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Stephen Lee, Director
Louisiana Department of Natural Resources
Office of Conservation - Injection & Mining Division
617 North Third Street, LaSalle Building
Baton Rouge, Louisiana 70802-5431

DATE
October 18, 2023

SUBJECT
Monitoring Well Installation Plan
Westlake US 2, LLC
Sulphur Mines Dome
Calcasieu Parish, Louisiana

REFERENCE
0704754

Dear Mr. Lee:

Environmental Resources Management Southwest, Inc. (ERM), on behalf of Westlake US 2, LLC (Westlake), is pleased to provide this revised work plan for monitoring well installation at the Sulphur Mines salt dome. The original work plan was submitted on May 19, 2023 in response to the April 18, 2023, Louisiana Department of Natural Resources (LDNR) Office of Conservation's Second Supplement to Compliance Order No. IMD 2022-027. Based on discussions and comments received during several online meetings and conference calls with LDNR, ERM has developed this revised work plan for monitoring well installation.

1. GEOLOGIC SETTING

The Chicot aquifer system in the Lake Charles, Louisiana area has three named sand units – the 200-foot sand, the 500-foot sand, and the 700-foot sand. The piercement/uplift caused by the Sulphur Mines salt dome has altered the Chicot aquifer system above the dome, as the caprock has been mapped as shallow as 300 feet below ground surface (bgs). Geologic cross-sections of the salt dome and surrounding area are provided as Figures 1 and 2.

The Chicot aquifer sand units in the Lake Charles area are based on a general classification and are not well defined due to the complex sequence of variably thick interbedded sands and clays. Identification of the different sand intervals on the dome is expected to be somewhat challenging, as stratigraphic layers have been thinned or compressed by the piercement salt dome. Physically logging drill cuttings in combination with open-hole electric logging will be used to best identify the thicknesses and bases of these zones. Harder (1960) describes the 200-foot and 500-foot sands as fining upward sequences with gravel at the base, while the 700-foot sand is described as grading from fine to coarse sand. These gravel or coarse sand zones, if present, will be used to identify the base of the three sand units.

Based on communications with LDNR, monitoring wells will be installed at the base of each of the three Chicot sand units at three locations on the salt dome (Figure 3). A review of the available well logs indicates that the 200-foot and 500-foot sands are expected to be present at the three proposed locations. However, the 500-foot and the 700-foot sand may be indistinguishable at the MW-3 location based upon the existing well control in the area. The depths of base of each of these sands is anticipated to be as follows (annotated well logs provided in Attachment 1):

Depth to Bottom of Sand Interval (ft bgs)

Sand	**MW-1**	**MW-2**	**MW-3**
200-foot	210	290	270
500-foot	540	510	595?
700-foot	760	740	670?
	elog SN 36144	elog SN 32938	elog SN 110602

2. INSTALLATION PROCEDURES

The installation of three monitoring well clusters is proposed in the vicinity Caverns 6 and 7 to establish baseline groundwater quality on the salt dome between the salt caverns and the nearest municipal water supply wells. Each well cluster will consist of three monitoring wells, with one well installed in the base of the 200-foot, one well installed in the base of the 500-foot, and one well installed in the base of the 700-foot sand of the Chicot aquifer. The proposed approximate locations (dependent upon access and underground utilities) are shown on Figure 3. The wells will be installed utilizing a truck mounted, mud-rotary drilling rig operated by a Louisiana-licensed water well driller and will be constructed in accordance with LDNR's *Guidance Manual for Environmental Boreholes and Monitoring Systems* (2021). The total depth of each well will be dependent on the depth at which the Chicot aquifer sands are identified using the appropriate geophysical logging tools. A generalized schematic of the proposed well construction is provided as Figure 4.

To minimize the potential for a blow-out due to subsurface gas pressure, a minimum 8-inch outside diameter (OD), carbon steel surface casing will be installed in an approximately 12-inch diameter borehole to a minimum depth of 100-feet bgs at each location and cemented using a Portland cement/bentonite grout mixture. Additional grout will also be placed around the outside of the casing at the ground surface. The grout will be allowed to set overnight prior to re-entering the borehole. A blow-out preventor (BOP) will be affixed to the surface casing prior to further advancement of the borehole.

A minimum approximately 6-inch diameter drill bit will be utilized to drill through the grout and advance the borehole to total depth. The drill pipe will be advanced with mud created using water obtained from one of Westlake's industrial water wells. Core samples will not be collected during the drilling process. However, soil cuttings will be logged by a Louisiana registered professional geologist. The first boring in the cluster

will extend below the expected base of the 700-foot sand by as much as 50 feet, which is estimated to be approximately 800-feet bgs. If caprock is encountered prior to the target total depth the boring will be terminated at the caprock.

Upon reaching the target depth of the deepest borehole in each cluster, the drilling mud-filled borehole will be kept open to run geophysical logging tools. An open hole log will be run for the entire length of the borehole to evaluate the depth of the base of the Chicot sands. A "triple combo" log, consisting of a gamma-ray log, density log, neutron log and a resistivity log, will be run. Notification will be made to LDNR at least 24 hours prior to the logging so an LDNR representative can be available to discuss the logging results either in person or via telephone to determine the most appropriate screened intervals.

