LABELLA Associates, D.P.C.
Engineering
Architecture
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Planning

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January 8, 2015

Todd M. Caffoe
Division of Environmental Remediation
New York State Department of Environmental Conservation
6274 East Avon-Lima Road
Avon, New York 14414

Re: Remedial Investigation Work Plan; Amendment 3 – P-1 Plume Area
Former Emerson Street Landfill
NYSDEC Site #828023
LaBella Project No. 210173

Dear Mr. Caffoe,

LaBella Associates, D.P.C. (LaBella) is submitting this letter on behalf of the City of Rochester (City) to the New York State Department of Environmental Conservation (NYSDEC) to propose an additional amendment to the approved Remedial Investigation Work Plan (RIWP) dated November 2012 for the Former Emerson Street Landfill (FESL), Rochester, New York (hereinafter referred to as “the Site”). The work addressed by this amendment includes tasks to further assess the distribution of volatile organic compounds (VOCs) in soil/fill, bedrock, and groundwater in the vicinity of the P-1 well at 1655 Lexington Avenue. Additional data is sought after in anticipation of completing a remedial alternatives analysis for the P-1 plume. A Site Location Map is included as Figure 1.

The tasks proposed herein include 1) advancement of MIP borings in 17 locations in proximity to the P-1 well; 2) drilling, rock core matrix analysis, installation and sampling of three shallow bedrock groundwater monitoring wells in proximity to the P-1 well; 3) drilling, rock core matrix analysis, installation and sampling of one deep bedrock groundwater monitoring well hydraulically down gradient of the P-1 well; 4) bedrock well pumping tests to evaluate bedrock aquifer parameters and the connectivity between monitoring well locations; and 5) groundwater sampling of wells in the vicinity of P-1 using passive diffusion bags. Figure 2 provides the locations of existing monitoring wells and Figure 3 provides the proposed additional testing locations.

LaBella has retained GEI Consultants Inc., P.C. (GEI) to provide technical support in conducting the proposed work plan amendment. A LaBella and/or GEI representative will be on-Site during all portions of the field sampling activities in order to evaluate for evidence of impairment (i.e., elevated PID readings, staining, odors, etc.), guide the contractor on the work, and conduct the necessary Community Air Monitoring Plan (CAMP) and Health and Safety Plan (HASP). All applicable work will be completed in accordance with the approved RIWP dated November 2012.

Background

The RIWP was submitted in November 2012 and an amendment to the RIWP was submitted on September 30, 2013. The NYSDEC approved the RIWP in a letter dated November 29, 2013. An additional amendment was submitted on July 11, 2014 to further investigate the area of the Delist Well north of the P-1 plume. Tasks associated with the second amendment were completed through July 2014. This third amendment intends to further investigate the presence of VOCs in the area of the P-1 plume.

Tasks completed under the RIWP and amendments included the advancement and evaluation of a total of 16 test pits, 30 soil borings, 6 shallow bedrock wells, 1 deep bedrock well, 1 overburden well, and groundwater sampling. Bedrock wells were sampled at the time of installation between December 17th 2013 and January 20th 2014 and all newly-installed wells in addition to P-1, GMX-MW-3 and GMX-MW-4 were sampled in May 2014. Investigations in the vicinity of the P-1 plume to date have determined the presence of VOCs, including chlorinated VOCs (CVOCs), in the overburden, bedrock, and groundwater. The CVOC plume as determined in previous investigations follows the direction of groundwater, traveling in a south-southeast direction towards McCrackanville Street and the deep storm sewer (and associated bedding material) which is installed in blasted bedrock. Figure 5 represents the CVOC groundwater plume source area as determined from the sampling events conducted as part of this RI to date. The model was developed using groundwater data collected during monitoring well installation in 2013-2014 and a groundwater sampling event conducted in May, 2014.

Proposed Amendment

The additional investigation activities will be completed to accomplish the following objective:

1) Characterize the distribution of VOCs, in particular CVOCs, in the P-1 plume source area in the overburden, bedrock, and groundwater to evaluate potential remedial alternatives.

To accomplish these objectives, the following tasks are proposed:

1) Advancement of 17 MIP borings at locations in proximity to the P-1 well;
2) Drilling, rock core matrix analysis, installation, sampling and NOD testing of three shallow bedrock groundwater monitoring wells in proximity to the P-1 well;
3) Drilling, rock core matrix analysis, installation, sampling, and NOD testing of one deep bedrock groundwater monitoring well hydraulically down gradient of the P-1 well;
4) Bedrock well pumping tests to evaluate bedrock aquifer parameters and the hydraulic connectivity between monitoring locations; and
5) Groundwater sampling of wells in the vicinity of P-1 using passive diffusion bags.

At this time it is anticipated that the tasks will occur in the order listed. A LaBella or GEI representative will be on-Site at all times during P-1 work. In the event that during the course of the investigation it is determined that containers with chemicals are encountered, the City and the NYSDEC will be contacted immediately to discuss the situation and if warranted implement any emergency actions. The following details the tasks that will be completed as part of this amendment:

Task 1: Membrane Interface Probe Technology
Membrane Interface Probe (MIP) technology uses various sensors to collect continuous vertical data in soil/fill material that directly correlates to VOC concentrations. It is advanced using a direct-push method at approximately one foot per minute, ensuring that depth-specific data is recorded using various sensors. This task involves the advancement of MIP in seventeen (17) locations. The relative VOC concentrations, represented by XSD data, by depth are graphed and will be modeled using a program with 3D capabilities throughout the course of the MIP work. If it is apparent that additional testing is warranted based on the concentrations determined in the field, locations may change or be added to eliminate data gaps. This type

of data is important for source area characterization and would support the assessment of the vertical and horizontal extent of VOC, specifically CVOC, contamination in the overburden.

