All samples will be managed in accordance with the WSTF Groundwater Monitoring Plan (GMP; NASA, 2022).
Geophysical Logging	The use of the ARCA or dual rotary drilling methods precludes the opportunity to perform a geophysical logging suite within the upper alluvial section of the boreholes due to the advancement of outer casing to stabilize the borehole. Geophysical logging can be performed in the open borehole from below the depth of the outer casing to total depth, assuming sufficient borehole integrity. If geophysical logging is performed, a complete suite of open borehole geophysical logs will be attempted as a single event to aid in the selection of potential monitoring zones. Open borehole logging will be performed by a qualified geophysical subcontractor, and will include gamma, neutron porosity, resistivity, spontaneous potential, caliper, and borehole deviation logs.
Well Installation and Annular Materials	The proposed monitoring wells (400-001-GW, 200-001-GW, and 200-002-GW) will be constructed in accordance with the requirements stated in Permit Section 19.3.2 (NMED, 2009) with nominal 4 in. Schedule 80 polyvinyl chloride (PVC) casing and screen. This diameter accommodates the use of up to a 3-in. diameter downhole pump for well development. The general well construction configuration is presented in Figure 5. The depths of individual components (screen depths, centralizer locations) is subject to change dependent on the location of monitoring zones identified during borehole installation. NASA will prepare a final well construction diagram for the well for expedited (2 hours requested) NMED review and approval immediately prior to each well installation. Ten-ft length 0.020-in. slotted Schedule 80 PVC screens will be located at a minimum of one, and maximum of two, locations. The number and location of the well screens will be determined through drilling observations, lithological logging, and downhole geophysical logging, if performed. Specific consideration will be given to the depth of the water table, known depth of groundwater plume contamination at nearby monitoring wells, lithologic unit boundaries, and any highly transmissive zones identified during evaluation. A 5-ft well sump with an end cap will be installed below the bottom screen (Figure 5). Annular materials will be emplaced under pressure using a minimum 1.5-in. ID tremie pipe. A 10/20 or similar silica sand filter pack will be placed to a height of approximately two ft above and below each monitoring screen. Three feet of fine

Well Installation and Annular Materials (cont.)	silica sand, such as 30/70 or similar, will be used to grade from the sand pack to a 5 ft bentonite seal composed of hydrated bentonite chips or pellets. Intervals between the individual bentonite seals will be comprised of bentonite grout with at least 20% solids. The upper 10 ft of the borehole and well pad will be completed with Type I Portland cement (Figure 5).
Well Development and Sampling	Each groundwater monitoring well will be developed in accordance with the requirements of Permit Attachment 19 (Section 19.3.5) (NMED, 2009). The drilling subcontractor will operate equipment used to develop the well under the supervision of WSTF contractor environmental organization personnel. The well yield from the fractured bedrock aquifer is anticipated to be low and in the 1 to 3 gpm range at each of the three proposed wells with screens targeting the fractured bedrock aquifer. Flow rates are expected to be relatively higher in wells 200-001-GW and 200-002-GW if hosted within the fractured limestone (effective porosity of approximately 4%). Well 400-001-GW is expected to have a relatively lower flow rate if hosted within the fractured andesite aquifer (effective porosity of approximately 0.5%). Initial development for the sampling zones will consist of mechanical bailing, swabbing, and pumping by the drilling subcontractor using a submersible pump if feasible. During development activities, WSTF environmental contractor personnel will sample and monitor discharged development water for water quality parameters including pH, specific conductance (conductivity), temperature, and turbidity. Well development will be considered complete for each monitoring zone when the measured water quality parameters are stable (vary less than 10%) and turbidity is below 5 nephelometric turbidity units. Following well development and sampling system installation, groundwater characterization samples will be collected from the sampling zones of the completed wells. Samples will be collected for the analysis of VOCs by the current revision of SW-846 Method 8260, SVOCs by the current revision of SW-846 Method 8270C, NDMA by Modified EPA Method 607M or an acceptable low-level analytical method, and a variety of metals by the most effective laboratory-selected analytical method. Samples will be collected and managed in accordance with the WSTF GMP (NASA, 2022).
Investigation-Derived Waste	Investigation-derived waste (IDW) characterization is conducted in accordance with Permit Section II.C (Waste Characterization) and Attachment 12 (Waste Analysis Plan) (NMED, 2009). All waste will be properly managed and disposed of in accordance with NASA procedures and state and federal regulations. The waste streams that are anticipated to be generated groundwater monitoring well installation activities include: • **Drill cuttings.** Unsaturated drill cuttings are defined as soil cuttings or rock fragments generated from the vadose zone that have not come into contact with groundwater. Unsaturated cuttings are not hazardous solid waste. Saturated drill cuttings are defined as soil cuttings or rock fragments generated from below the water table that have come into contact with contaminated groundwater. This environmental media potentially contains listed hazardous waste constituents from the WSTF