Once the screened interval is selected, a minimum two-inch inside diameter, carbon steel casing and a minimum 2-inch inside diameter 10-foot long stainless-steel screen [No. 10 slot – 0.01-inch] will be installed inside the borehole at the base of the sand.

A filter pack consisting of silica sand (20-40 grade minimum) will be placed on top of the native sand pack as needed. A minimum five-foot thick bentonite pellet/and or Volclay seal will be placed on top of the sand pack and allowed to hydrate per the manufacturer's recommended time or overnight. The remaining annulus will be tremie-grouted from the bottom up using a Portland cement/bentonite grout mixture.

The monitoring wells will be capped with a locking well cap and completed at the ground surface with a protective steel or aluminum casing installed in an approximate 5-foot by 5-foot four-inch thick concrete pad equipped with four guard posts. The protective casing and guard posts will be painted safety yellow. An ERM geologist will document the installation and construction of each monitoring well in a field logbook and/or field log sheets.

The drilling residuals will be containerized and managed by Westlake as Exploration and Production (E&P) waste. Disposal facilities are currently being evaluated to best meet the needs of the project. LDNR will be notified once a decision has been made as to where the waste will be disposed. Investigation-derived waste will be manifested and transported following appropriate procedures.

Following the installation and surface completion of the wells, each well will be surveyed by a Louisiana-licensed professional surveyor. The survey will include the well's horizontal position as well as the top-of-casing [TOC (i.e., top of well casing)], top of well pad, and ground surface elevations of each monitoring well.

3. WELL DEVELOPMENT PROCEDURES

The monitoring wells may be developed by a combination of flushing, swabbing, surging, air-lifting, and/or overpumping utilizing a drilling rig and associated equipment to remove water/drilling mud residuals. Initial well development will be completed by surging within the well screen using a surge block to loosen drilling mud or skin remaining in the well. Air-lifting or overpumping will be used to further remove residuals. If air-lifting is used the air injection point will not be closer than 100 feet from the top of the well screen. Field parameters, including specific conductance (SC), pH, temperature, and turbidity, will be recorded with a water quality meter (Ultrameter or equivalent) during the well development process. Development of the well will continue until the field parameters stabilize and/or the water shows no further improvement in clarity and a minimum of three borehole volumes of water have been removed from each well. The well development water will be containerized during the well development process and managed by Westlake. ERM's field observations and field parameters will be recorded in a bound field logbook.

4. SAMPLING PROCEDURES

The newly-installed monitoring wells will be allowed to recover for a minimum of 48 hours following installation and development before groundwater samples are collected.

Groundwater samples will be collected using low-flow purging and sampling techniques. Due to the anticipated depth of groundwater (>30-feet bgs) a submissible pump with drop-tubing intake will be utilized to collect the samples. The intake will be installed at the approximate mid-point of the well screen interval. A closed flow-through cell and recording field instrument (YSI or equivalent) will be utilized to measure field parameters including SC, pH, temperature, oxidation-reduction potential (ORP), and dissolved oxygen during well purging/sampling. Turbidity will be measured with a field turbidity meter.

Based on the results of the groundwater and brine sample previously collected at the site, ERM proposes to sample for the following constituents:

- Total metals (As, Ba, Ca, Cr, Fe, Pb, Mg, Mn, Hg, Ni, K, Na, Sr, V, Zn) by Method SW-846 6020A
- Chloride, bromide, and sulfate by SW-846 Method 9056A
- pH by method SW-846 9040B or EPA 150.2
- Total dissolved solids (TDS) by Method SM 2540C
- Carbonate and bicarbonate alkalinity by Method SM2320B
- TPH fractions by method MADEP EPH/VPH
- BTEX (benzene, toluene, ethylbenzene, xylenes) by Method SW-486 8260C

- Dissolved gases (methane, ethane, ethane, propane and butane), including methane stable isotopes.

Each groundwater sample will be collected in new, clean laboratory supplied containers. The sample containers will be placed on ice following collection and hand-delivered or shipped with proper Chain-of-Custody documentation to ALS in Houston, Texas or Isotech Laboratories, Inc. (Isotech) in Champaign, Illinois for analysis.

5. WATER LEVEL MONITORING

Upon installation of the new monitoring wells, a full round of water level measurements will be recorded utilizing an electronic tape to the nearest hundredth of a foot to manually measure the depth to water from the TOC. Water levels will be recorded prior to sampling the wells.

Following the installation of the wells, pressure transducers equipped with data loggers will be installed in the wells to collect continuous water level measurements at 1-hour intervals. The data will be downloaded, and sensors calibrated periodically to ensure reliable data quality.

6. SCHEDULE

Installation and geophysical logging of the monitoring wells is expected to take approximately one month from mobilization of the drilling crew to final completion of the nine wells. The scheduled start date at this time is pending, based on LDNR approval of this work plan, rig availability, and weather conditions but the goal is to complete the work before the end of the calendar year. Weather, equipment malfunctions, access, etc. may impact the schedule.