Based on previous soil sampling results in the vicinity of the P-1 plume, it is apparent that CVOCs are present in the overburden soil/fill material detected at concentrations as high as 770 parts per million (ppm) in laboratory analytical soil samples. Figure 4, attached depicts the inferred approximate extent of CVOCs exceeding 1 ppm in the overburden soil/fill material. The proposed MIP locations were determined based on this interpolation model of CVOCs in soil/fill and the direction of groundwater flow being to the south-southeast as determined from previous investigations.

Seventeen MIP testing locations were selected using an approximate 30 feet by 30 feet grid overlaid on the above referenced plume modeling. It is assumed that the MIP will be advanced to refusal (i.e. bedrock). In the event that the MIP cannot be advanced through fill material, locations will be off-set in an attempt to collect data to the top of bedrock across the grid as shown on Figure 3. Groundwater samples (where saturated soils exist) will be collected from up to five select locations and will be determined based on the highest apparent concentrations determined from MIP data and proximity to previous sample locations. In addition, up to five soil borings will be advanced adjacent to the MIP locations with the highest XSD values encountered and analyzed for target compound list (TCL) VOCs by an Environmental Laboratory Accreditation Program (ELAP) laboratory in order to corroborate the MIP reported data with bulk soil laboratory analytical data. It is anticipated that the MIP work will be completed in one week. In the event that the overburden fill material results in shallow refusal above apparent bedrock and presents difficulties and; therefore, timing setbacks, the soil boring portion of the work will be eliminated or reduced to ensure that MIP data collection is maximized.

Task 2: Shallow Bedrock Groundwater Evaluation

Previous investigations have indicated that overburden soils are generally unsaturated, and the upper water bearing zone is present in shallow bedrock. Five shallow bedrock wells were installed in 2013 under the RIWP which confirmed that CVOCs are present in shallow bedrock. The inferred extent of shallow bedrock groundwater impacts from the P-1 plume from the most recent data collection is included in Figure 5. In addition, pore water concentrations were calculated for the bedrock core samples collected during initial RIWP work and the results were compared to the compound solubility to evaluate the potential for the presence of dense non-aqueous phase liquid (DNAPL). An estimated rock matrix pore water concentration greater than the compound solubility indicates the potential for high concentrations of CVOCs trapped in bedrock porosity through matrix diffusion to diffuse back out of the rock matrix posing a long-term source of bedrock groundwater contamination. Bedrock monitoring well locations LAB-DBW-01, LAB-SBW-02, and LAB-SBW-05 suggest pore water concentrations exceed compound solubility limits and the bedrock matrix will continue to back diffuse contaminants into groundwater. Table 1A and Table 1B include the estimated pore water concentrations for each tested location and the equations used to determine locations that will provide a long-term source of bedrock contamination.

Further investigation of a potential source area in the shallow bedrock will be assessed through bedrock coring, rock matrix analytical data, discrete depth groundwater sampling, and shallow bedrock well installation and sampling at three additional locations. Proposed locations are based on the pore water concentrations as described above and data gaps that are present on the outermost edges of the inferred P-1 plume. One shallow bedrock groundwater monitoring well will be installed approximately 30 feet southeast of LAB-SBW-05 which resulted in the highest concentration of total VOCs of the wells previously installed under the RIWP. Due to the south-southeast groundwater flow direction identified in several investigations including most recently the groundwater sampling event in May 2014, additional groundwater data hydraulically down gradient of the P-1 plume will assist in assessing the extent of contaminant source material in the bedrock matrix and support the mapping of dissolved phase constituent concentrations in bedrock groundwater. A lack of groundwater data west of P-1 has led to interpolation of the P-1 plume in previous models. As such, a shallow bedrock groundwater monitoring well is proposed approximately 35 feet west-southwest of the P-1 well. Similarly, a well is proposed approximately 80 feet to the east-southeast of SBW-02 which will fill in data gaps along the eastern edge of the inferred P-1 plume. Proposed shallow bedrock groundwater monitoring locations are included in Figure 3.

This task will be completed in a controlled and careful manner in order to assess impacts within the rock as the borings are advanced. Monitoring well installation procedures will be conducted in accordance with the RIWP dated November 2012. As stated in the RIWP, at the shallow bedrock groundwater evaluation locations the following methodology will be utilized:

Overburden Assessment

The borehole will be advanced through the overburden/fill using 4 1/4" diameter hollow-stem augers. The soil/fill will be continuously sampled with a four-foot stainless steel Macrocore sampler using acetate sleeves or potentially once every five feet using split spoon samplers. Soil samples will be screened with a PID and classified similarly to the previously completed soil borings. Due to the potential for VOCs, special care will be taken to evaluate the interface of overburden and bedrock. One overburden soil/fill sample will be collected for analysis of NOD by Carus Corporation to evaluate the potential for in-situ chemical oxidation in the overburden.

Uppermost Shallow Bedrock Assessment (Top 3-ft. of Bedrock)

Because the upper bedrock surface is generally more highly fractured than deeper bedrock, the assessment of NAPL will initially focus on the upper three feet of bedrock. Upon reaching the bedrock surface, the augers will be removed from the borehole and a temporary 6" diameter steel casing will be driven into the bedrock approximately 2" to 3" in an attempt to seal off overburden groundwater from shallow bedrock groundwater. An HQ rock core barrel will then be advanced approximately three feet into the bedrock. Solvent dye will be used to identify the presence of DNAPL identification. In order to minimize the potential of potable water loss during rock coring, an attempt will be made to utilize air-coring methods during the advancement of the core barrel. Air rotary was previously successfully used during well installation under the RIWP; however, if air-coring proves to be unsuccessful, potable water will be utilized as a drilling fluid.