Investigation-Derived Waste (cont.)	groundwater plume and is initially characterized as hazardous waste (EPA, 1991). • **Drilling fluids.** Fluids utilized during drilling activities are anticipated to be limited to air with the addition of potable water if necessary. Drilling fluids generated during drilling in the vadose zone are characterized as non-hazardous solid waste. Drilling fluids from below the water table potentially contain listed hazardous waste constituents that are present in the WSTF groundwater plume. Any drilling returns generated from below the water table will be initially characterized as hazardous waste. • **Groundwater.** Groundwater produced from within the WSTF groundwater plume during well drilling and development is characterized as environmental media containing listed hazardous waste with the F001 and F002 hazardous waste codes. • **Decontamination fluids.** Decontamination fluids, such as water and soap solutions used to wash and decontaminate equipment generated during drilling above the water table, are non-hazardous solid waste. Decontamination fluids generated by cleaning equipment that has contacted potentially contaminated soil, cuttings, or fluids generated when drilling below the water table is characterized as hazardous waste. • **Contact waste.** Contact waste, or debris, such as used disposable sampling equipment, personal protective equipment, plastic sheeting, and other debris generated during drilling above the water table is non-hazardous solid waste. Contact debris contaminated with soil, cuttings, or fluids that were generated when drilling below the water table is initially characterized as hazardous waste. • **Petroleum Contaminated Debris and Environmental Media.** Debris, such as rags and wipes, may be contaminated with petroleum products during routine drilling equipment maintenance. While every precaution will be taken, petroleum contaminated environmental media may also be generated during an unexpected drilling equipment failure. The petroleum contaminated debris and environmental media will be characterized as hazardous waste with the D018 hazardous waste code. Drill cuttings and drilling fluids generated from the vadose zone will not contain listed hazardous waste and will not meet the definition of a hazardous waste. Vadose zone drill cuttings and, if necessary, drilling fluids, will be managed in 1-cubic yard (yd^3) Super Sack®[1] containers or roll-off containers as required for project implementation. Drill cuttings and drilling fluids generated below the water table will be managed as hazardous waste in 1-yd^3 containers or roll-off containers. If possible, contaminated water may be decanted from this waste stream prior to shipment offsite and transferred to the Mid-plume Interception and Treatment System (MPITS) for storage, treatment, and discharge in accordance with Discharge Permit (DP)-1255 (NMED, 2017).

1 Super Sack is a registered trademark of Better Agricultural Goals Corporation DBA/ B.A.G. Corp.

Investigation-Derived Waste (cont.)	All containers containing waste generated below the water table will be managed in accordance with 20.4.1.300 New Mexico Administrative Code (NMAC) and 40 CFR 262.17. The as-generated waste will be sampled, and analytical data used to further characterize the waste. Waste characterization samples will be analyzed for VOCs by the current revision of SW-846 Method 8260, NDMA by Modified EPA Method 607M, and RCRA metals using the current revision of EPA Method 1311 (Toxicity Characteristic Leaching Procedure) and the current revision of EPA Method 6010, or equivalent. NASA will request a "contained-in" determination from the NMED if the analytical data indicate drill cuttings and drilling fluids generated below the water table do not contain listed hazardous waste or exhibit characteristics of a hazardous waste. If the analytical data indicate the presence of listed waste or the waste exhibits characteristics of a hazardous waste, the waste will be properly treated and disposed of at a RCRA permitted treatment, storage, and disposal facility (TSDF). Groundwater generated during drilling, development, and purging, and contaminated water generated during decontamination of equipment that has come into contact with contaminated groundwater or hazardous debris from below the water table, will be accumulated in appropriately sized containers and managed as hazardous waste. Actively managed groundwater sourced from the contaminant plume is characterized as listed hazardous waste with the F001 and F002 hazardous waste codes through application of the EPA "Contained-In" Policy. The EPA "Contained-In" Policy states that groundwater, soil, and other environmental media are not solid waste but are subject to regulation as hazardous waste when it contains listed waste (EPA, 1996). Because groundwater and other environmental media are subject to regulation when it contains listed hazardous waste, waste generated after reaching the water table will be managed as hazardous waste. Containers will be managed in accordance with requirements of 20.4.1.300 NMAC and 40 CFR 262.17. Within permissible accumulation time limits, contaminated water will be transferred to the MPITS for storage, treatment, and discharge. The MPITS is designed with provisions for the storage and treatment of contaminated water generated from activities at WSTF monitoring wells (NMED, 2009). Contact waste, or hazardous debris, that has come into contact with contaminated groundwater will be collected at the end of each working shift and transferred to an appropriate container. All hazardous waste containers will be managed on-site in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.17. If analytical results from drill cuttings and fluids are favorable, this waste stream may be included in a "contained-in" determination request. If analytical results indicate the drill cuttings and fluids contain hazardous waste, or the NMED determines the waste still contains hazardous waste, this debris will be shipped off-site for treatment and disposal at a RCRA permitted TSDF within the permissible accumulation time limits. As discussed previously, NASA may request a "contained-in" determination for individual waste streams initially characterized as containing listed hazardous wastes, should analytical data from the as-generated waste support such a request. If NMED finds contaminant concentrations do not pose an unacceptable risk, then NMED may allow the waste included in the request to be managed as non-hazardous solid waste that no

