

VAPOR INTRUSION SCOPING MEETING SUMMARY

MAIN INSTALLATION, DEFENSE DEPOT MEMPHIS, TENNESSEE

12 February 2020, 8:30 AM EDT

LOCATION: Environmental Protection Agency, 61 Forsyth Street, SW Atlanta, Georgia

ATTENDEES:

U.S. EPA, Region 4 – Diedre Lloyd, Ben Bentkowski

CALIBRE BEC – Joan Hutton

USACE: Mobile – Melissa Shirley

HDR EOC, USACE Contractor – Tom Holmes, Clayton Mokri (Call-in)

GENERAL

Mr. Holmes noted that this meeting was a follow-up to a conference call on 12 December 2019. There was general agreement by participants that data gaps identified by EPA in the *Soil Vapor Sampling Memo* (Memo) were appropriate and warranted additional work. There was also agreement that Army halt plans for additional limited sampling in order to develop an updated vapor intrusion (VI) conceptual site model (CSM) and prepare a comprehensive sampling plan (CSP) to guide additional investigation. In order to proceed with that agreement, this meeting was arranged to discuss additional information needed to prepare the CSM and the CSP to address data gaps to be identified in the CSM, including those previously identified by EPA. All were in agreement with that objective.

Prior to reviewing the figures and tables distributed electronically prior to the meeting, Mr. Holmes briefly discussed development of the initial limited scope for the VI study. The plan was based on previous work that found low concentrations of volatile organic compounds (VOCs) in soil on the Main Installation (MI) and that the fine-grained soils from the ground surface to depths of 30+ feet or more provided an effective barrier to migration of VOCs in groundwater. However, soil vapor sampling on the MI in 2018 found VOCs in shallow soil vapor at concentrations that presented a potential VI hazard for workers and additional sampling was proposed.

Mr. Holmes also noted that an Indoor Air Sampling Quality Assurance Project Plan (QAPP) has been submitted to EPA for review. Building locations for indoor air (IA) sampling were selected based on 2018 soil vapor sample locations with the highest potential VI risk estimates. Although initially recommended, Buildings 972 and 1089 were not selected for IA sampling in the QAPP; 1089 is open on one side and not occupied regularly by employees, and 972 is used for repair and maintenance of heavy equipment including use of solvents that could not be removed prior to IA sampling. The building locations selected for IA sampling are all in the TTA-2 area, which is not currently suitable because the ongoing soil vapor extraction (SVE) pilot test will impact the sample results. Army suggests that IA sampling locations and procedures be reconsidered during preparation of the CSM and the CSP and that the review of the QAPP is not necessary. Ms. Lloyd and Mr. Bentkowski agreed with that approach.

Background

Several tables and figures were prepared by HDR to show currently available information to be included in the CSM. Mr. Holmes reviewed the tables and figures, which are attached to this summary.

[Table 1](#), Maximum CVOC Concentration in Fluvial Aquifer Plumes, lists the ten groundwater plumes/areas on the MI, eight of which contain one or more CVOCs at concentrations above current VI screening levels for commercial exposure with total cancer risk at 1E-06 or total hazard quotient at 1 (VISL-C). The CVOCs commonly detected in groundwater above VISL-C are tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), carbon tetrachloride (CT) and

chloroform (CF). cis-1,2 dichloroethene (cDCE), which is not included on [Table 1](#), is also commonly detected in groundwater but its VISL-C concentration is very high and not exceeded on the MI.

[Table 2](#), Geotechnical Test Results, lists soil classification, porosity, density, permeability and other test results for 13 soil samples collected in 2018 and 2019. The results are listed by geologic unit, which are from shallowest to deepest: loess, upper fluvial deposits (fine-grained), lower fluvial deposits (coarse-grained) and upper Claiborne (coarse-grained). The samples from the loess were noted to have permeability values of 10^{-7} to 10^{-9} centimeters per second.

[Table 3](#), Vapor Concentrations in Vapor Monitoring Points, lists vapor sample results for vapor monitoring points (VMPs) screened at depths of 35 to 45 feet below ground surface (bgs) in the first sand layer encountered. The VMPs were installed in 2019 to identify the location for the SVE pilot test on the MI. The CVOCs commonly detected in groundwater, as listed above, were the VOCs detected at the highest concentrations in the vapor samples.

[Table 4](#), Soil Gas and VMP Sample Results, compares results for the 2018 soil vapor samples, collected from sub-slab (SS) samples at approximately 6 to 18 inches bgs, with sample results from nearby VMPs.

The locations of the VMPs, SS samples and geotechnical samples were discussed along with procedures for installation of the VMPs, and the shallow vapor and SS sample points. Correlation of the analytical results for SS samples and VMPs was briefly discussed; CVOCs were detected at similar relative concentrations in SS-09 and VMP TTA1N-1 and at SS-03 and VMP TTA2-3, but not at other locations. However, repeat SS samples did not have consistent results, which shows the need for semi-permanent sample points and multiple samples over time as the VI study proceeds.

SVE pilot test operations were also briefly discussed. Mr. Holmes stated the test was being conducted in the TTA-2 area (southeastern MI) and pointed out the area on the figures. He stated the SVE system removed 128 pounds of CVOCs from startup in late August through December 2019, and that the mass is significantly more than estimated to be present from the 2009 soil sample results in that area. The pilot test will continue until early April in order to end just before April 2020 long-term monitoring (LTM) samples are collected; the impact of the CVOC mass removal will be seen without the potential rebound which may occur when the SVE system is shut down. Ms. Lloyd asked about treatment of the SVE effluent and Mr. Holmes replied that treatment was not required because the VOC emission rate was less than the de minimus rate (0.10 pounds per hour) established by Shelby County Pollution Control (SCPC). Mr. Holmes noted that system emissions have been documented in memoranda submitted to SCPC.

[Table 5](#), Summary of MI Building Information, presents the building information included in the 4th Five-Year Review for DDMT to support the protectiveness determination.

More detailed information for buildings overlying groundwater plumes was identified as a data gap to be addressed in preparing the CSM.

[Figure 1](#), Site Aerial Photograph, shows buildings, open areas and ground cover on the MI and Dunn Field, and the surrounding area.

[Figures 2 to 6](#), Fluvial Aquifer CVOC Concentrations, show plume maps with concentrations and isopleths for PCE, TCE, CT, CF and VC from the October 2019 LTM event. The lowest isopleth value on each figure is the VISL-C concentration, which shows the extent of the plume with potential for VI impacts.

The extent of the individual CVOC plumes and the relatively low maximum concentrations of the individual CVOCs were discussed. Changes in CVOC concentrations following implementation of the selected remedy, enhanced bioremediation treatment, were discussed. The treatment areas (TTA-1N, TTA-1S, TTA-2, West-Central and Building 835) had reduced concentrations of PCE and TCE, and increased concentrations of cDCE and VC. However, PCE and TCE concentrations were

not significantly reduced outside the treatment areas, which is the reason for the ongoing supplemental remedial investigation (SRI).

[Figure 7](#), Combined CVOC Plumes and Buffer, overlays the extent of each plume, based on the VISL-C concentration, with a 100-ft buffer indicating the areas requiring further investigation for VI.

The extent of the TTA-1N plume offsite into the residential area west of the MI was noted. Ms. Lloyd stated that the extent of the plume was not well-defined in that area. Mr. Holmes replied that additional wells were installed in that area during SRI Phase 4 and the additional information will be included in the CSM. In addition, the plume extent and 100-ft buffer based on VISL concentrations for residential exposure (VISL-R) will be added to the CSM for the off-site areas and the former housing area in the southeastern MI. Ms. Lloyd also noted that information on the use and construction of buildings in those areas would be needed.

[Figure 8](#), Depth to Water, shows the depth of groundwater below ground surface at each Fluvial Aquifer LTM well based on measurements from October 2019. The depths range from 54 ft bgs in the northeast corner to 96 ft bgs in most of the central MI; depths within the 'window' increase to 117 ft bgs.

[Figure 9](#), Depth to First Sand, shows the depth below ground surface of the first sand layer encountered in LTM well borings on the MI. The depth is equivalent to the thickness of the fine-grained soil in the loess (clayey silt) and underlying upper fluvial deposits (clayey sand). [Figure 9](#) also shows the locations of VMPs, shallow vapor samples and geotechnical samples on the MI.