Following completion of the initial core interval, a section of the bedrock core (approximate 3" to 6" in length) exhibiting non-mechanical fracturing will be selected for laboratory analysis of VOC mass in the rock matrix. The selected core interval will be immediately wrapped in aluminum foil for preservation, placed in a one-quart plastic bag, and packed in blue ice for delivery to the laboratory. The rock core will be frozen, crushed and placed in a sample jar containing methanol for extraction via EPA Method 5035 and analyzed by EPA Method 8260 following two weeks of preservation. Currently, it is anticipated that up to two such rock cores per shallow bedrock well will be analyzed via this method.

After rock coring, a temporary well will be constructed in the bedrock corehole. The well will consist of a two-inch diameter Schedule 40 PVC 10-slot well screen (5 feet in length) with riser pipe which will be lowered to the base of the core hole. Filter sand will be placed around the well screen; a well construction diagram can be found in Attachment 1. An electric submersible pump will be used to purge water from the core hole. A goal is to remove 10 core hole volumes and any drilling water lost to the bedrock formation during the coring process (if used). During the purge process, water quality parameters (temperature, conductivity, pH, dissolved oxygen [DO], turbidity and oxidation-reduction potential [ORP]) will be monitored after the removal of each core hole volume until the ten volumes, or stability in all water quality parameters, has been reached (10% or less variation between readings for each parameter).

Following adequate purging of the bedrock core interval, a groundwater sample will then be collected from the interval and analyzed for CP-51 and TCL VOCs by USEPA Method 8260.

Lower Shallow Bedrock Assessment (3-ft. to 23-ft. Below Top of Rock)
Subsequent to shallow bedrock coring and groundwater sample collection, the PVC screen and riser will be removed and the cored interval will be reamed with a 5 7/8" roller bit to remove the temporary filter sand and to facilitate the installation of a permanent 6" steel casing. The 5-7/8" rock socket will extend approximately three feet into bedrock and the casing will be grouted in place using a tremie pipe and allowed to cure for a minimum of 24 hours prior to further bedrock coring.

An HQ core barrel will be advanced to a depth of 20 feet below the bottom of the permanent casing in 10-foot increments. A groundwater sample will be collected from each 10 foot interval using the procedures outlined for the shallow top of bedrock interval. For the bottom 10-foot interval, a temporary monitoring well completed with sand and bentonite installed to hydraulically isolate the upper 13 feet of the core hole from the lower interval. At the completion of purging and sampling of each cored interval, the HQ core hole will be reamed using a 3 7/8" roller bit, and the monitoring well will be completed as an open bedrock hole. All drilling equipment utilized during the installation and testing of each well will be decontaminated between monitoring well installations.

Details of the rock coring procedure including drill rate, water loss, and the presence of voids noted during core barrel advancement will be recorded on appropriate field forms. The retrieved rock core will be logged by a qualified GEI or LaBella representative, and will include a description of rock type, the presence of natural and mechanical breaks, calculation of rock-quality designation (RQD), voids, and the presence of any odors or staining associated with the rock core. Rock core samples will be collected from different rock lithologies and analyzed for NOD by Carus Corporation to evaluate the potential for in-situ chemical oxidation in bedrock. The selected core interval will be immediately wrapped in aluminum foil for preservation, and placed in a one-quart plastic bag for shipment to the laboratory.

All soil and drilling fluids generated during the installation of each monitoring well will be containerized in 55 gallon drums as described in the RIWP. The location and elevation of each monitoring well will be surveyed by a LaBella representative.

Task 3: Deep Bedrock Groundwater Evaluation
This task will be limited to one deeper bedrock groundwater monitoring well. The deep bedrock well will be installed to characterize the vertical distribution of CVOC impacts in bedrock groundwater hydraulically down gradient of the P-1 well approximately 10 feet north of LAB-SBW-05. Though the location of this well is subject to change based on the findings of the MIP advancement and shallow

bedrock well installations, the anticipated location of the deep bedrock groundwater monitoring well is shown on Figure 3. In the event that an alternate location is warranted, NYSDEC will be contacted to discuss well placement prior to initiating well installation.

The final depth of the deeper bedrock well will be determined based upon previous work as outlined in this work plan amendment, along with City approval; however, based on the previous deeper bedrock investigation, it is anticipated that this well will be installed 60 to 70 feet below ground surface. The bedrock coring/logging and depth discrete bedrock groundwater sampling will be conducted using the same procedure outlined in the shallow bedrock well installation procedure described above; however, the deeper bedrock well will be sealed into the deeper bedrock by advancing a permanent 6" steel casing approximately 20 to 25 feet or more (depending on geologic conditions noted at the time of drilling) into the bedrock in an attempt to seal off the upper bedrock flow zones from the deeper bedrock flow zones.

At this time, it is anticipated that four (4) rock core samples for VOC analysis will be completed as part of the deep bedrock well installation using the same methodology as above. Care will be taken during installation of wells near P-1 to prevent DNAPL from migrating vertically deeper into rock. DNAPL will be evaluated for during installation and periodically after installation. If DNAPL is identified, the City and the NYSDEC will be contacted to discuss decommissioning of the well. One additional rock core sample will be collected and analyzed for natural oxidant demand (NOD) by Carus Corporation to evaluate the potential for in-situ chemical oxidation in deep bedrock. The selected core interval will be immediately wrapped in aluminum foil for preservation, and placed in a one-quart plastic bag for shipment to the laboratory.