7. REPORTING

The monitoring wells will be registered with LDNR within 30 days of installation. A report summarizing the well installation and relevant findings will be provided to LDNR within 30 days of receipt of the final laboratory reports from the first sampling event. Additional data collected from these wells will be included in regular data transmittals to LDNR.

We look forward to receiving LDNR approval and moving forward with the well installation. Should you have any questions or need additional information, please contact us at scott.himes@erm.com and david.upthegrove@erm.com.

Sincerely,

Environmental Resources Management Southwest, Inc.

Scott A. Himes, P.G.
Senior Hydrogeologist

David C. Upthegrove, P.G.
Partner
SAH/DCU:pcv

FIGURES

DRAWN BY: SAH

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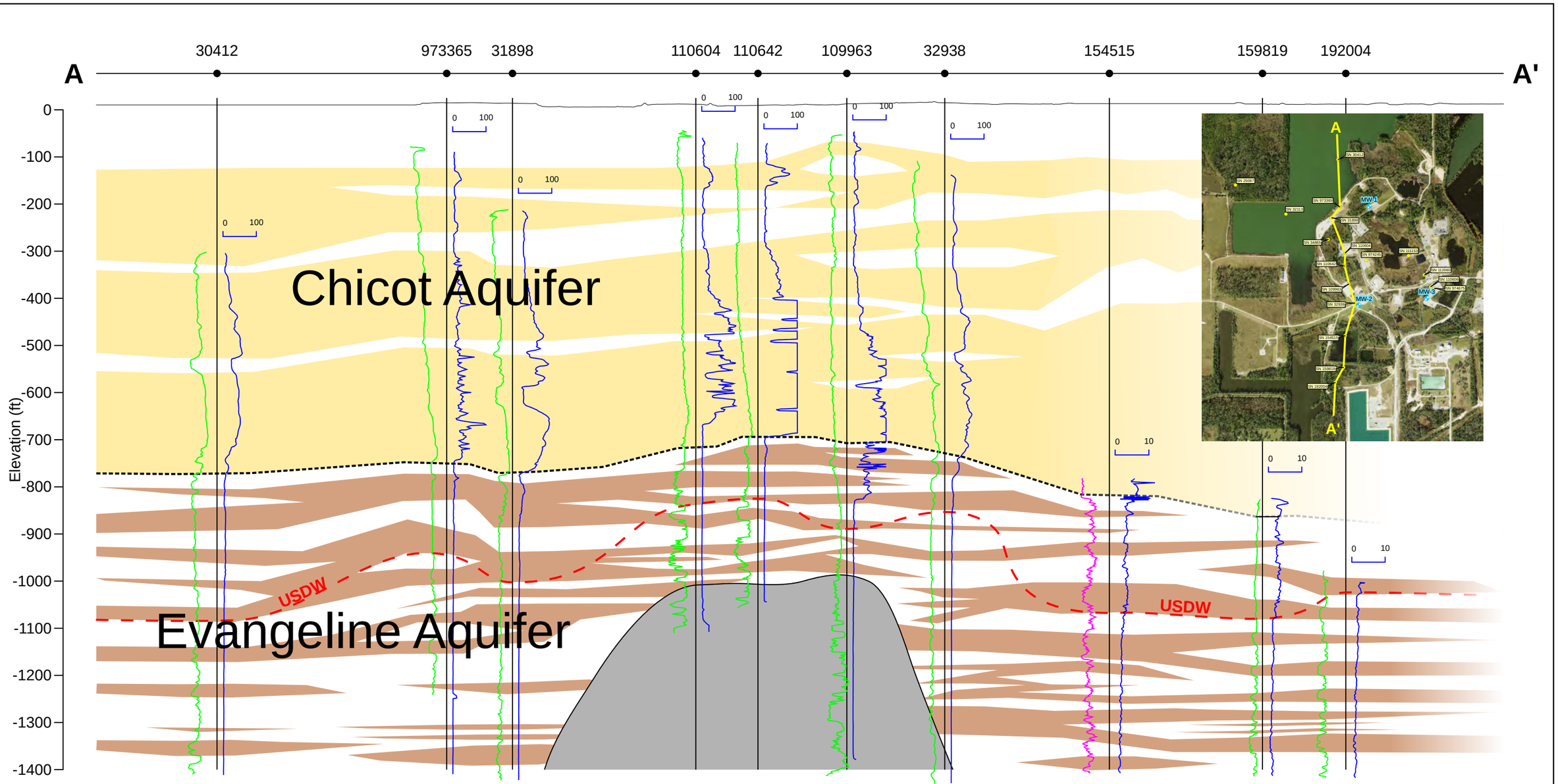

Legend

- Resistivity Log
- SP Log
- Gamma Log
- Chicot Aquifer Sands
- Evangeline Aquifer Sands
- Cap rock

FEET
200
100
50
0
250
500
1000
FEET

Notes:
Well logs and locations obtained from SONRIS database.
Cap rock contours via Lonquist.