[Figure 10](#), Cross-Section 2, MW-278 to MW-263, and [Figure 11](#), Cross-Section 3, MW-24 to MW-266, show the geologic units and water table in roughly parallel sections aligned southwest to northeast across the MI. PCE and TCE concentrations from the October 2019 LTM event are shown for the wells on the sections. Cross-Section 2 extends from the off-site upgradient extent of the TTA-1N plume in the southwest MI through the West-Central and North-Central plumes to the property boundary in the northeast MI. Cross-Section 3 extends from the southern property boundary in the central MI through the groundwater 'sink' near MW-259/MW-302 and the TTA-2 plume near Building 260/261, which is the SVE pilot test area.

The location of the SVE pilot test and screen depths of the VMPs and the SVE well at TTA-2 was discussed during review of [Figure 11](#). Mr. Holmes discussed the general CSM for groundwater impacts at DDMT. Spills/releases of VOCs to the ground are retained in the fine-grained soil near the surface and slowly migrate vertically into the deeper coarse-grained sand and gravel, and then to groundwater. The SVE well interrupts the migration through the coarse-grained deposits within its zone of influence preventing further impacts to groundwater while the system operates. Ms. Lloyd stated the SVE system should also increase the migration from the fine-grained deposits.

Ms. Lloyd asked if the pilot test work plan or reports had been provided to EPA. Mr. Holmes replied that pilot test documents had not been submitted, but that the final pilot test memorandum would be provided for information and included in the final SRI report to be submitted for agency review. Mr. Bentkowski asked if costs for the pilot test were being tracked and, if so, should be included in the memorandum. Mr. Holmes stated costs were tracked but are normally not included in operations and monitoring reports. The costs will be included in the feasibility study to be performed after the SRI.

Conceptual Site Model

The information to be included in the CSM was discussed based on EPA guidance (OSWER Publication 9200.2-154, 2015), which identifies the following:

Presence of vapor-forming chemicals in the subsurface.

Mr. Holmes stated that the presence of contaminants in groundwater was generally well-defined; additional information may be needed in some areas. The only identified data gap for extent in groundwater was the off-site portion of the TTA-1N plume which underlays some residences and a church; the area is listed as 'Prospect Park' on Google Maps.

Mr. Holmes asked whether Army was responsible for the offsite portion of the plume. Mr. Bentkowski and Ms. Lloyd stated that Superfund sites are defined by plume boundaries, not property boundaries.

As noted above, the MI groundwater plumes are considered to result from multiple spills or releases on the MI prior to closure in 1997 and the releases would have caused residual soil contamination in the shallow fine-grained deposits; the residual contamination provides a source for VI as well as groundwater impacts. Although soil sampling conducted to date has not identified source areas in soil, the stable concentrations in groundwater plumes and the mass of VOCs removed by the SVE pilot test in TTA-2 indicates that sources are present on the MI.

Mr. Bentkowski asked if the outlined areas on [Figure 7](#) would cover all vadose zone sources given the thickness of the vadose zone shown by depth to water on [Figure 8](#). Soil vapor sampling within the outlined areas, which show the current extent of groundwater plumes based on VISL-C with a 100-ft buffer, was considered generally sufficient to identify the extent of soil vapor contamination in areas of commercial-industrial use. However, the CSM will incorporate historic groundwater concentrations for the plume boundaries based on VISL-C; VISL-R with a 100-ft buffer will be used to define the plume boundaries for the housing area in the southeast MI and for offsite areas.

Mr. Holmes suggested vapor samples from VMPs installed at various depths and locations above the plumes. Ms. Lloyd suggested vapor samples be collected at three depths: shallow, intermediate and deep samples extending to just above the water table.

Mr. Bentkowski suggested use of passive soil gas sampling to screen the large area outlined by the plumes and buffer; a large initial spacing could be used with additional passive samples placed where higher concentrations are observed. VMPs could then be installed for more definitive analytical results. Ms. Lloyd suggested the sample area include areas with higher groundwater concentrations prior to EBT and that vapor samples be collected from multiple depths from the water table to 5 ft bgs.

Mr. Bentkowski briefly described the use of Beacon passive samplers at a site in Macon, GA. Samplers were placed approximately 3 ft bgs using a hammer drill; Mr. Holmes asked about EPA guidance stating soil vapor samples should be no shallower than 5 ft bgs; Mr. Bentkowski stated the depth could vary based on site conditions such as the presence of low permeability shallow soil at DDMT.

Mr. Holmes asked if additional geotechnical samples should be collected. Mr. Bentkowski and Ms. Lloyd considered the existing test results ([Table 2](#)) to be sufficient for showing the difference in permeability between the fine-grained and coarse-grained deposits.

Location, size, age, condition, use, occupancy, and basic construction (e.g., foundation type) of existing buildings.

The building information identified in the guidance will be collected through review of plans and building inspections, and presented in the CSM. Ms. Lloyd noted that areas of different uses/activities in buildings, such as office space versus warehouse space, should be identified.

Hydrologic and geologic setting in and around the subsurface vapor source(s) and the buildings.

The hydrogeological setting at DDMT is considered to be well understood and will be described in the CSM.

Preferential migration pathways.

Mr. Holmes stated available information on utility corridors would be reviewed and included in the CSM. There was general agreement that utility corridors were the most likely preferential pathway at DDMT due to the thickness of the low permeability, fine-grained deposits throughout DDMT.

Potentially exposed population.

Occupancy of each building, including number of staff and period of time spent in the building, will be necessary for risk assessment. The number of staff will be requested by gender due to the presence of TCE and potential risk to child-bearing women. The presence of sensitive receptors, as identified in EPA guidance (OSWER Publication 9200.2-154, 2015) will also be requested: elderly, women of child-bearing age, infants/children, disadvantaged populations and those with chronic illness.

Summary

Mr. Holmes asked if other information should be gathered for the CSM. Mr. Bentkowski said he had no concerns other than those mentioned: passive samplers, utility corridors and target buildings-areas above groundwater plumes.

Comprehensive Sampling Plan

The information to be included in the CSP was discussed based on previous comments and EPA guidance, which include the following:

Plan to be developed in accordance with EPA and DOD Guidance.

Mr. Holmes stated current VI guidance from EPA and DOD. The requirements are similar and terminology from the EPA guidance can be used for clarity.

Identify screening levels and indoor air action levels.

It was agreed that VISL concentrations for groundwater, near-source/sub-slab vapor and IA would be used for screening. Mr. Bentkowski stated that if IA results show TCE exceedance, confirmation sampling should be conducted immediately. He then discussed acute exposure levels for TCE.

Develop DQOs for sample locations based on the CSM.

Mr. Holmes stated DQOs would be developed using EPA guidance on systematic planning.

Prioritize buildings/areas with the greatest commercial and residential VI potential for investigation.

Initial screening with passive samplers will focus on the overall plume boundary with buffers and some sampling outside the boundary. Additional screening may be performed in areas with high concentrations. Definitive samples will be collected with Summa canisters from VMPs and in selected buildings.

Identify vapor intrusion inclusion zone, 100 feet from plume boundary based on VISL.

Current and historic groundwater concentrations will be used to define the plume boundaries with a 100-ft buffer. VISL-C will be used to define the plume boundaries, except for the housing area in the southeast MI and for offsite areas where VISL-R will be used.

Provide multiple lines of evidenceSemiannual groundwater analytical results from Fluvial Aquifer wells.

Semiannual groundwater sampling for LTM events will continue and the most recent results will be used in evaluating VI risk. VOC concentrations in groundwater will be compared to vapor sample results and VISL concentrations to evaluate groundwater as a source for VI.

Vapor samples collected at multiple locations and depths over multiple events: soil vapor, sub-slab vapor, near-source samples from coarse-grained fluvial soils, and subsurface pressure measurements.

After site screening for soil vapor contamination, VMPs will be installed for repeat sampling at sufficient locations and depths to evaluate the potential VI risk and for use in calculating site specific attenuation factors.

Use ppbPID or HAPSITE to screen buildings for VOCs before indoor air sampling.