Task 4: Hydraulic Conductivity Assessment

Following shallow and deep bedrock groundwater monitoring well installation, up to four short-term pumping tests will be performed to assess the hydraulic conductivity and connectivity among bedrock wells in the vicinity of the P-1 plume source area to support the assessment of remedial alternatives. The pumping tests will consist of removing a large volume of groundwater from select bedrock wells in the P-1 plume area to determine the hydraulic conductivity in the saturated zone. Anticipated testing locations are identified on Figure 2; however, locations are subject to change as the assessment proceeds based on the findings.

During installation of LAB-SBW-04, hydraulic communication was observed in wells LAB-SBW-03 and LAB-SBW-05. During installation of LAB-DBW-01, hydraulic communication was observed in well LAB-SBW-03. During installation of LAB-SBW-05, hydraulic communication was observed in GMX-MW-4. To confirm the connectivity and monitor additional wells in the vicinity of P-1, it is proposed that the pumping tests be performed at LAB-SBW-02, LAB-SBW-04, LAB-SBW-05, and LAB-DBW-01. Locations are subject to change based on observations made during well installation detailed above. The pumping tests will aid in developing an appropriate remedial approach to the P-1 plume.

Static water level measurements will be recorded using a water level meter from the following wells: LAB-SBW-01, LAB-SBW-02, LAB-SBW-03, LAB-SBW-04, LAB-SBW-05, LAB-OBW-01, LAB-DBW-01, P-1, GMX-MW-3, and GMX-MW-4. Pressure transducers will be placed in each pumping well and the three nearest bedrock wells that are not being pumped. A pump capable of a flow rate of at least 10 gallons per minute will be place in one of the designated monitoring wells. Water will be pumped at a constant rate to induce a hydraulic gradient for a minimum of four (4) hours. Water will be directly pumped into an above ground holding tank for temporary storage. Static water levels from the remaining wells listed above will be measured and recorded every 30 minutes for the first two hours, then every 60 minutes for at least two additional hours using a water level meter. Following completion of each pumping test, water level recovery will be manually measured in each of the above wells every 15 minutes for a period of one hour. Pressure transducers will be removed from the wells 60 minutes following termination of the pumping test. Transducer data will be downloaded at the completion of each test and will serve as the primary data source; static water level measurements are meant to serve as a backup and as confirmation of water level drawdown. No more than one pumping test will occur in one day. A Jacob Straight-Line approximation or other appropriate analytical method will be used to derive aquifer values (yield and hydraulic conductivity) from each pumping test. Tank contents will be disposed of via the sanitary sewer upon permit issuance from Monroe County Pure Waters.

Task 5: Groundwater Monitoring

Each newly installed bedrock groundwater monitoring well will be sampled at discrete intervals during installation as described in Task 2 and Task 3 above. Newly installed bedrock monitoring wells will be developed in accordance with the RIWP and purge water will be containerized in 55 gallon drums. In addition, approximately three months after well installation, passive diffusion bags (PDBs) will be lowered into each of the four newly installed monitoring wells described herein, as well as P-1, LAB-SBW-01, LAB-SBW-02, LAB-SBW-03, LAB-SBW-04, LAB-SBW-05, LAB-OBW-01, LAB-DBW-01, GMX-MW-3, and GMX-MW-4 at discrete depths. The PDB depth placement will be determined based on the findings during installation of the four new bedrock monitoring wells. If warranted based on apparent bedrock fracture locations, multiple PDBs may be installed in a single well. Immediately prior to retrieving the samples, an oil-water interface probe will be used to check for the presence of light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) in each well. A minimum of two weeks following placement of the PDBs, the PDBs will be retrieved and the groundwater analyzed for CP-51 and TCL VOCs.

Investigation Derived Waste

Soil/fill and water encountered and derived during the work described herein will be handled in accordance with the approved RIWP. Material will be containerized and disposed of pending the appropriate analytical sampling and permit issuance.

Health and Safety and Community Air Monitoring

All fieldwork will be completed in accordance with the previously approved Health and Safety Plan and Community Air Monitoring Program as described in the NYSDEC approved RI Work Plan.

Reporting

Data and findings from this investigation will be included in a Remedial Investigation Report along with the work completed under the approved RIWP to date. In addition, a Feasibility Study will be completed to evaluate remedial alternatives for the P-1 plume.

If you have any questions, please do not hesitate to contact me at (585) 295-6611.

Sincerely,

LABELLA ASSOCIATES, D.P.C.