Investigation-Derived Waste (cont.)	longer contains listed waste and does not exhibit the characteristic of hazardous waste. NASA understands a separate letter from NMED will be required to document such a determination. For waste that is characterized as hazardous waste, land disposal restriction notifications, disposal facility profiles, and hazardous waste manifests will be completed as required. Hazardous waste manifested off-site will be transported for treatment and disposal at a permitted RCRA TSDF. Contaminated groundwater and decontamination water generated during the project will be managed at the MPITS. If that system is not capable of receiving the waste, it will be disposed of at a permitted RCRA TSDF.
Schedule	The mobilization of drilling equipment for the installation of three groundwater monitoring wells downgradient of the 200 Area will commence within 90 days following NMED approval of this ADWP. Following the equipment mobilization, the anticipated schedule is as follows: • Borehole installation, lithological sampling, and installation of wells 400-001-GW, 200-001-GW, and 200-002-GW: completed 30 days after equipment mobilization. • Well development and groundwater sampling: 60 days after equipment mobilization. • Data compilation, review, and preparation of well completion reports that include results from groundwater sampling to NMED: 180 days after equipment mobilization.
References	EPA. (1991, March 26). N.t. (EPA Publication Number RO 11593). Washington, DC: U.S. Environmental Protection Agency. Retrieved from https://yosemite.epa.gov/osw/rcra.nsf/ EPA. (1996, April 29). Requirement for Management of Hazardous Contaminated Media (HWIR-Media). Federal Register 61, No. 83: 18780. https://www.govinfo.gov/content/pkg/FR-1996-04-29/pdf/96-10096.pdf NASA Johnson Space Center White Sands Test Facility. (2009, April 27). *2008 Annual Post-Closure Care Report for the NASA White Sands Test Facility*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2015, June 29). *NASA WSTF 200 Area Phase II Investigation Report*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2022, April 29). *NASA WSTF Groundwater Monitoring Plan Update for 2022*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2022, July 26). *NASA WSTF Periodic Monitoring Report – Second Quarter 2022*. Las Cruces, NM. NMED Hazardous Waste Bureau. (2009, November). *Hazardous Waste Permit. NM8800019434, to United States National Aeronautics and Space Administration for the White Sands Test Facility Located in Doña Ana County, New Mexico.* Santa Fe, NM.

References (cont.)	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, April 5). *Approval with Modification Report on Tracer Testing in the 200/600 Areas and Mid-plume Constriction Area*. Santa Fe, NM.