Figure 1
North-South Cross Section
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Louisiana

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B

B'

25067 32113 34865 110604 974245 111153 112060 110606 974675

Elevation (ft)

0 -100 -200 -300 -400 -500 -600 -700 -800 -900 -1000 -1100 -1200 -1300 -1400

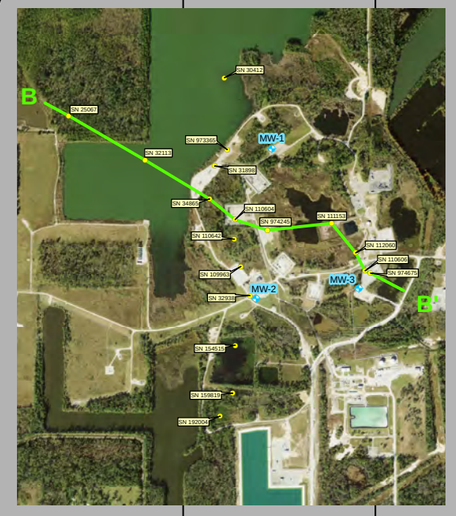
0 100

1 3 10

Chicot Aquifer

USDW

Evangeline Aquifer



Legend

- Resistivity Log
- SP Log
- Gamma Log
- Chicot Aquifer Sands
- Evangeline Aquifer Sands
- Cap rock

FEET
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250 500 1000
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Notes:
Well logs and locations obtained from SONRIS database.
Cap rock contours via Lonquist.

Figure 2
West-East Cross Section
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Louisiana

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Legend

- Proposed Monitoring Well
- Cavern Footprint
- Top of Caprock Contour
- Westlake Property

Figure 3
Proposed Monitoring Well Locations
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Louisiana

Notes:
Cavern footprint and caprock contours via Lonquist.
Nov 22, 2021 aerial imagery via USGS.

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Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

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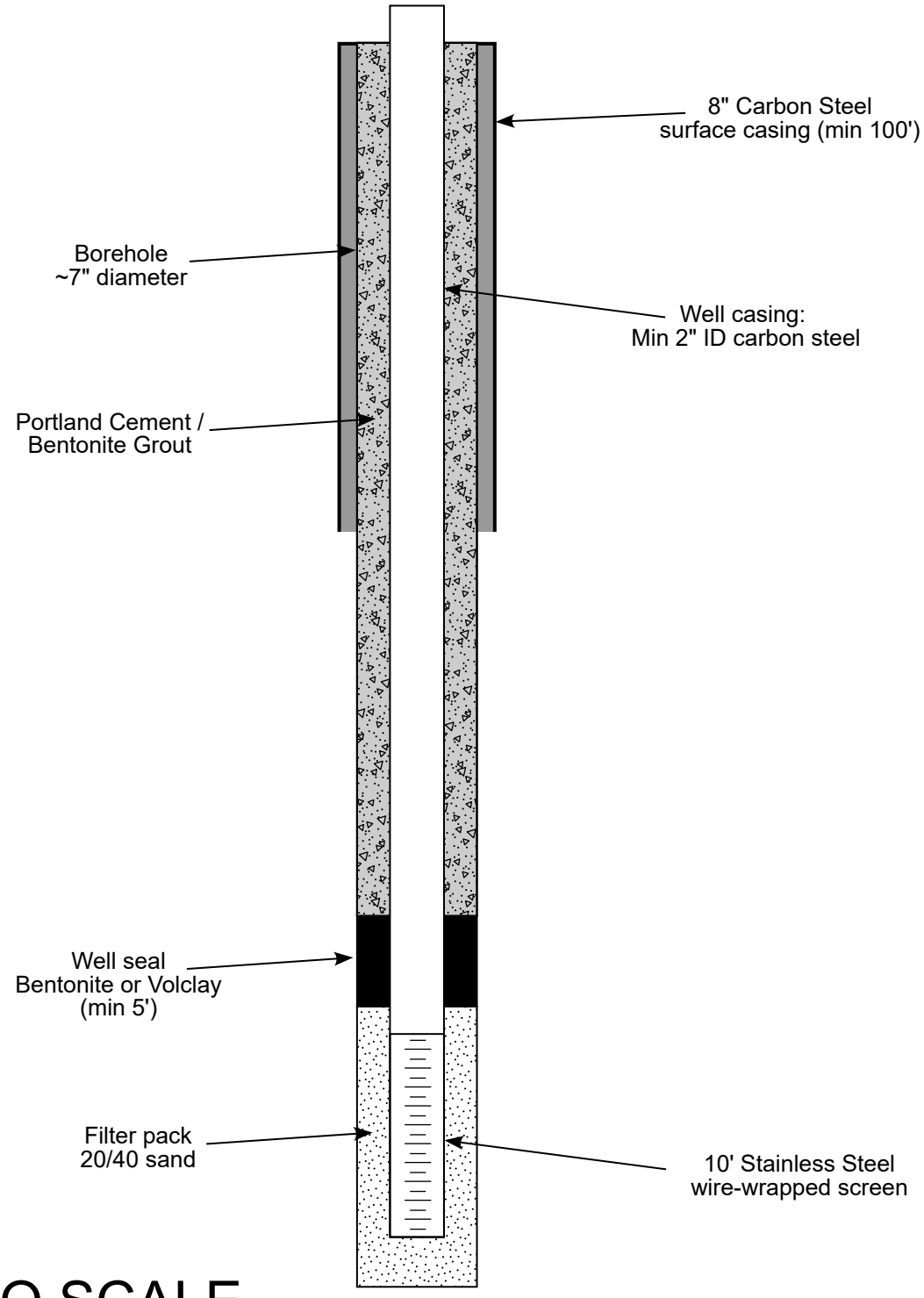