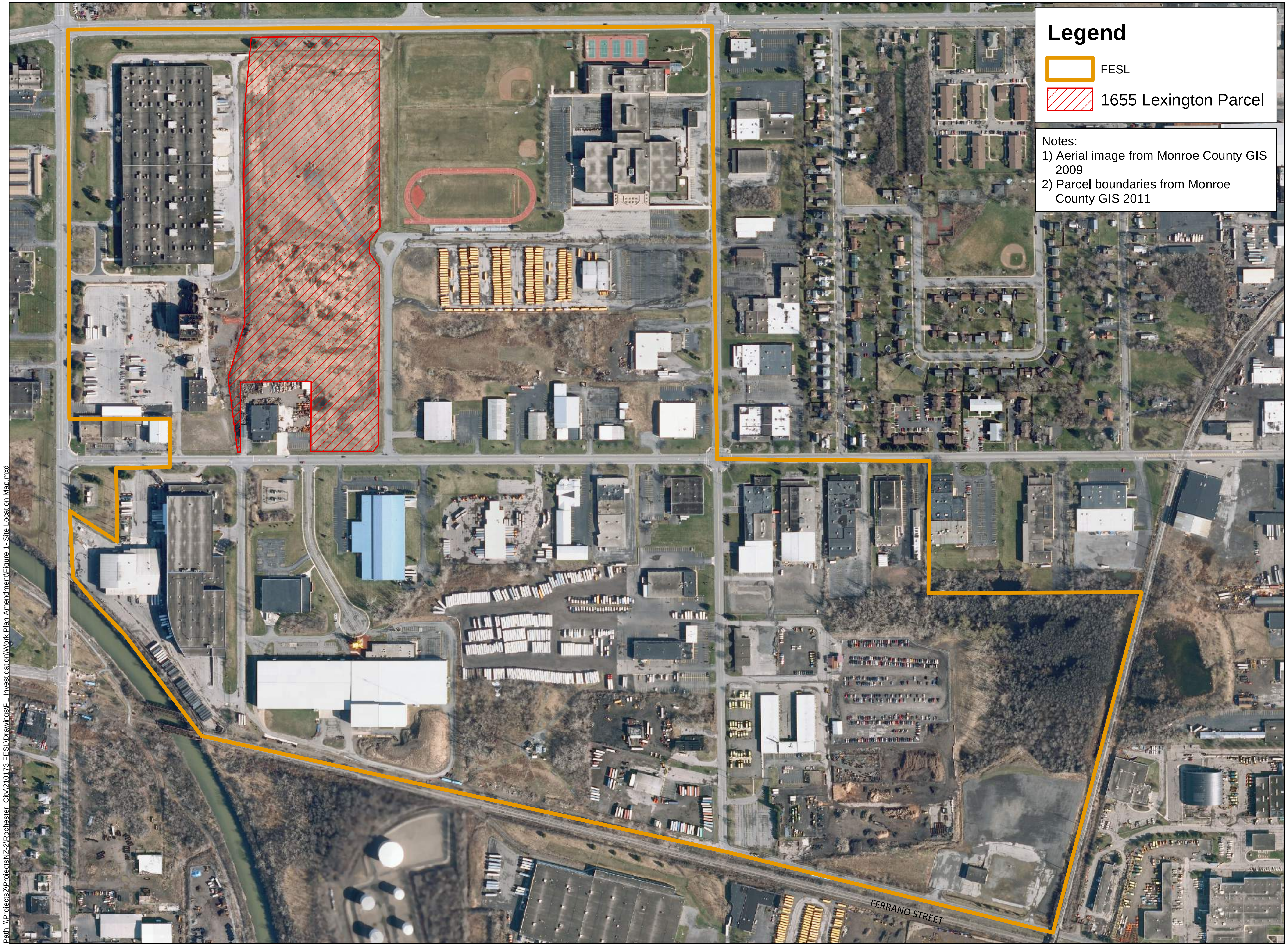
Daniel P. Noll, P.E.
Project Manager

DPN/dk

cc: J. Biondolillo – City of Rochester
R. Frappa - GEI

Figure 1: Site Location Map
Figure 2: Existing Monitoring Well Locations
Figure 3: Proposed Testing Locations
Figure 4: Chlorinated VOCs in Overburden Soil
Figure 5: Chlorinated VOCs in Groundwater
Table 1A: Bedrock Core Properties and Estimated Pore Water Concentrations
Table 1B: Pore Water Concentrations References and Calculations
Attachment 1: Well Construction Diagram

Figures



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P-1 REMEDIAL INVESTIGATION WORK PLAN AMENDMENT

Site Location Map

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FIGURE 1

Path: \\Projects2\ProjectsNZ-2\Rochester, City\210173 FESL\Drawings\P1 Investigation\Work Plan Amendment\Figure 1- Site Location Map.mxd

1 inch = 80 feet

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Path: \\Projects2\ProjectsNZ-2\Rochester, City\210173 FESL\Drawings\P1 Investigation\Work Plan Amendment\Figure 2- Existing Monitoring Well Locations.mxd