Figures

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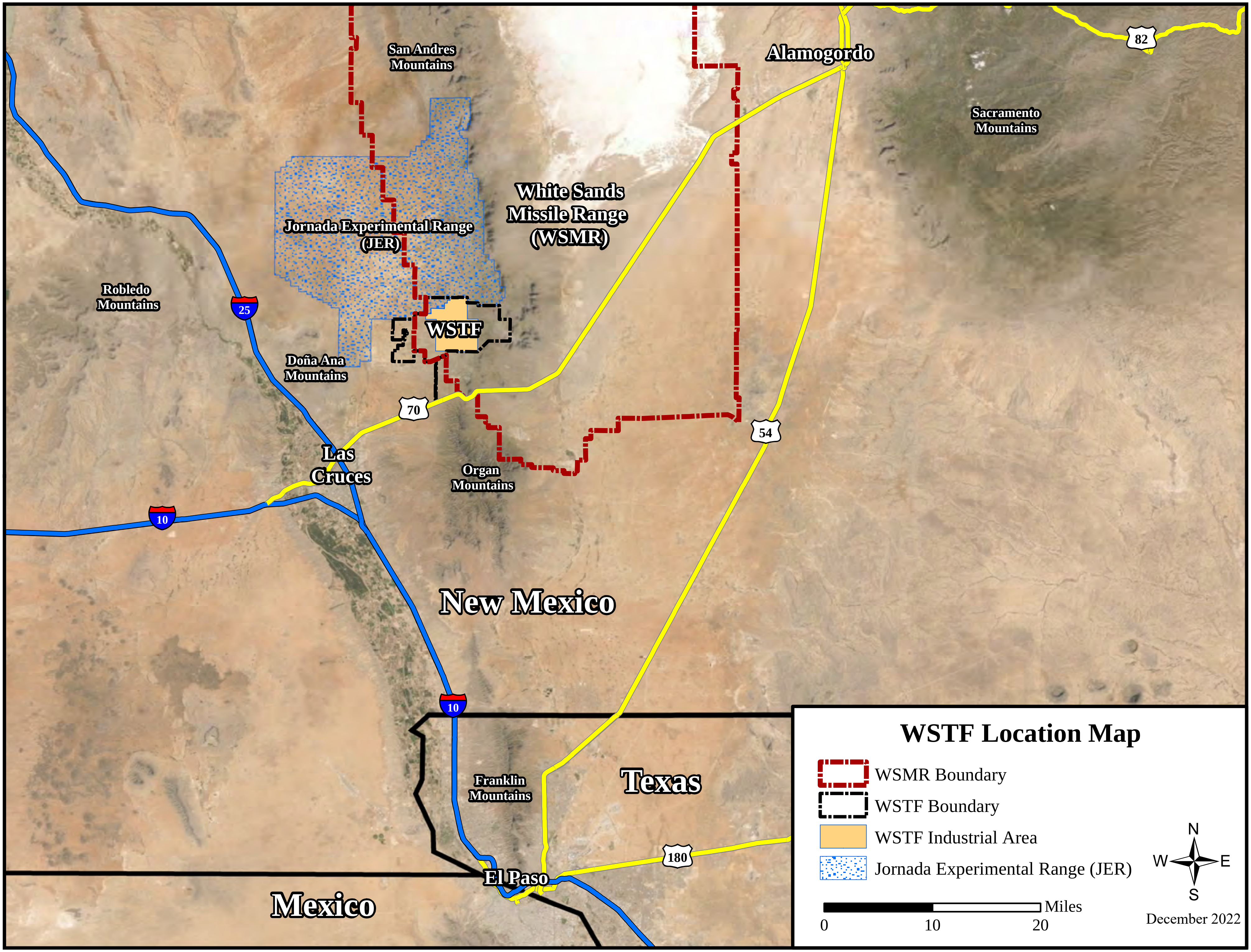

San Andres Mountains
Alamogordo
82
Sacramento Mountains
White Sands Missile Range (WSMR)
Jornada Experimental Range (JER)
Robledo Mountains
25
WSTF
Doña Ana Mountains
70
54
Las Cruces
Organ Mountains
10
New Mexico
10
Franklin Mountains
Texas
180
El Paso
Mexico
WSTF Location Map
WSMR Boundary
WSTF Boundary
WSTF Industrial Area
Jornada Experimental Range (JER)
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20
December 2022