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Figure 4
Proposed Monitoring Well Schematic
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Louisiana

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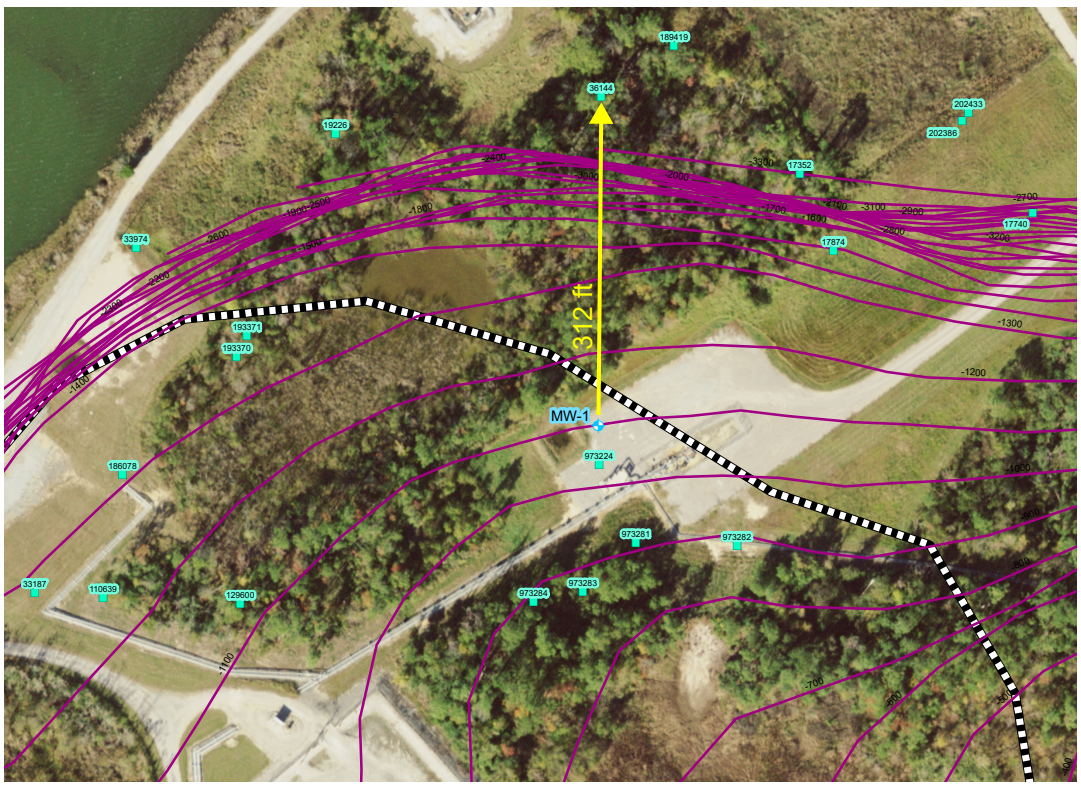
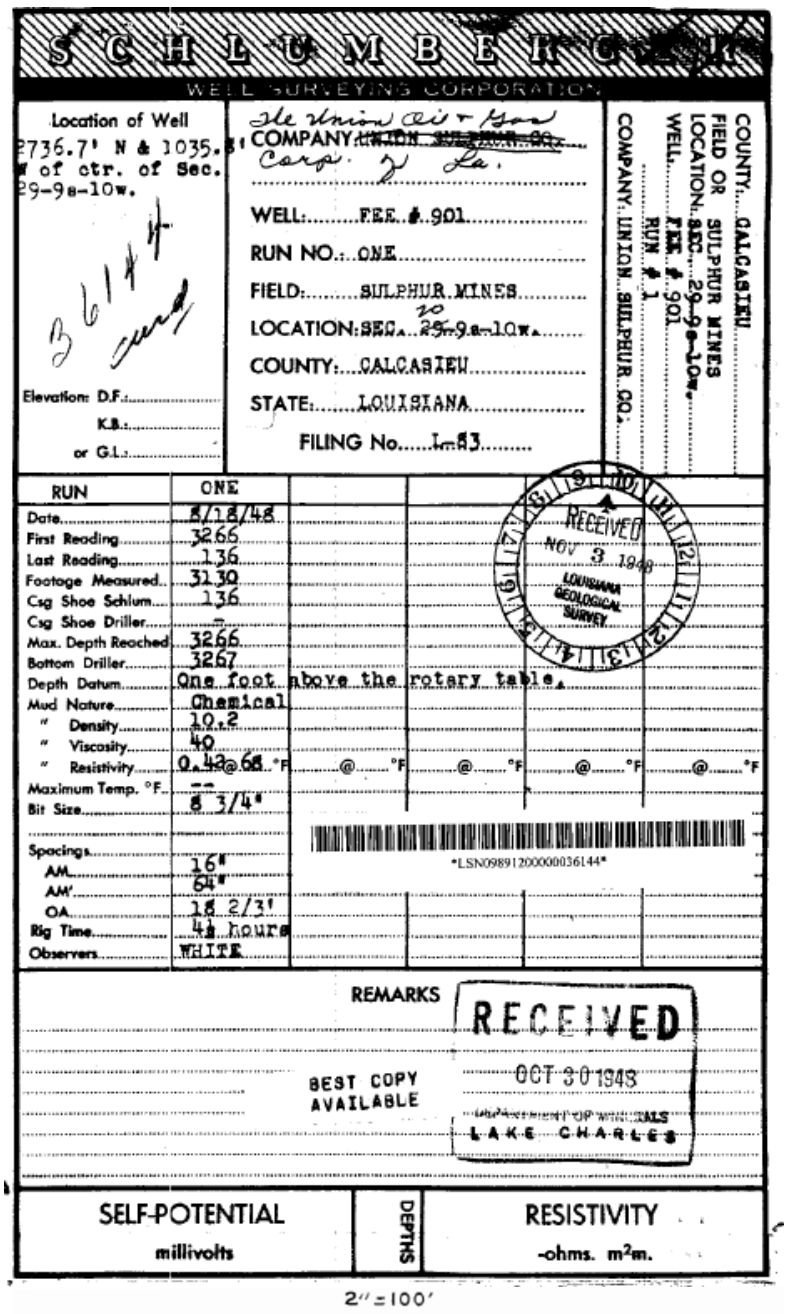
ATTACHMENT 1 ANNOTATED WELL LOGS