Prior to IA sampling, buildings will be screened to identify and remove potential contaminant sources within the building and to identify potential VI pathways related to plumbing, cracks in the foundation or other areas of concern.

Time-weighted indoor and outdoor air samples during soil vapor sampling.

Mr. Bentkowski suggested use of a barometric data logger during IA sampling and collecting sub-slab samples when collecting IA samples.

Calculate site-specific attenuation factors; use depth discrete sampling to evaluate soil vapor migration and attenuation through vadose zone.

Procedures for determining site-specific attenuation factors will be included in the CSP.

Plans for each phase of sampling and risk assessment.

Planning documents were discussed including preparation of UFP-QAPPs as opposed to work plans. Ms. Lloyd expressed a preference for work plans, and that was agreeable to Army. Ms. Hutton will provide a copy of the MW-87 Area Investigation Work Plan to Ms. Lloyd following internal review, in order to determine if the level of detail is sufficient for EPA.

Risk assessment

Final evaluation of VI risk will be made by experienced risk assessors. Ms. Lloyd has identified an EPA risk assessor that will review the data and procedures.

Identified Data Gaps

Mr. Holmes stated that the sampling plan will address the data gaps previously identified by EPA, which are listed below.

Determine source and extent of contamination associated with MW-50 based on exceedance of the residential VISL for TCE.

The onsite residential area will be evaluated consistent with other areas of the MI except that criteria for residential exposure will be used for VISL concentrations and risk assessment.

Determine source and extent of contamination associated with samples SG04, SS04-RE, SG06, SS08 and SS09.

The area of these samples will be included in the initial screening but will have a higher priority for installation of VMPs for definitive sampling.

Determine source and extent of contamination associated with screening level exceedances at SG06, SS08/SS08-RE and associated buildings (e.g., 649, 650, 1089). Perform indoor air sampling at these buildings.

The area of these samples will also be included in the initial screening and have a higher priority for installation of VMPs for definitive sampling. The timing of initial IA sampling will be identified in the CSP along with selection criteria for building locations.

Assess variability of results between samples collected in August and October (SG04/SS04, SS08), though supplemental sampling.

Variability of sample results will be evaluated through installation of semi-permanent VMPs and collection of multiple samples over time. The 2018 sample results will be considered but the new samples will be the basis for VI evaluation and risk assessment.

Assess the impact of the insufficient number of samples associated with Building 260/261 as well as sample locations, and the need for resampling to ensure adequate and representative characterization.

The CSP will provide for a sufficient number of samples to be determined in consultation with EPA.

Develop site-specific attenuation soil gas-to-indoor air attenuation factors.

As stated above, procedures for determining site-specific attenuation factors will be included in the CSP.

Determine temporal variability of sub-slab soil gas conditions and support upper-bound indoor air contaminant concentrations through collection of several rounds of samples.

Multiple sample events are planned as stated previously; criteria for the number of sample events will be stated in the CSP.

Develop rationale/DQOs for selection of the number and placement of sub-slab soil gas samples.

Rationale/DQOs for number and placement of all sample types will be included in the CSP.

Need for a comprehensive sampling plan, Supported by the following data gaps/needs identified in the RTC review: a representative sampling plan and current supporting CSM; assessment of buildings located within 100 feet of a groundwater contaminant plume; building construction assessments; geology of study area; and, extent/distribution of the loess/other soil types and their impact on the VI assessment.

This scoping meeting and summary, and preparation of the CSM and the CSP are intended to address this data gap.

Decisions and Action Items from the Discussion

Ms. Lloyd noted that multiple activities are underway that may require changes to the MI Record of Decision (ROD): SRI/FS for groundwater; additional sampling and risk assessment of soil, sediment and surface water to address data gaps in the Human Health and Ecological Risk Assessment; and the MI VI Study. She suggested additional discussion of these activities in order to coordinate the schedules and capture changes to the selected remedy in a single ROD amendment. The coordinated schedule should be included in the 2021 Site Management Plan.

Army will proceed with contracting for the CSM and the CSP. The CSM will include existing data discussed during the meeting with additional data on identified data gaps: building assessments, utility corridors as preferential migration pathways, and identification of potential receptors. The CSP will focus on nature and extent of vapor forming chemicals in soil vapor including off-site

exposure. The CSP will describe the initial site-wide screening, possibly using passive samplers; the area to be screened will be based on current and historic VOC concentrations in Fluvial Aquifer groundwater.

The current VISL calculator for residential and commercial exposure will be used for screening levels. The final VI risk assessment will be conducted using EPA Region 4 guidance.

Ms. Shirley asked why soil sampling was not included in the discussion since residual soil contamination was considered the most likely source for VI at the MI. Mr. Holmes replied that previous soil sampling had not been successful in identifying source areas, but groundwater concentrations of VOCs indicate soil contamination is present. The focus of the CSP is the nature and extent of VOCs in soil vapor, therefore soil vapor is the primary sample medium. Once the VI risk is identified, soil sampling may be conducted to identify areas for source removal.

Ms. Hutton said she will discuss the statement of work for the VI study with Ms. Lloyd.

TABLES

- 1 Maximum CVOC Concentrations in Fluvial Aquifer Plumes
- 2 Geotechnical Test Results
- 3 Vapor Concentrations in Vapor Monitoring Points
- 4 Soil Gas and VMP Sample Results
- 5 Summary of MI Building Information

TABLE 1
 MAXIMUM CVOC CONCENTRATIONS IN FLUVIAL AQUIFER PLUMES
 FEBRUARY 2020 SCOPING MEETING
 MAIN INSTALLATION VI STUDY
 Defense Depot Memphis, Tennessee

Analyte	PCE	TCE	VC	CT	CF
VISL-C	65	7.4	2.5	1.8	3.6
VISL-R	15	1.2	0.15	0.42	0.81
Area	µg/L	µg/L	µg/L	µg/L	µg/L
TTA-1N	189	129	148	-	-
TTA-1S	32	30.8	-	-	-
TTA-2	103	27.8	44.7	90.1	14.8
West-Central	26.8	31.3	27.3	1.07	2.7
Building 835	-	55.7	12.7	-	-
North-Central	17	45.2	-	0.965	4.9
South-Central	-	18.2	-	-	-
Southeast		30.5	-	-	0.816
Window	43.2	3.21	-	-	-
Background	-	3.64	-	-	-

Notes:

- 1) Concentrations are the most recent results from MI LTM wells as of October 2019.
(See Figures 2 to 6.)
 - 2) Concentrations above VISL-R in bold **font** and concentrations above VISL-C in red, bold **font**.
- VISL-C: Commercial Vapor Intrusion Screening Levels (TCR=1E-06 or THQ=1)
 VISL-R: Residential Vapor Intrusion Screening Levels (TCR=1E-06 or THQ=1)
 µg/L: micrograms per liter
 -: Analyte not detected above VISL criteria

TABLE 2
 GEOTECHNICAL TEST RESULTS
 FEBRUARY 2020 SCOPING MEETING
 MAIN INSTALLATION VI STUDY
 Defense Depot Memphis, Tennessee

Boring Identification	Depth	Geologic Unit	Soil Classification	Air Content	Water Content	Total Soil Porosity	Dry Bulk Density	Moisture Content	Permeability
	ft bgs			cm ³ air/ cm ³ soil	cm ³ water/ cm ³ soil	cm ³ / cm ³ soil	g/cm ³ soil	Percent	cm/sec
SB-1	5.5	Loess	Brown Lean Clayey Silt	0.029	0.414	0.443	1.504	27.5	6.20E-08
SB-2	5.5	Loess	Brown Lean Clayey Silt	0.014	0.414	0.428	1.538	28.7	9.00E-08
SB-3	5.5	Loess	Brown Lean Clayey Silt	0.06	0.315	0.375	1.681	25.9	4.60E-08
DB-01	8	Loess	Brown Silty Clay	0.017	0.412	0.429	1.54	26.74	1.60E-07
DB-01	22	Loess	Brown Silty Clay	0.018	0.399	0.417	1.603	26.02	4.50E-08
DB-02	18	Loess	Brown Silty Clay	0.026	0.404	0.43	1.54	26.26	3.70E-08
DB-02	32	Loess	Brown Clay with Ironstone	0.017	0.381	0.398	1.625	23.45	4.10E-08
DB-02	42	Fluvial	Red Sandy Clay	0.079	0.206	0.285	1.93	10.65	2.60E-06
MW-318	116.5	Fluvial	Tan Sand	0.077	0.352	0.429	1.512	23.3	5.30E-04
MW-318	117	Fluvial	Tan Sand	0.104	0.32	0.424	1.528	20.97	2.10E-04
MW-318	167	Upper Claiborne	Grey Sand	0.043	0.288	0.331	1.773	16.24	6.70E-05
MW-318	182.5	Upper Claiborne	Light Grey Sand	0.087	0.362	0.449	1.47	24.65	9.50E-04
MW-318	183	Upper Claiborne	Grey Sand with Tan Clay Seam	0.004	0.401	0.405	1.606	24.99	1.30E-05

Note:

- 1) Sample locations are shown on Figure 9.