Figure 2 **Site-wide Well Locations and Cross-section A – A'**

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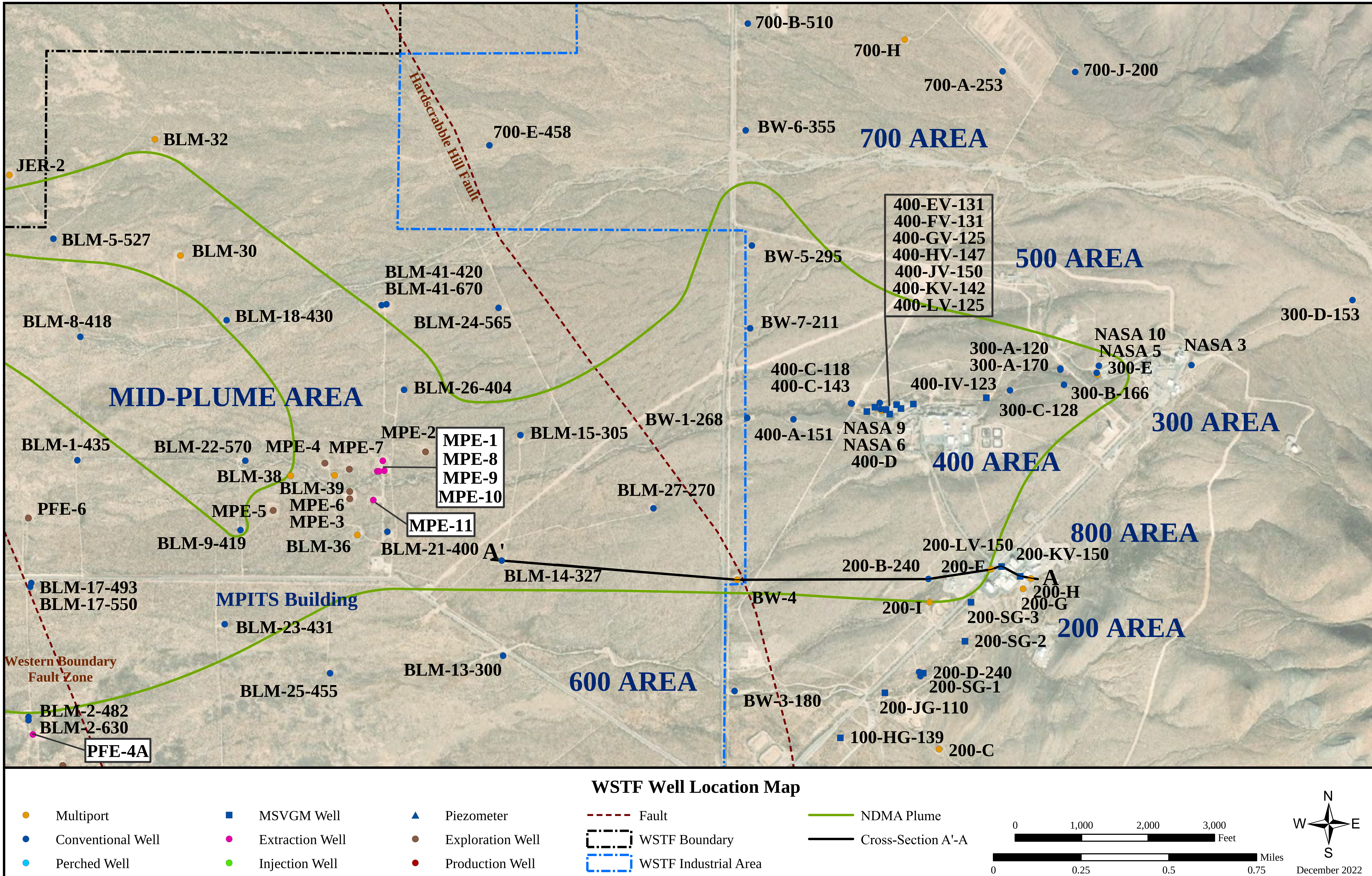
700-B-510
700-H
700-A-253
700-J-200
BW-6-355
700 AREA
700-E-458
Hardscrabble Hill Fault
BLM-32
JER-2
BLM-5-527
BLM-30
BW-5-295
400-EV-131
400-FV-131
400-GV-125
400-HV-147
400-JV-150
400-KV-142
400-LV-125
500 AREA
BLM-41-420
BLM-41-670
BLM-24-565
BLM-18-430
BLM-8-418
BW-7-211
300-D-153
NASA 10
NASA 5
NASA 3
300-A-120
300-A-170
300-E
400-C-118
400-C-143
400-IV-123
300-B-166
MID-PLUME AREA
BLM-26-404
300-C-128
BW-1-268
400-A-151
NASA 9
NASA 6
400-D
300 AREA
MPE-2
MPE-1
MPE-8
MPE-9
MPE-10
BLM-15-305
BLM-1-435
BLM-22-570
MPE-4
MPE-7
400 AREA
BLM-38
BLM-39
MPE-6
MPE-3
BLM-27-270
PFE-6
MPE-5
MPE-11
800 AREA
BLM-9-419
BLM-36
BLM-21-400
A'
200-LV-150
200-KV-150
BLM-14-327
200-B-240
200-F
A
BLM-17-493
BLM-17-550
MPITS Building
BW-4
200-H
200-G
200-I
200-SG-3
BLM-23-431
200 AREA
200-SG-2
Western Boundary
Fault Zone
BLM-13-300
600 AREA
200-D-240
200-SG-1
BLM-25-455
BW-3-180
200-JG-110
BLM-2-482
BLM-2-630
PFE-4A
100-HG-139
200-C
WSTF Well Location Map
Multiport
Conventional Well
Perched Well
MSVGM Well
Extraction Well
Injection Well
Piezometer
Exploration Well
Production Well
Fault
WSTF Boundary
WSTF Industrial Area
NDMA Plume
Cross-Section A'-A
0
1,000
2,000
3,000
Feet
0
0.25
0.5
0.75
Miles
N
W
E
S
December 2022