SN 36144

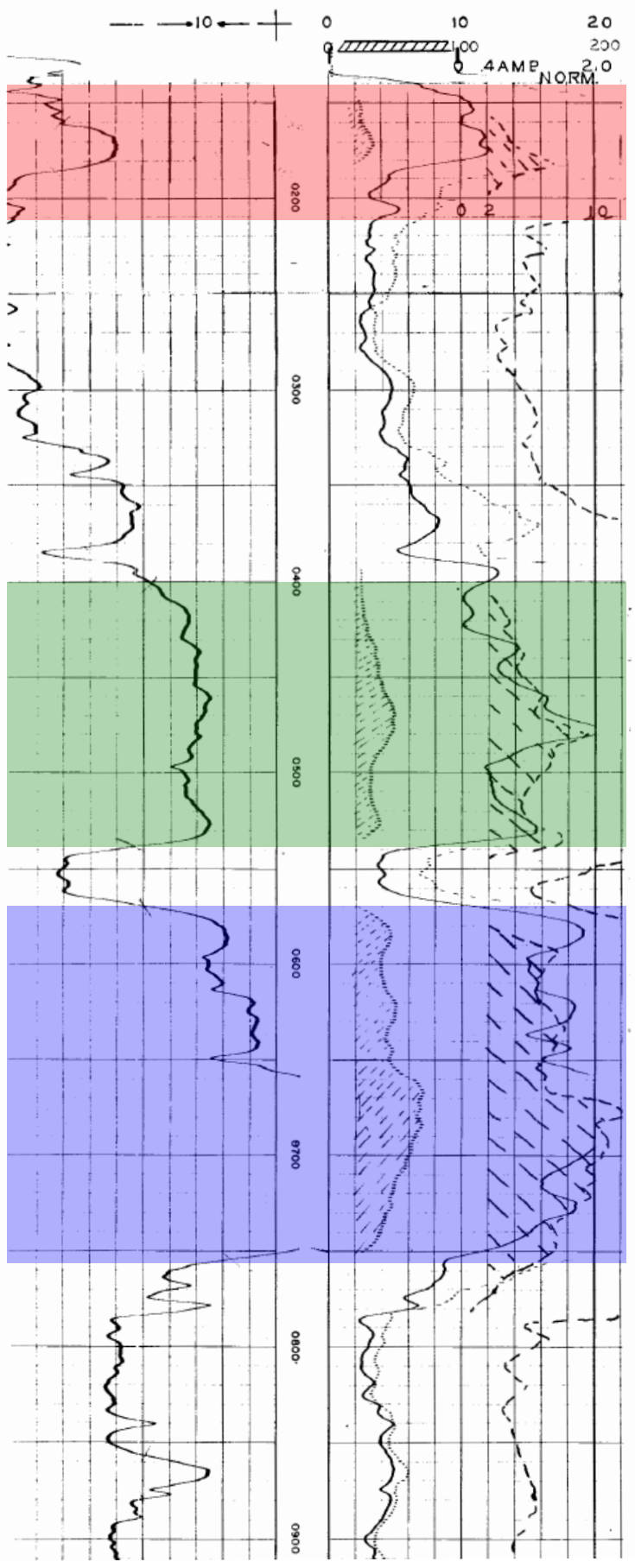




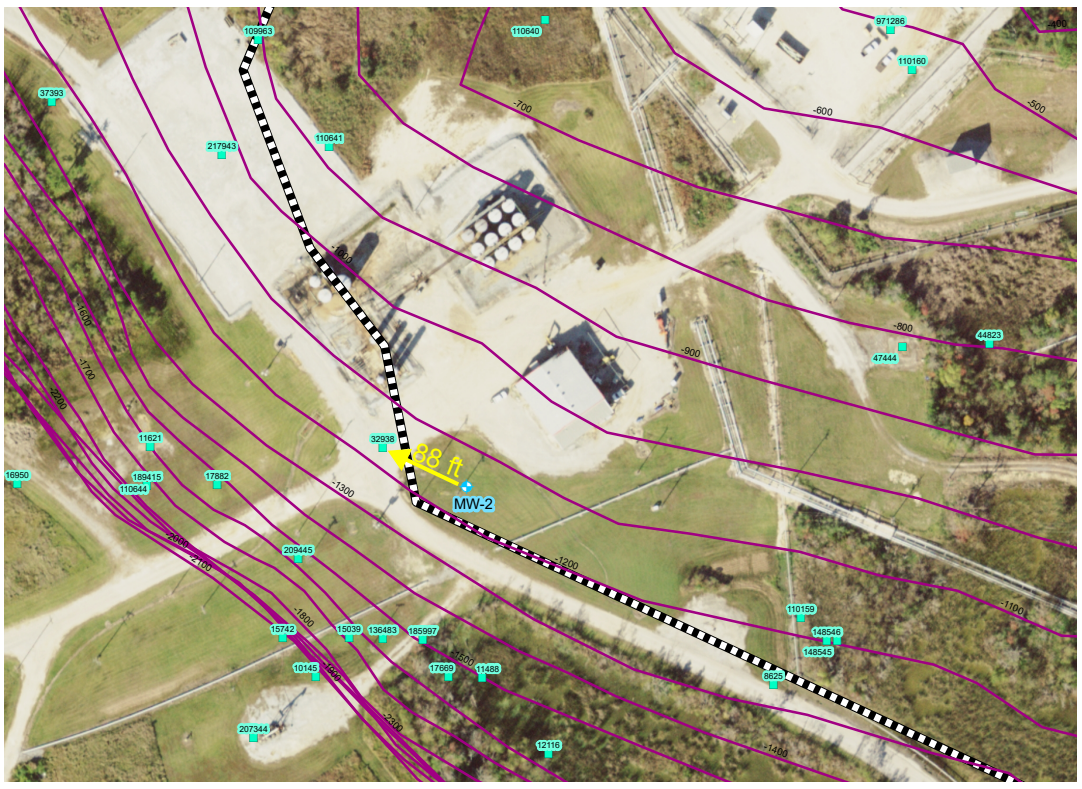
200-foot sand