TABLE 3
VAPOR CONCENTRATIONS IN VAPOR MONITORING POINTS
FEBRUARY 2020 SCOPING MEETING
MAIN INSTALLATION VI STUDY
Defense Depot Memphis, Tennessee

Analyte	PCE		TCE		VC		CT		CF	
VISL-C	1570		99.7		92.9		68.1		17.8	
VISL-R	360		15.9		5.6		15.6		4.1	
Area	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
TTA-1N	312	882	537	29,558	-	-	29.6	81.8	5.9	303
TTA-2	4,613	94,965	69.9	8,599	-	-	880.9	94,380	230	3,272
Building 720	88.2	427	537	3,386	1.8	5.6	11.3	88.1	4.3	34.7

Notes:

- 1) VMP locations are shown on Figure 9.
 - 2) TTA-1N is located in the southwestern area of the MI near Buildings 970, 972 and 1089. (See Figure 7.)
 - 3) TTA-2 is located in the southeastern area of the MI near Buildings 250, 260/261, 360 and 470. (See Figure 7.)
 - 4) Building 720 is located at the entrance to the window in the northern area of the MI; nearby wells did not exceed VISL-C criteria for groundwater. (See Table 1.)
 - 5) Vapor monitoring points installed in first sand of lower Fluvial Deposits at depths of 31.5 to 42.5 ft, bgs; samples collected in June 2019.
 - 6) Concentrations above VISL-R in bold **font** and concentrations above VISL-C in red, bold **font**.
- VISL-C: Commercial Vapor Intrusion Screening Levels for Sub-Slab and Near-Source Soil Gas (TCR=1E-06 or THQ=1)
VISL-R: Residential Vapor Intrusion Screening Levels for Sub-Slab and Near-Source Soil Gas (TCR=1E-06 or THQ=1)
 $\mu\text{g}/\text{m}^3$: micrograms per cubic meter
-: Not detected

TABLE 4
SOIL GAS AND VMP SAMPLE RESULTS
FEBRUARY 2020 SCOPING MEETING
MAIN INSTALLATION VI STUDY
Defense Depot Memphis, Tennessee

			SS01	TTA2-1								
	VISL-R	VISL-C	8/9/2018	6/17/2019	SS02	SS03	TTA2-3	SS08	SS08-RE	TTA1N-5	SS09	TTA1N-1
Primary CVOCs	µg/M ³	µg/M ³	µg/M ³	µg/M ³	8/6/2018	8/6/2018	6/18/2019	8/5/2018	10/10/2018	6/15/2019	8/5/2018	6/15/2019
Carbon Tetrachloride	16	68	10.7	24,531	10.1	42.2	881	0.5 J	23.9	60.4	1.26	81.8 J
Chloroform	4	18	1.12 J	283	44	55.7	229	0.49 UJ	88.9	83.0	48.8 J	303
Tetrachloroethene	360	1,570	287	88,140	452	1,898	4610	13,562 J	93.6	542	121	644
Trichloroethene	16	100	0.48	2255	0.43	4.41	69.8	2.85 J	1.61 U	3,866	8,061	30,072
Vinyl Chloride	6	93	0.08 U	54 U	0.08 U	0.08 U	6.9 U	0.08 UJ	0.77 U	7.4 U	0.08 UJ	56 U
Other VOCs												
Benzene	12	52	6.39	54 U	2.62	1.76	20.7 J	89.8 J	163	7.3 U	145	54 U
Ethyl Benzene	37	164	2.08 J	52 U	4.26	2.26	40.2	201 J	608	7.4 U	34.3	57 U
Naphthalene	3	12	4.25	100 U	9.44	5.24	12.6 U	5.77 J	5.24 U	13.6 U	12.1	100 U

Notes:

1) Soil gas and VMP sample locations are shown on Figure 9.

µg/M³ = micrograms per cubic meter

U = analyte not detected above specified reporting limit.

J = Estimated concentration

Concentrations above VISL-R in bold font and concentrations above VISL-C in red, bold font.

VISL-C: Commercial Vapor Intrusion Screening Levels for Sub-Slab and Near-Source Soil Gas (TCR=1E-06 or THQ=1)

VISL-R: Residential Vapor Intrusion Screening Levels for Sub-Slab and Near-Source Soil Gas (TCR=1E-06 or THQ=1)

TABLE 5
SUMMARY OF MI BUILDING INFORMATION
FEBRUARY 2020 SCOPING MEETING
MAIN INSTALLATION VI STUDY
Defense Depot Memphis, Tennessee

Buildings	Tenant	Area (sq. ft.)	Ceiling Height (ft.)	Use/Employees
429, 430 & 529	Cargill Cotton	109,994 per bldg.	14	Cotton Storage/NA
530	United Way (partial)	109,994	14	Four vacant bays, one bay used periodically for forklift training/NA
360	Avery Outdoors	207,272	25	Storage of hunting gear and equipment for retail sale/approximately 34 employees, 40hrs per week
470	Nickey Warehouse	207,921	20	Logistics; storage of client products to be shipped/56 employees at this and 3 other buildings.
260/261	Colliers	11,836	14	Storage for tools and equipment/1 employee 40hrs per week & 1 part time as needed.
265	HDR	8,033	14	Partially used for equipment & file storage/1 employee 2hrs per week.
970	Barnhart Crane	276,000	20	Construction, maintenance and storage/5 employees intermittently, 25-30hrs per week. Southern section of building is open on one side.
972	Barnhart Crane	276,000	20	Construction, maintenance and storage/50 employees, 40hrs per week. Multiple large bay doors which are generally open when occupied.
1089	Barnhart Crane	39,600	20	Construction, maintenance and storage/no regular employees; building is open on one side.

Notes:

1) Building numbers are shown on Figures 1 to 9.

NA not available

sq. square

ft. feet

FIGURES

- 1 Site Aerial Photograph
- 2 Fluvial Aquifer Tetrachloroethene Concentrations
- 3 Fluvial Aquifer Trichloroethene Concentrations
- 4 Fluvial Aquifer Vinyl Chloride Concentration
- 5 Fluvial Aquifer Carbon Tetrachloride Concentrations
- 6 Fluvial Aquifer Chloroform Concentration
- 7 Combined CVOC Plumes and Buffer
- 8 Depth to Water
- 9 Depth to First Sand
- 10 Cross Section 2, MW-278 to MW-263
- 11 Cross Section 3, MW-24 to MW-266