(SEE NEXT PAGE)

CROSS-SECTION A'-A

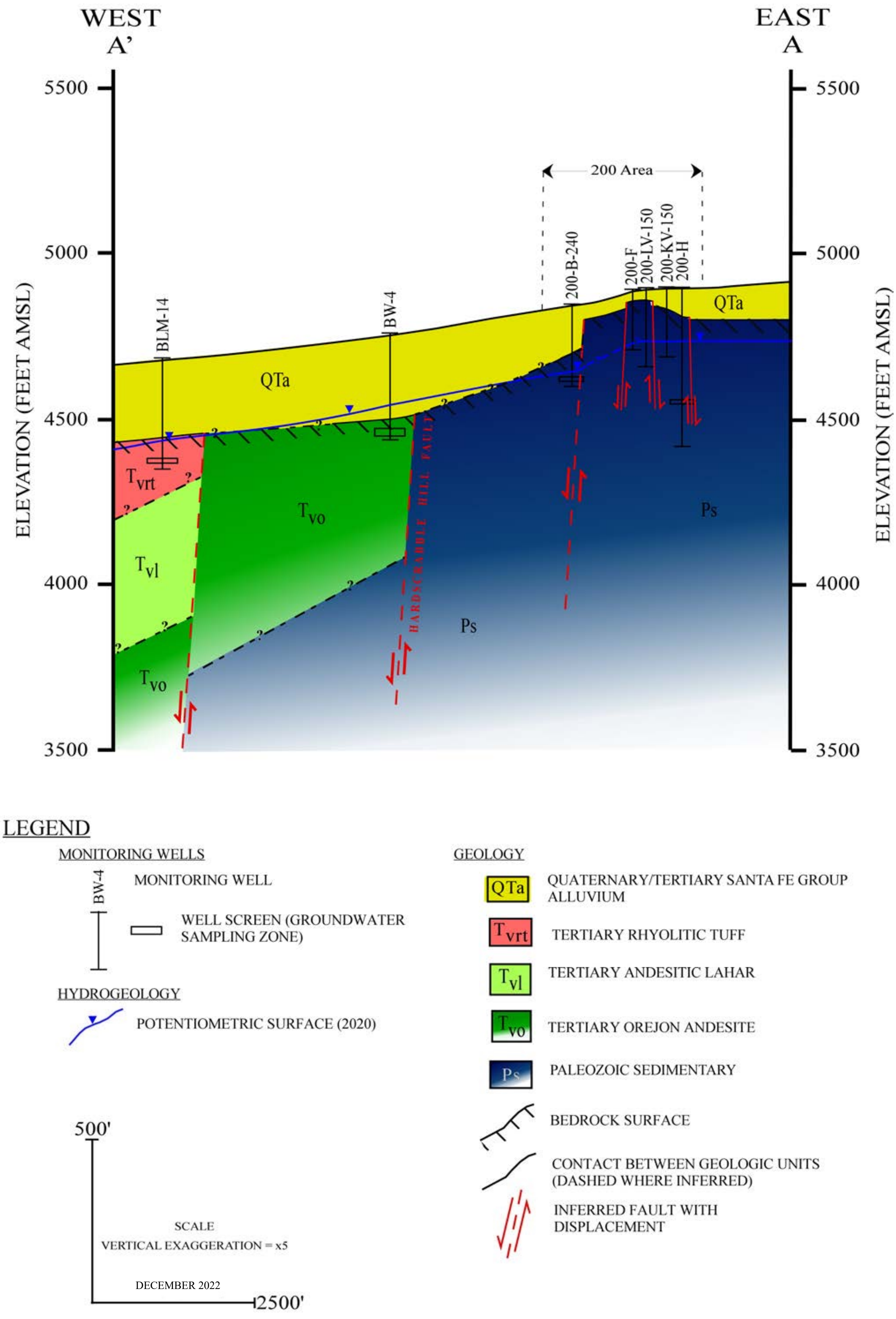

Figure 4 **Well Location Map**