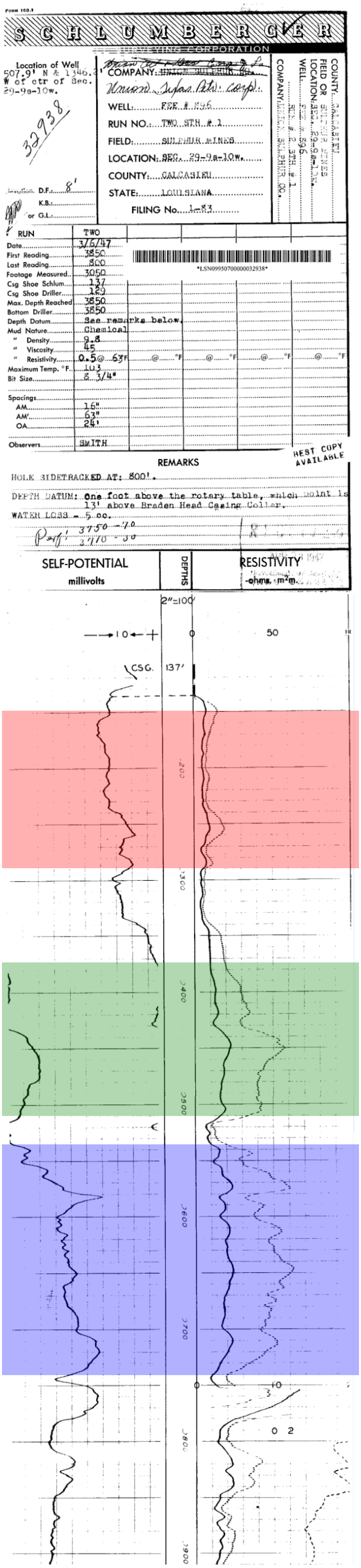
500-foot sand

700-foot sand



SN 32938



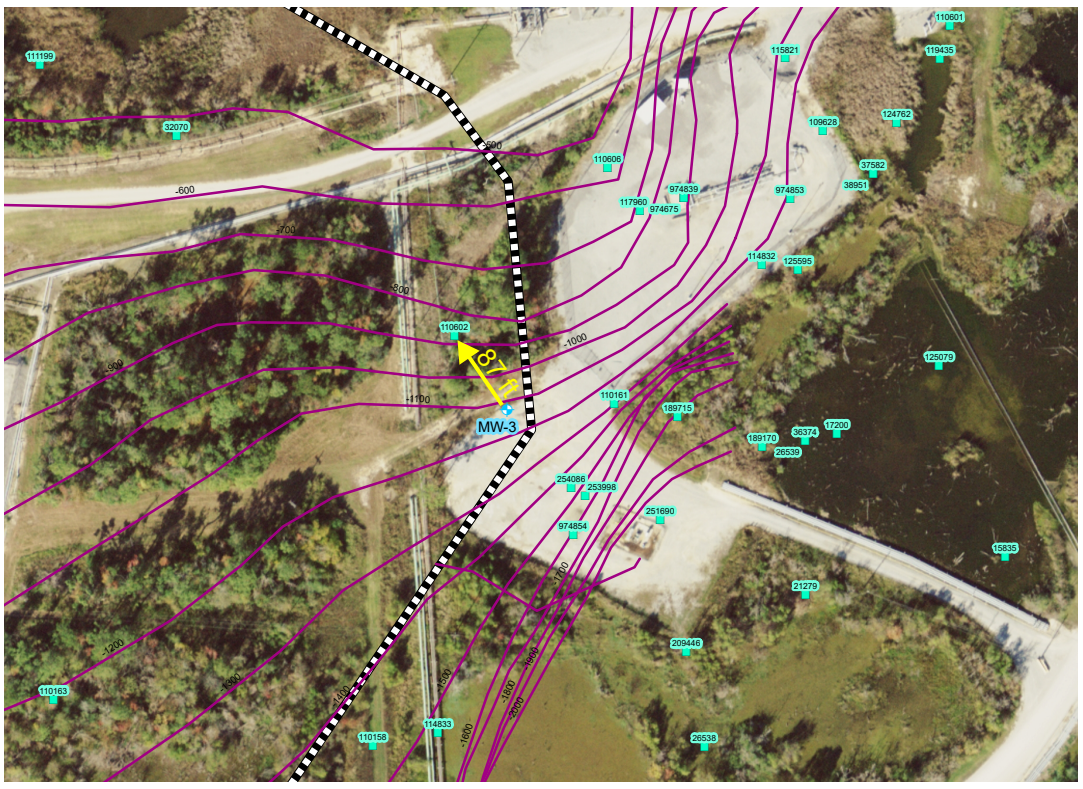