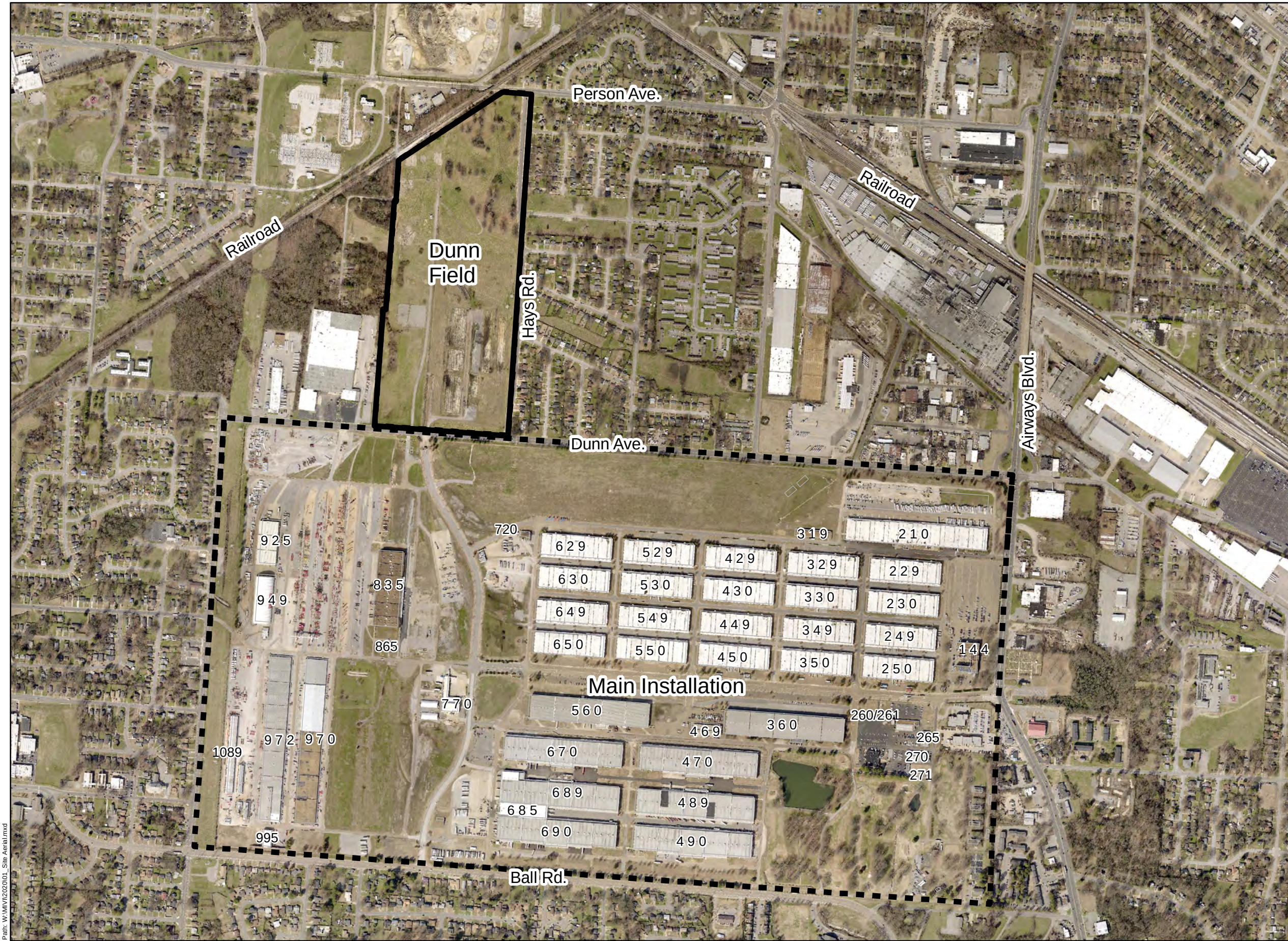


Figure 1

Site Aerial Photograph

February 2020 Scoping Meeting
Main Installation VI Study

Defense Depot
Memphis, Tennessee

Legend

- Main Installation Perimeter
- Dunn Field Perimeter

Notes:
1. Aerial date: 2019.
2. Source: Shelby County TN
Regional GIS Department.