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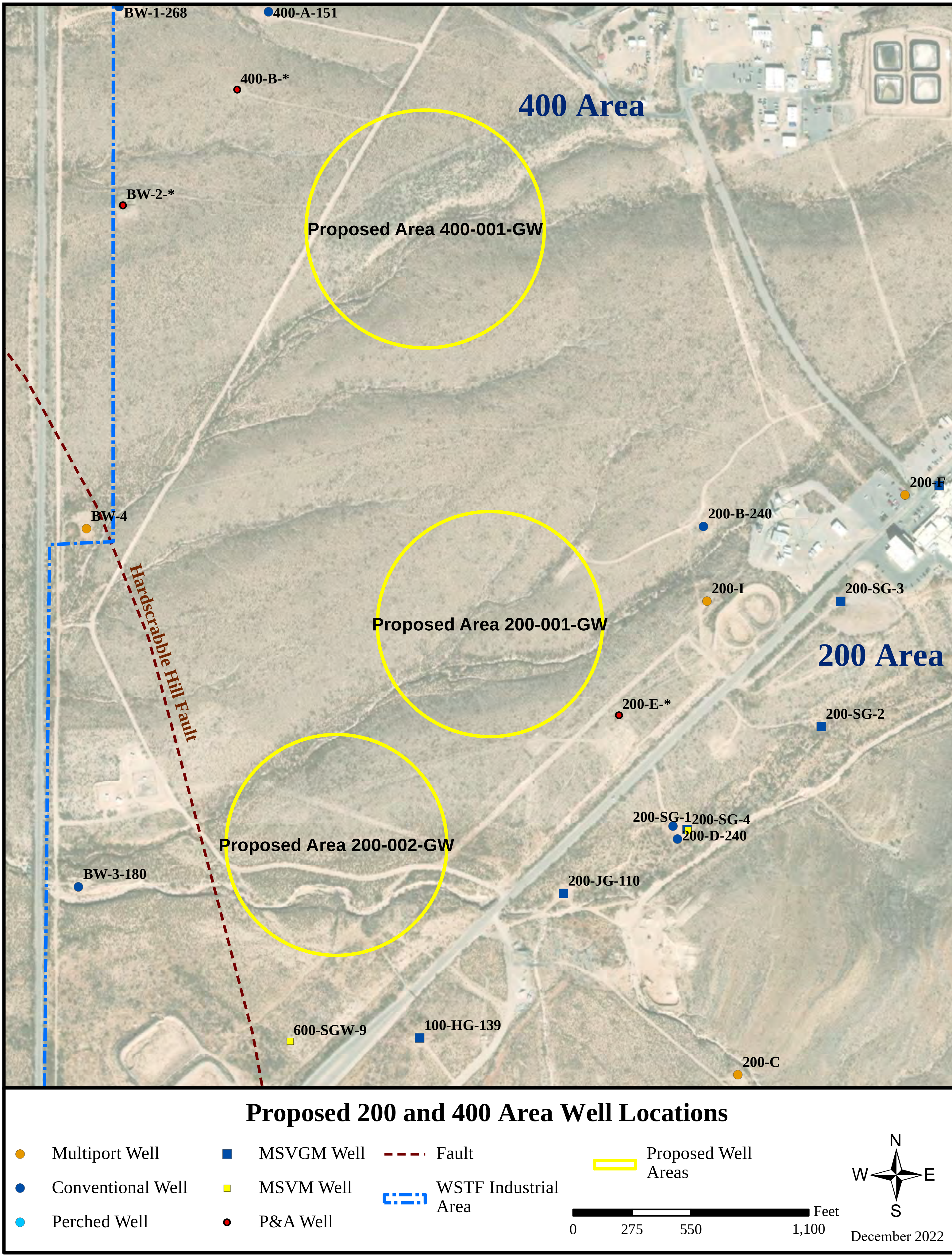