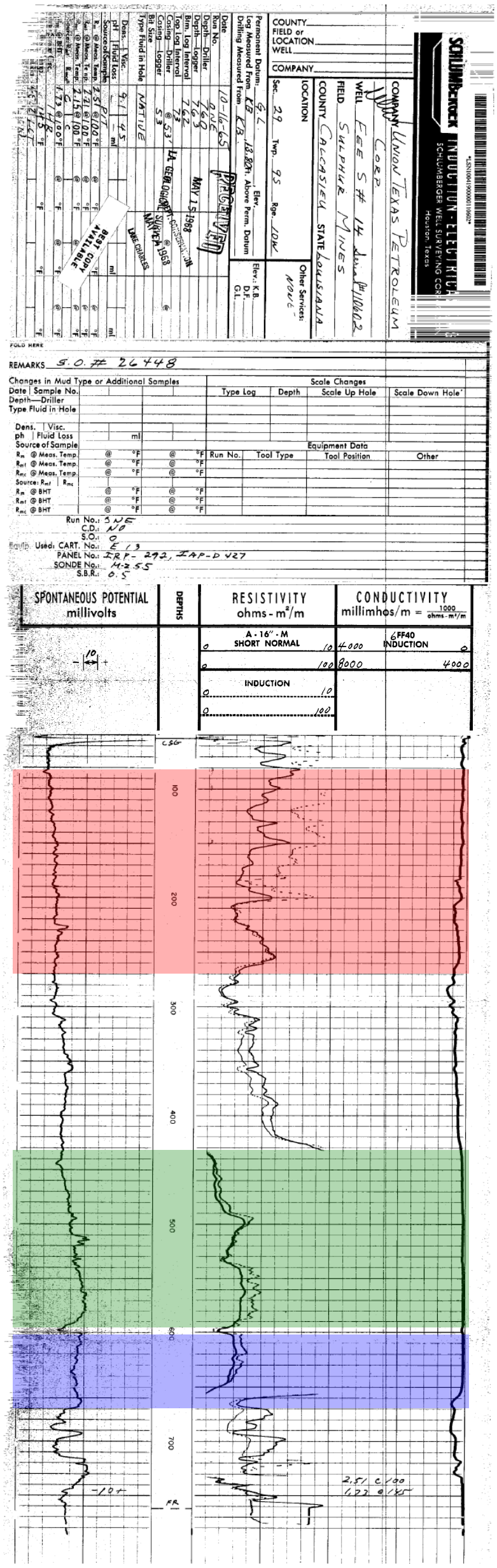
200-foot sand

500-foot sand

700-foot sand

SN 110602





200-foot sand

500-foot sand

700-foot sand