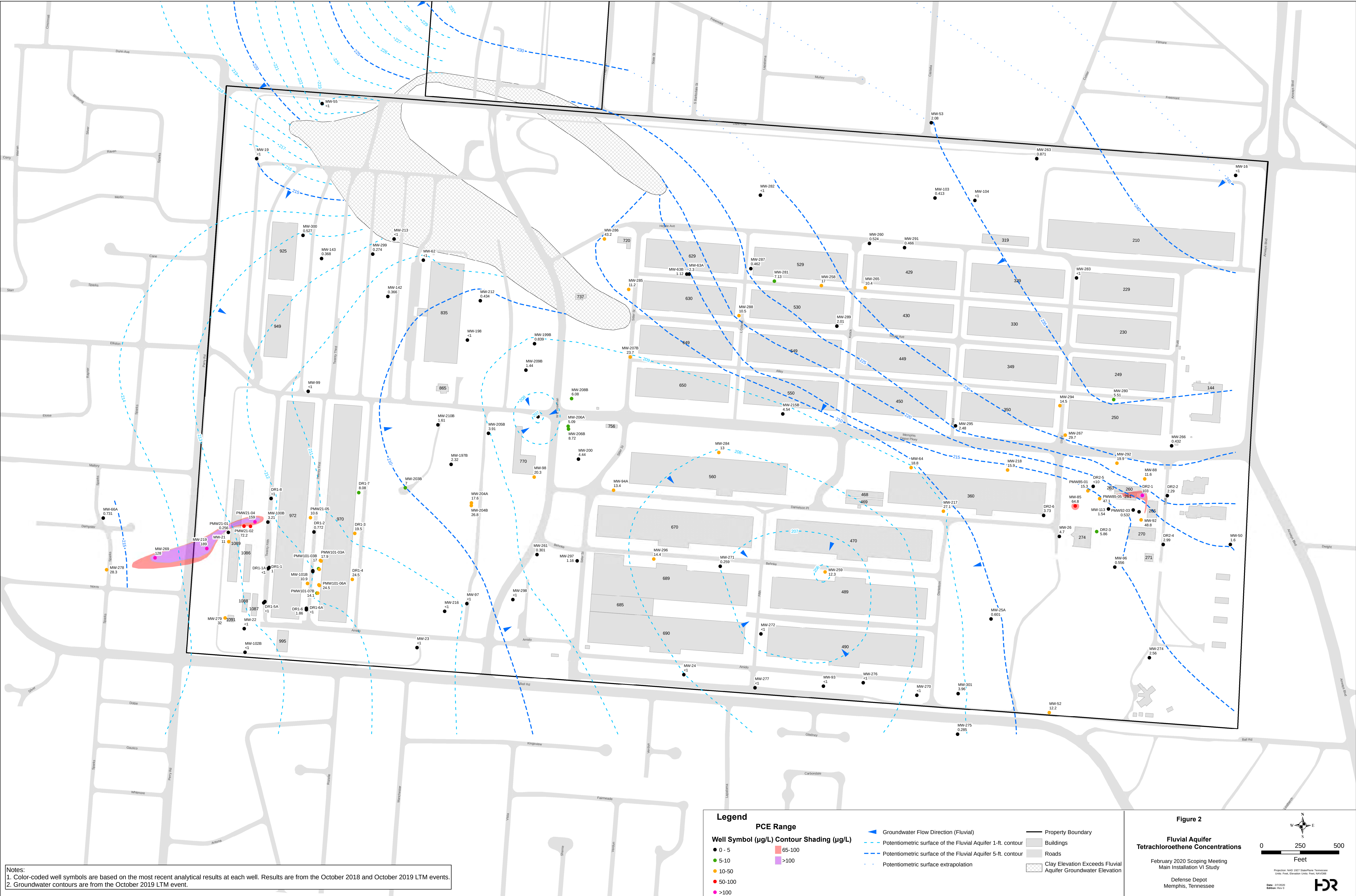
0 500 1,000
Feet

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

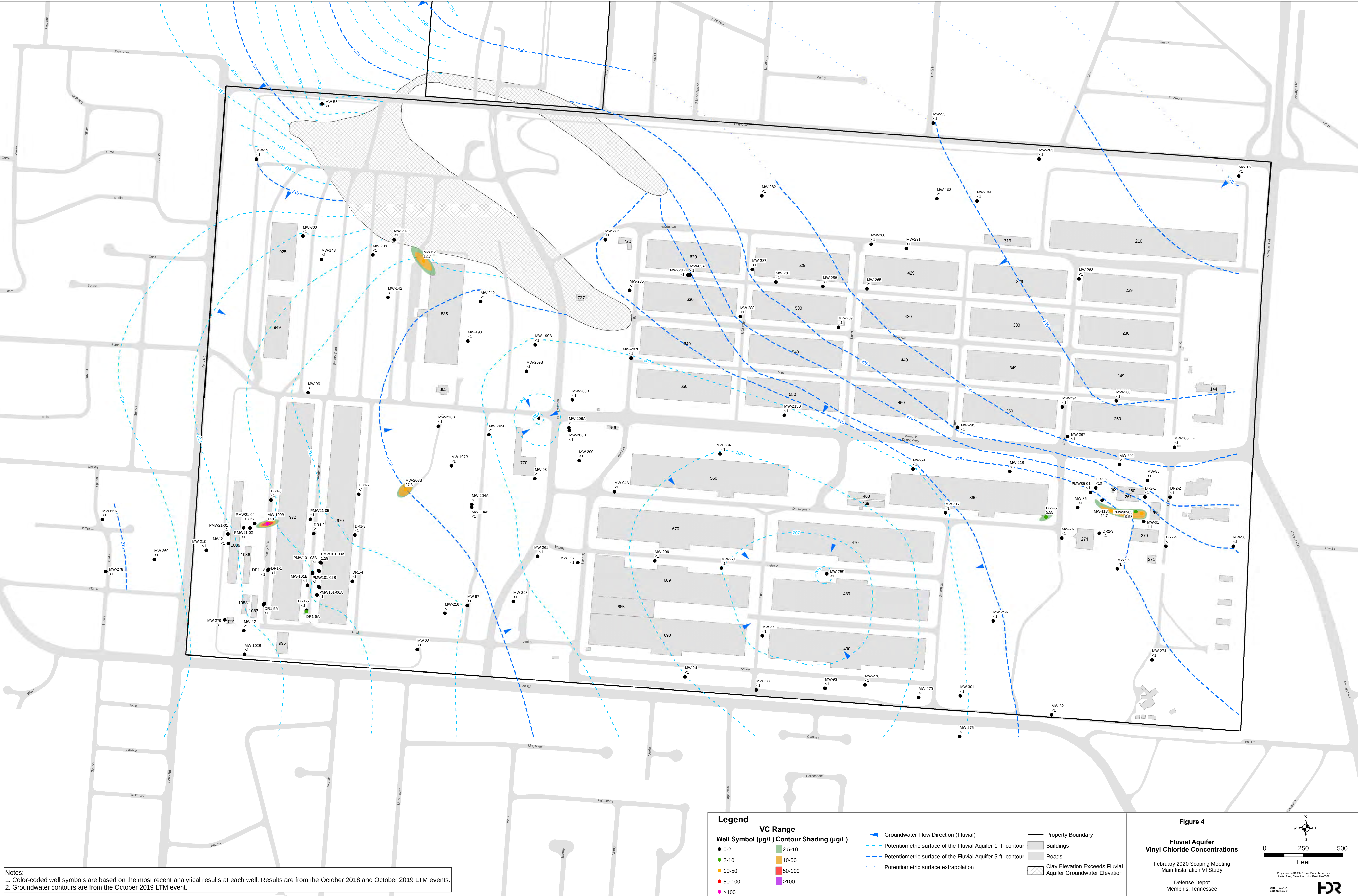
Date: 2/10/2020
Edition: Rev 0



Notes:
1. Color-coded well symbols are based on the most recent analytical results at each well. Results are from the October 2018 and October 2019 LTM events.
2. Groundwater contours are from the October 2019 LTM event.