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P-1 REMEDIAL INVESTIGATION WORK PLAN AMENDMENT

Existing Monitoring Well Locations

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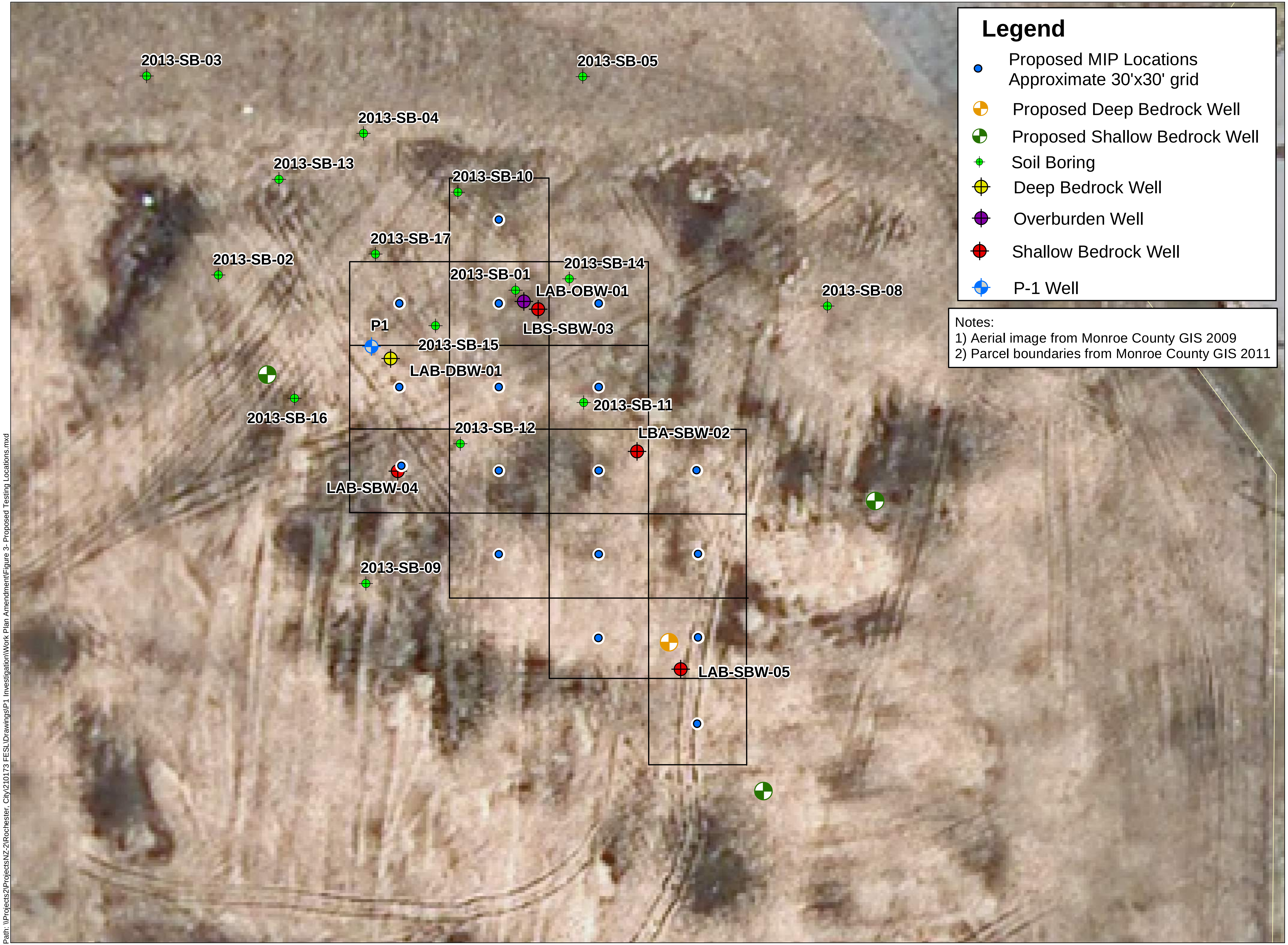
FIGURE 2



Path: \\Projects2\ProjectsNZ-2\Rochester, City\210173 FESL\Drawings\P1 Investigation\Work Plan Amendment\Figure 3- Proposed Testing Locations.mxd

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P-1 REMEDIAL INVESTIGATION WORK PLAN AMENDMENT

Proposed Testing Locations

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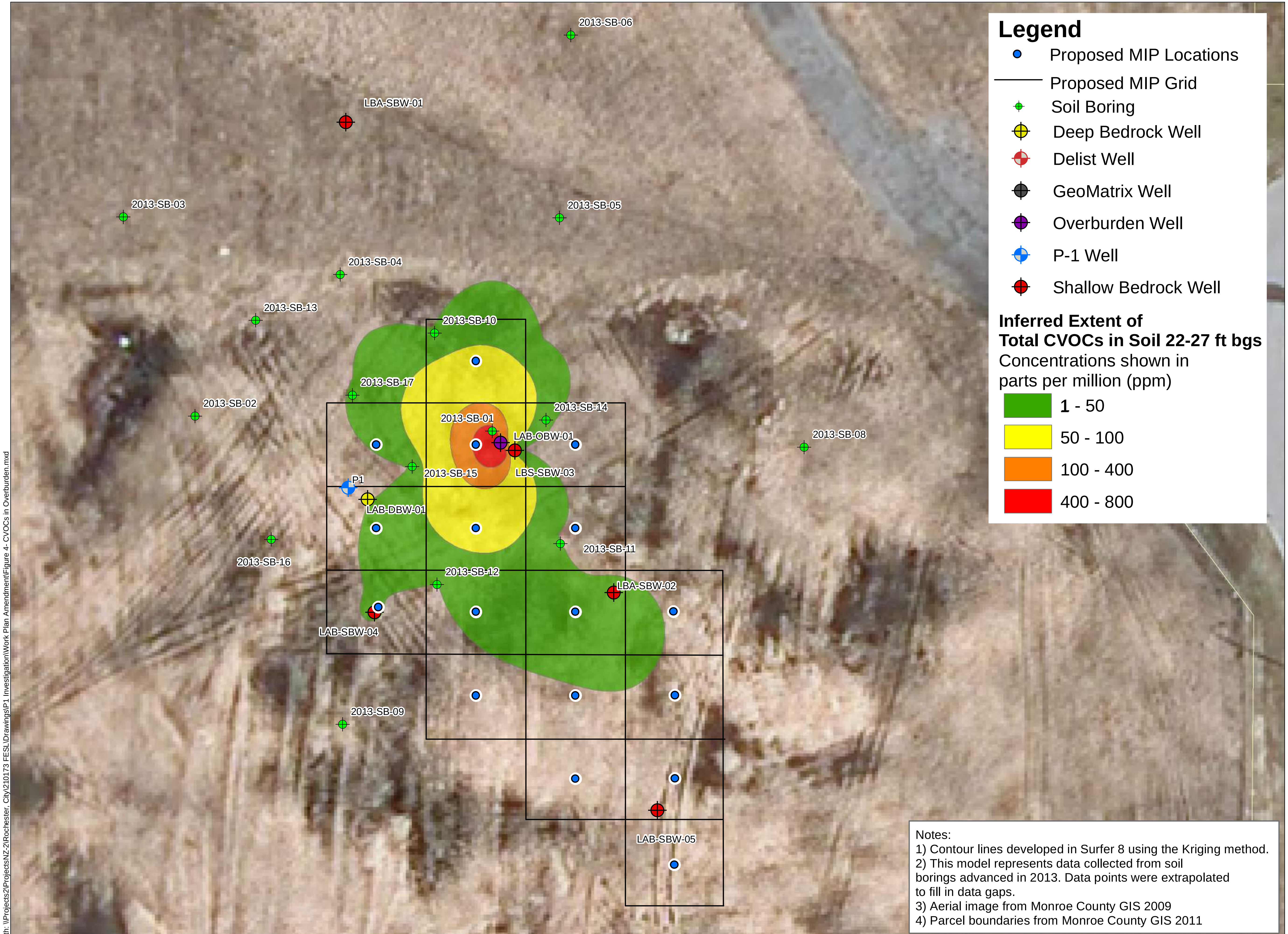
FIGURE 3