Proposed 200 and 400 Area Well Locations

December 2022

Figure 5 **Well Completion Diagram**

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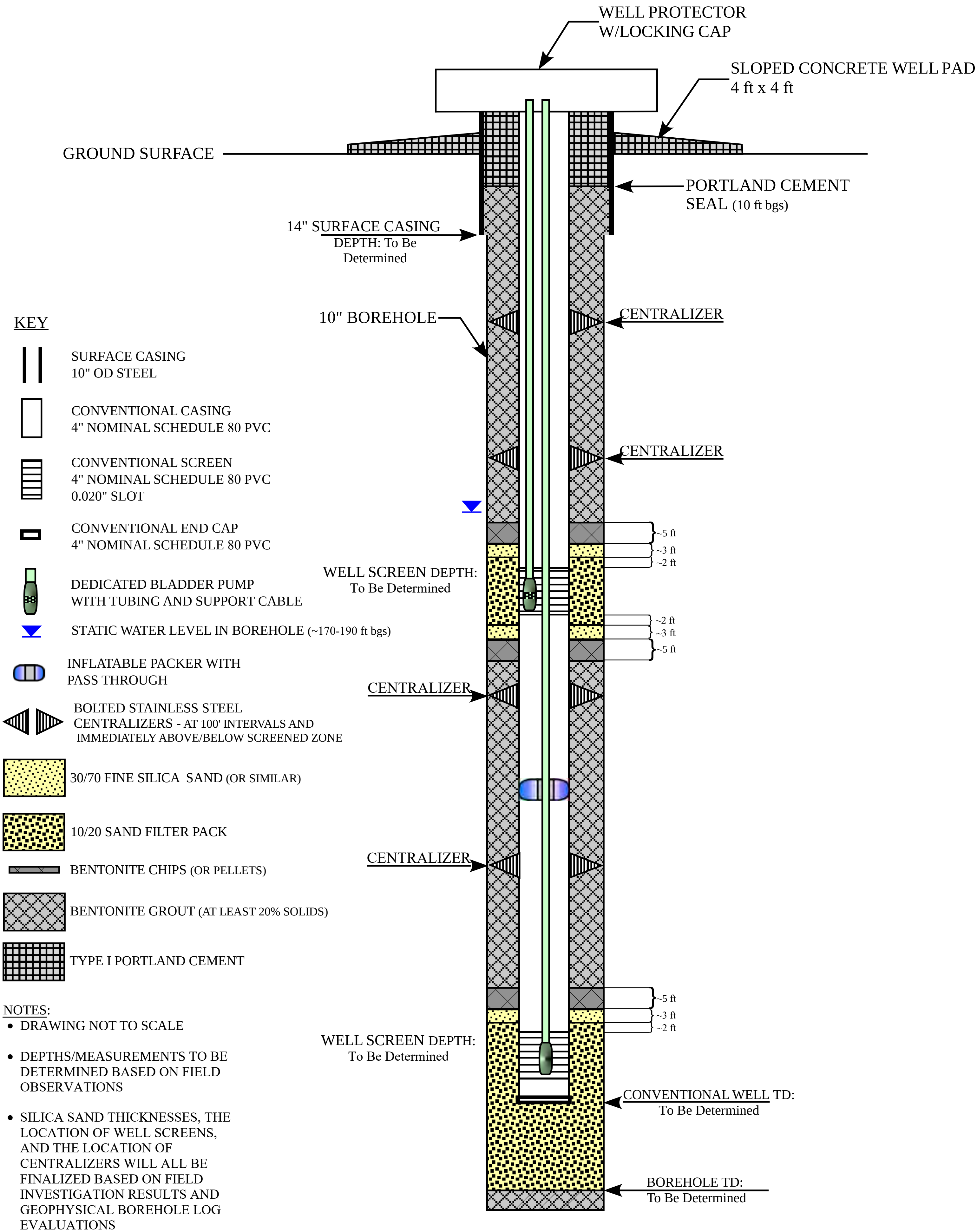

PROPOSED MONITORING WELL DESIGN: DUAL-ZONE CONVENTIONAL

Table 1 Anticipated Borehole Conditions

Borehole/ Well ID #*	Soil Boring Method	Diameter (in.)	Anticipated Groundwater Depth (ft)	Anticipated Bedrock Depth (ft)	Anticipated Borehole Depth (ft) *	Anticipated Lithology	Rationale
400-001-GW	Air rotary casing hammer	10	~170	~160	Up to 350	Andesite	Northwest of the 200 Area: boundary well
200-001-GW	Air rotary casing hammer	10	~190	~160	Up to 350	Limestone	Located west of the 200 Area: downgradient of the 200 Area
200-002-GW	Air rotary casing hammer	10	~170	~165	Up to 350	Limestone	Located west of the 200 Area: downgradient of the 200 Area

Notes:
= Proposed borehole/well locations pending NMED approval.
* = The 350 ft maximum borehole depth is significantly below the anticipated groundwater depth. Several dry boreholes have been installed within the general area due to the absence of well yield in low conductivity fractured bedrock.