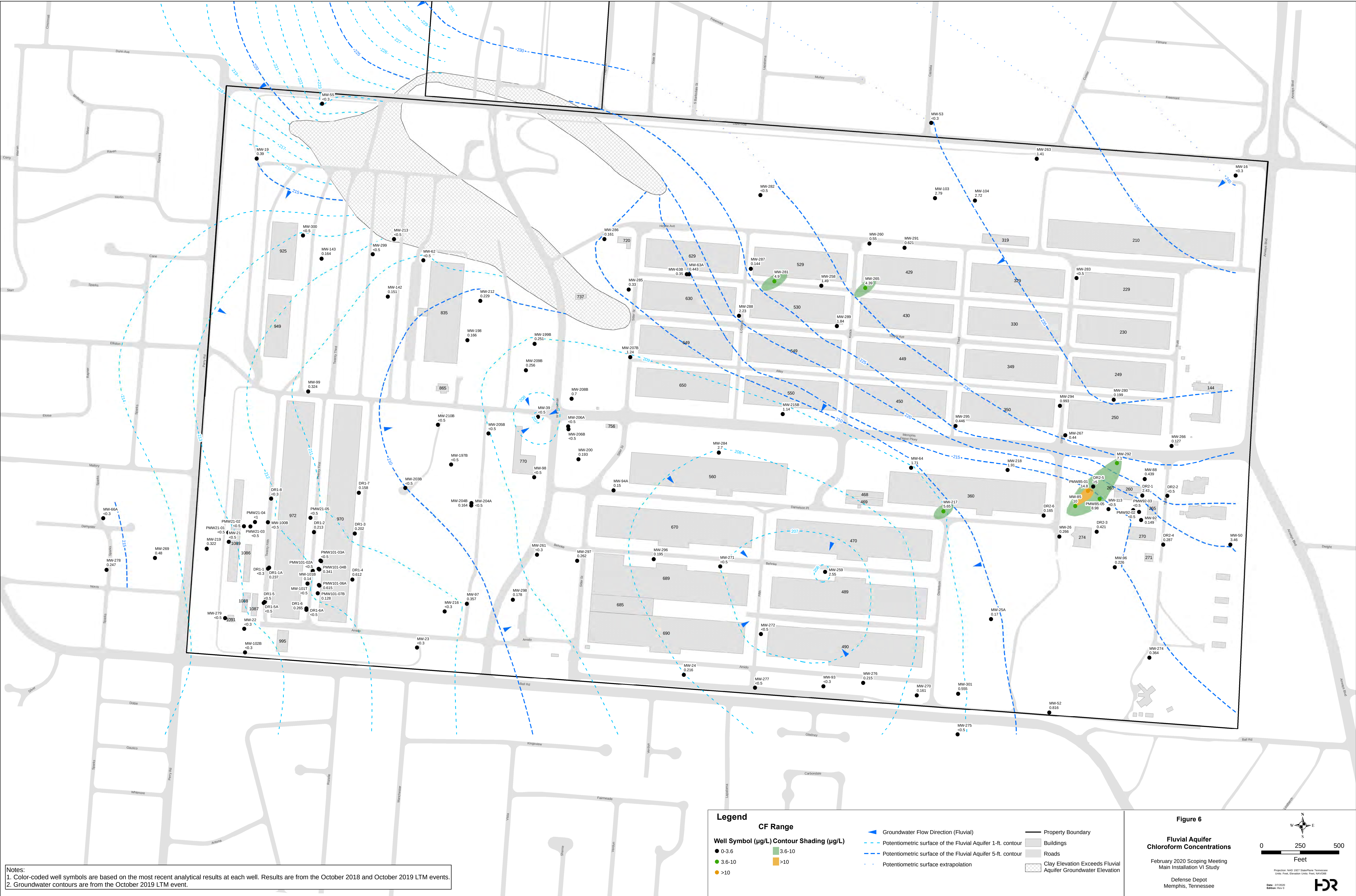
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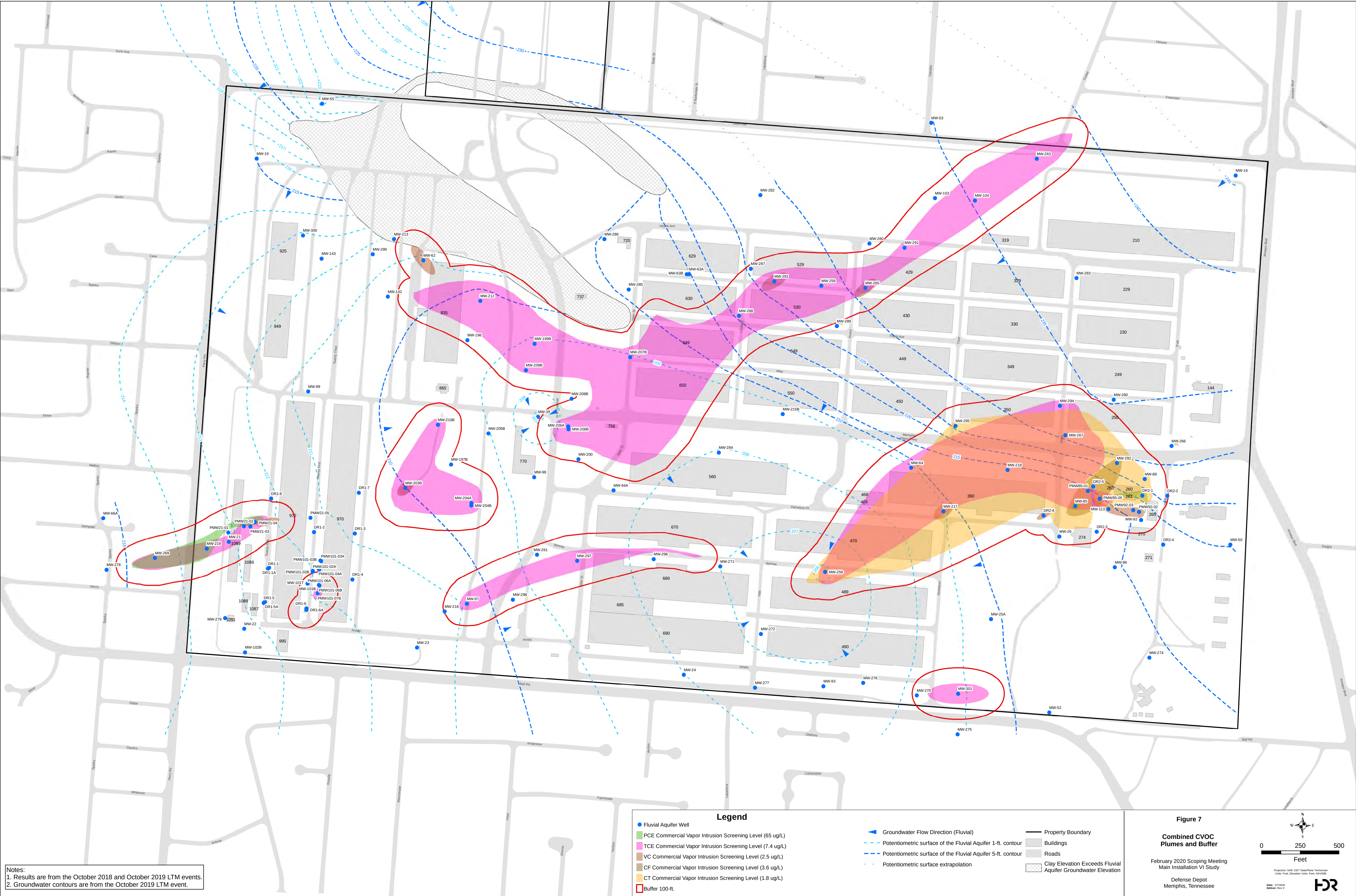
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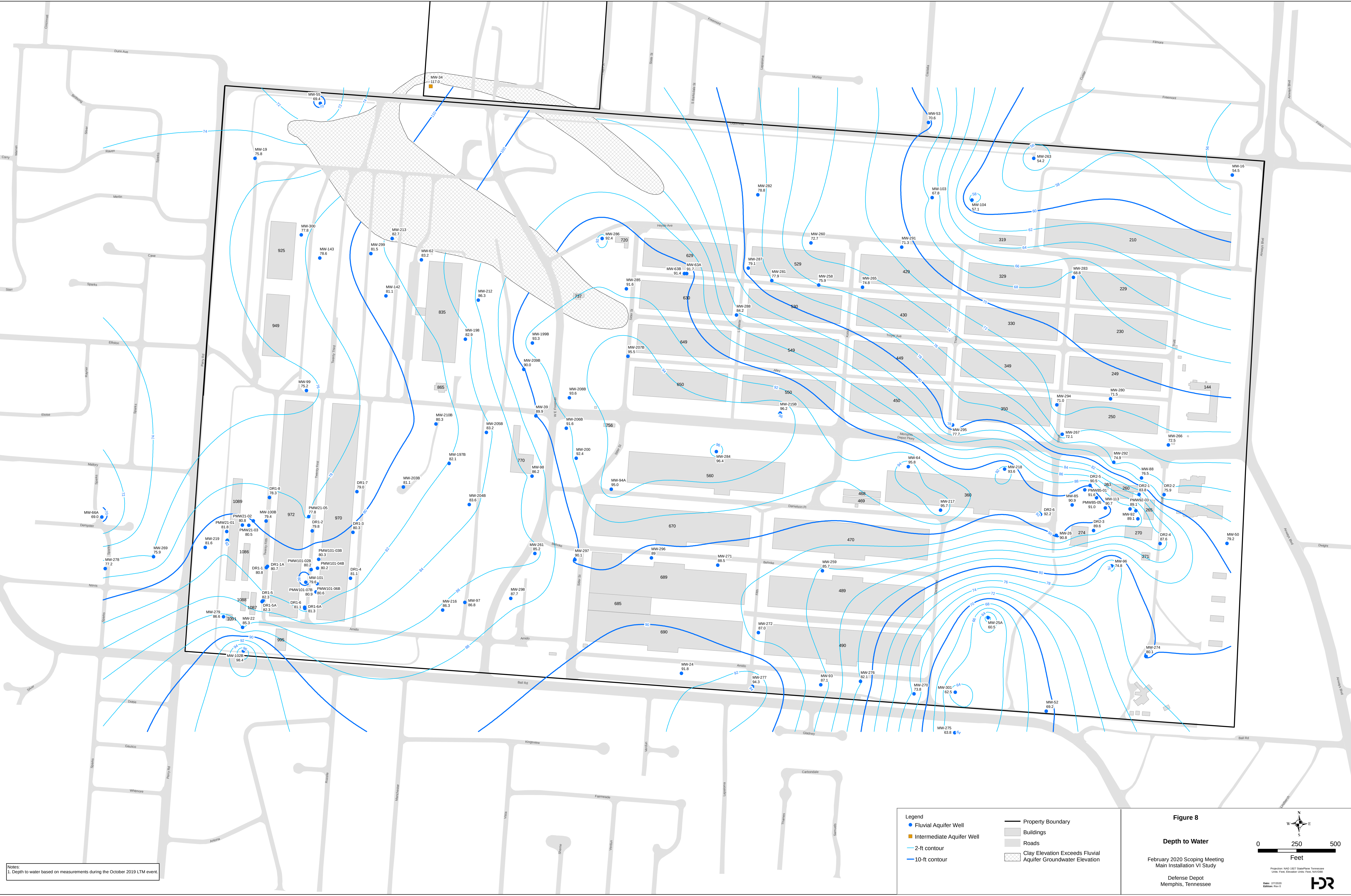


Notes:
1. Color-coded well symbols are based on the most recent analytical results at each well. Results are from the October 2018 and October 2019 LTM events.
2. Groundwater contours are from the October 2019 LTM event.



Notes:
1. Results are from the October 2018 and October 2019 LTM events.
2. Groundwater contours are from the October 2019 LTM event.