Notes:
1) Contour lines developed in Surfer 8 using the Kriging method.
2) This model represents data collected from soil borings advanced in 2013. Data points were extrapolated to fill in data gaps.
3) Aerial image from Monroe County GIS 2009
4) Parcel boundaries from Monroe County GIS 2011

Path: \\Projects2\ProjectsNZ-2\Rochester, City\210173 FESL\Drawings\P1 Investigation\Work Plan Amendment\Figure 4- CVOCs in Overburden.mxd

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P-1 REMEDIAL INVESTIGATION WORK PLAN AMENDMENT

Chlorinated VOCs in Overburden Soil

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1 inch = 30 feet

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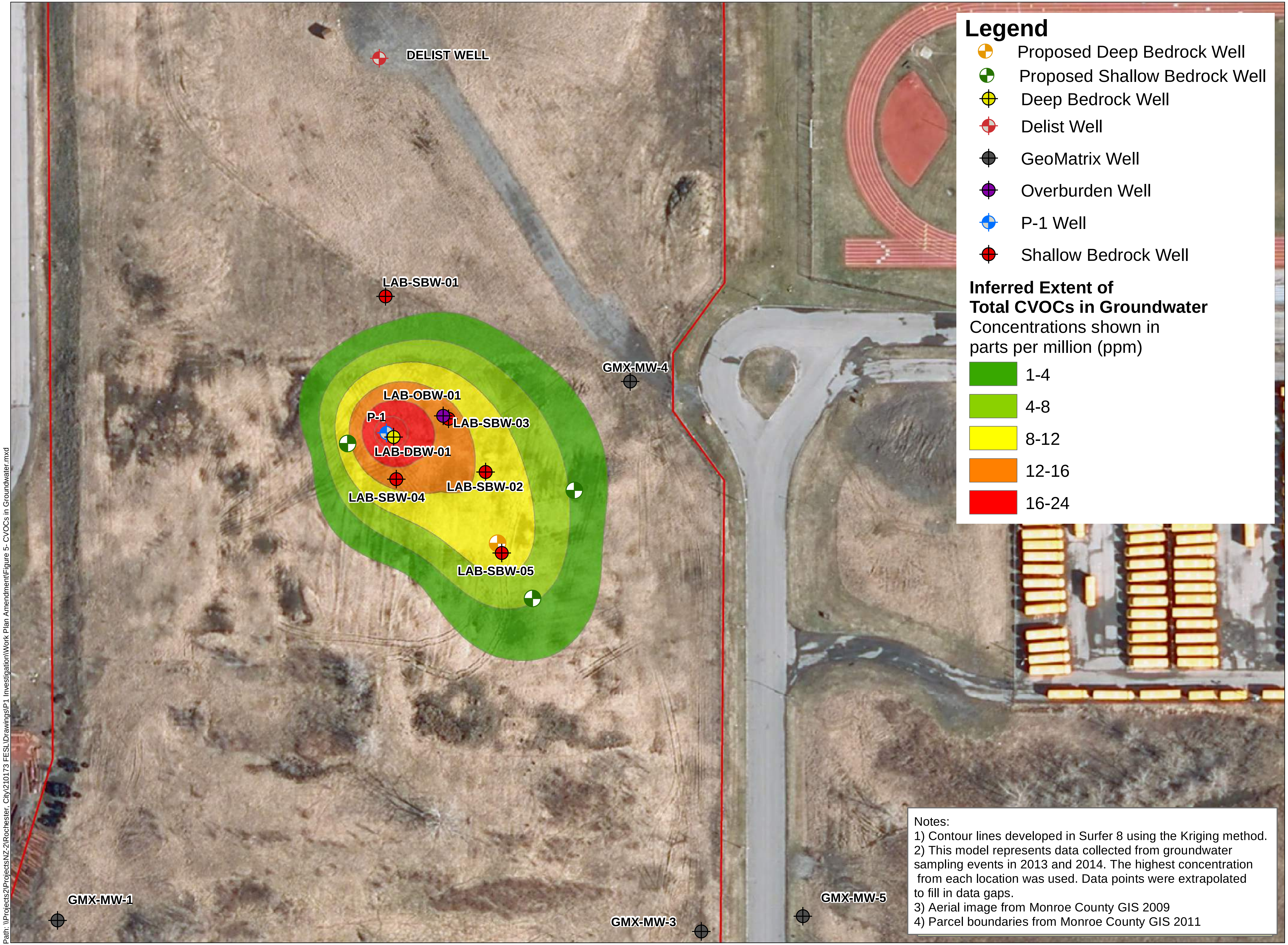
FIGURE 4