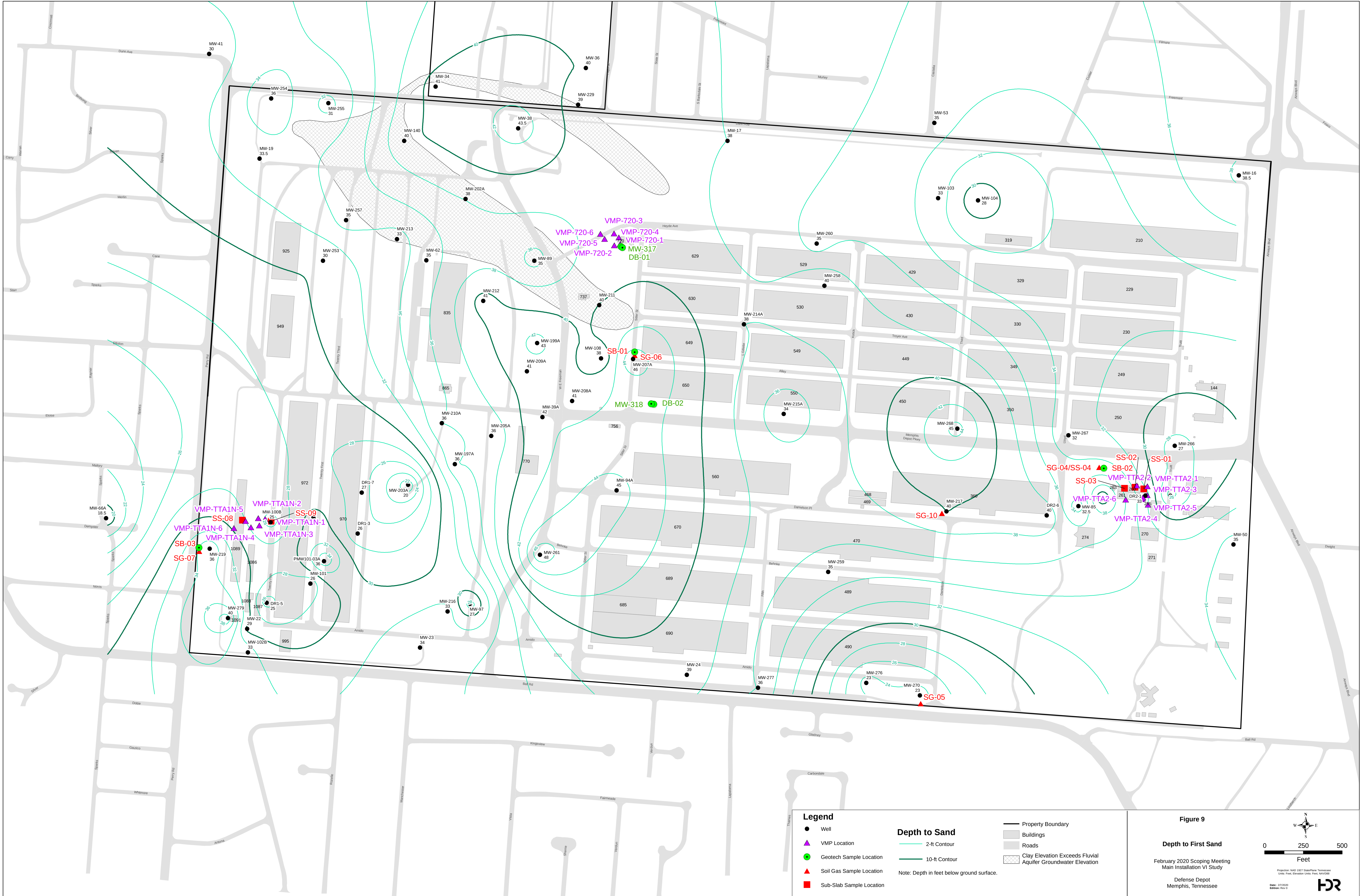
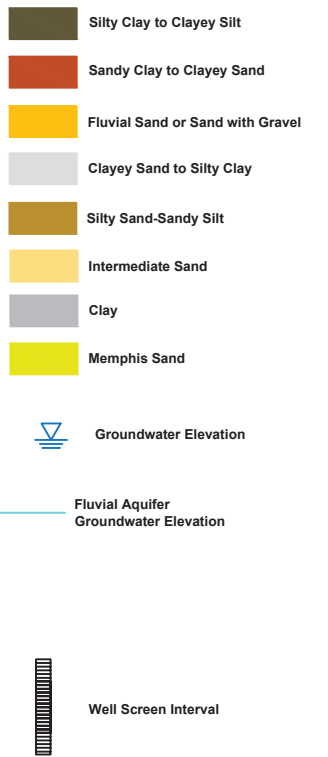


Figure 10

Cross Section 2,
MW-278 to MW-263

February 2020 Scoping Meeting
Main Installation VI Study

Defense Depot
Memphis, Tennessee



Well ID
PCE Result ug/L
TCE Result ug/L

Results from October 2019

Note: Water levels measured October 2019.



Date: February 2020
Edition: Rev 0



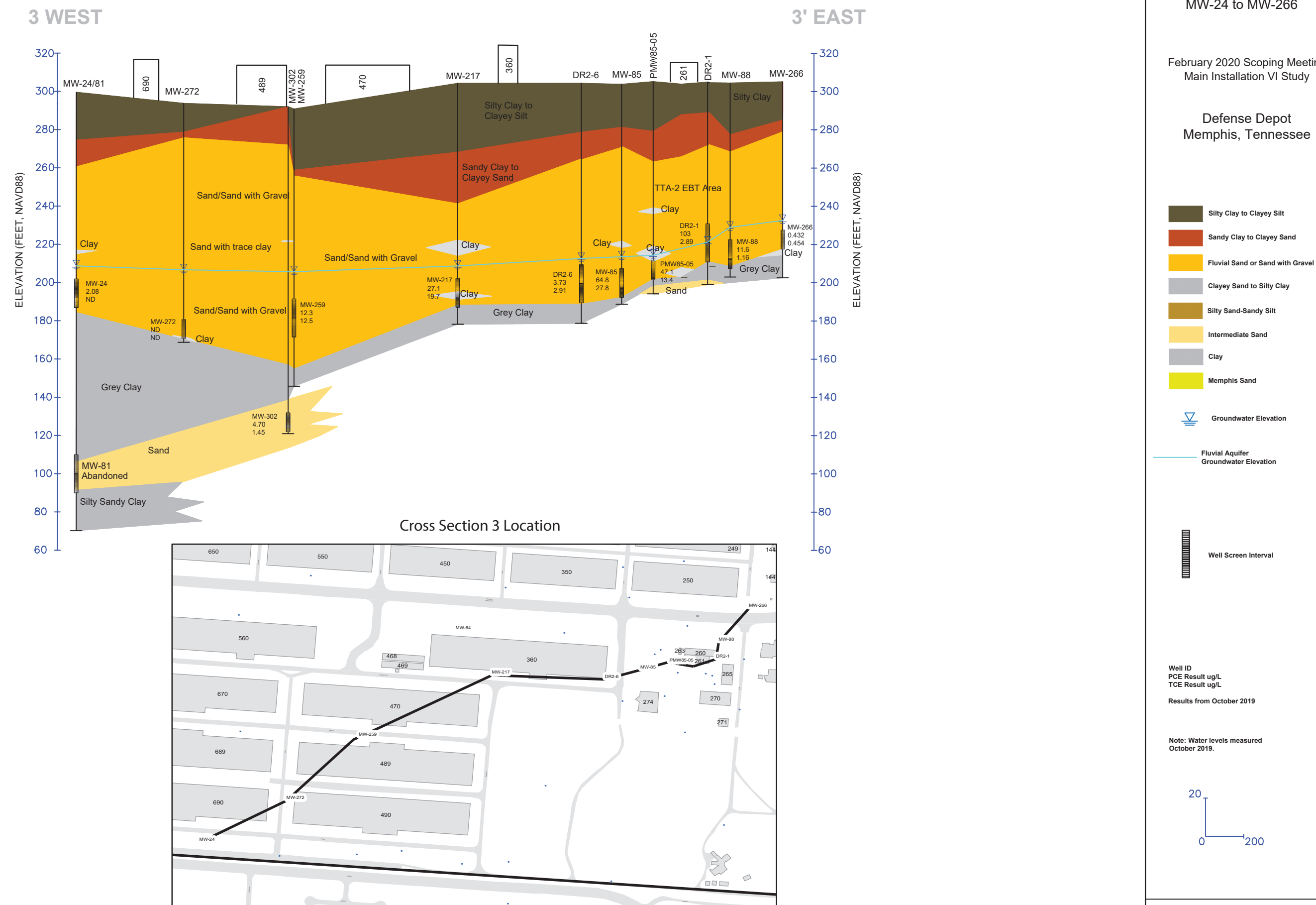


Figure 11

Cross Section 3,
MW-24 to MW-266

February 2020 Scoping Meeting
Main Installation VI Study

Defense Depot
Memphis, Tennessee

Well ID

PCE Result ug/L

TCE Result ug/L

Results from October 2019

Note: Water levels measured
October 2019.