Path: \\Projects2\Projects\Z-2\Rochester, City\210173 FESL\Drawings\P1 Investigation\Work Plan Amendment\Figure 5- CVOCs in Groundwater.mxd

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Chlorinated VOCs in Groundwater

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1 inch = 80 feet

Intended to print on 11x17

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FIGURE 5

TABLE 1A
BEDROCK CORE PROPERTIES AND ESTIMATED POREWATER CONCENTRATIONS
Former Emerson Street Landfill
Rochester, New York

Sample Name and Depth Interval	Analyte	Lab Reported Concentration (wet weight, ug/kg)	Lab Qualifier	LOQ (ug/kg)	Dilution	Rock Concentration (ug/g)	K_{oc} (1) (cm^3/g)	Porosity(1)	f_{oc} (1)	Dry Bulk Density (1) (g/cm^3)	Wet Bulk Density (g/cm^3)	R(1)	Estimated Rock Matrix Pore Water Concentration (ug/L)	Compound Solubility (ug/L)	DNAPL Indicator (Y or N) (2)
LAB-DBW-1 (26.5-26.75')	cis-1,2-Dichloroethene	3600	H		10	3.6	86	0.088	0.00027	2.51	2.56	1.66	63,089	3,500,000	N
LAB-DBW-1 (26.5-26.75')	Tetrachloroethene	41000	H	120	10	41	364	0.088	0.00027	2.51	2.56	3.80	313,876	200,000	Y
LAB-DBW-1 (26.5-26.75')	Trichloroethene	2000	J H	97	10	2	126	0.088	0.00027	2.51	2.56	1.97	29,534	1,100,000	N
LAB-DBW-1 (33.2-33.55')	cis-1,2-Dichloroethene	76	J H	6.9	1	0.076	86	0.088	0.00027	2.51	2.56	1.66	1,332	3,500,000	N
LAB-DBW-1 (33.2-33.55')	Tetrachloroethene	55	J H	12	1	0.055	364	0.088	0.00027	2.51	2.56	3.80	421	200,000	N
LAB-DBW-1 (33.2-33.55')	Trichloroethene	13	J H	9.7	1	0.013	126	0.088	0.00027	2.51	2.56	1.97	192	1,100,000	N
LAB-DBW-1 (43.8-44.1')	Tetrachloroethene	18	J H	12	1	0.018	364	0.088	0.00027	2.51	2.56	3.80	138	200,000	N
LAB-DBW-1 (54.4-54.7')	Tetrachloroethene	16	J H	12	1	0.016	364	0.088	0.00027	2.51	2.56	3.80	122	200,000	N
LAB-SBW-2 (25.75-26.05')	cis-1,2-Dichloroethene	22000	H	86	12.5	22	86	0.088	0.00027	2.51	2.56	1.66	385,542	3,500,000	N
LAB-SBW-2 (25.75-26.05')	Tetrachloroethene	1700	J H	150	12.5	1.7	364	0.088	0.00027	2.51	2.56	3.80	13,014	200,000	N
LAB-SBW-2 (25.75-26.05')	Trichloroethene	89000	H	120	12.5	89	126	0.088	0.00027	2.51	2.56	1.97	1,314,259	1,100,000	Y
LAB-SBW-2 (30.7-31')	Trichloroethene	52	J H	9.7	1	0.052	126	0.088	0.00027	2.51	2.56	1.97	768	1,100,000	N
LAB-SBW-3 (25.2-25.6')	1,1,1-Trichloroethane	2000	H	21	1	2	152	0.088	0.00027	2.51	2.56	2.17	26,812	1,300,000	N
LAB-SBW-3 (25.2-25.6')	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	4100	H	39	1	4.1	200	0.088	0.00027	2.51	2.56	2.54	46,958	170,000	N
LAB-SBW-3 (25.2-25.6')	1,1-Dichloroethane	260	H	17	1	0.26	30	0.088	0.00027	2.51	2.56	1.23	6,149	510,000	N
LAB-SBW-3 (25.2-25.6')	1,1-Dichloroethene	130	J H	18	1	0.13	65	0.088	0.00027	2.51	2.56	1.50	2,520	3,350,000	N
LAB-SBW-3 (25.2-25.6')	1,4-Dichlorobenzene	8	J H	8	1	0.008		0.088	0.00027	2.51	2.56	1.57	148	738,000	N
LAB-SBW-3 (25.2-25.6')	cis-1,2-Dichloroethene	1200	H	6.9	1	1.2	86	0.088	0.00027	2.51	2.56	1.66	21,030	3,500,000	N
LAB-SBW-3 (25.2-25.6')	Tetrachloroethene	5600	H	12	1	5.6	364	0.088	0.00027	2.51	2.56	3.80	42,871	200,000	N
LAB-SBW-3 (25.2-25.6')	trans-1,2-Dichloroethene	27	J H	9.2	1	0.027	59	0.088	0.00027	2.51	2.56	1.45	542	6,300,000	N
LAB-SBW-3 (25.2-25.6')	Trichloroethene	1500	H	9.7	1	1.5	126	0.088	0.00027	2.51	2.56	1.97	22,150	1,100,000	N
LAB-SBW-3 (25.2-25.6')	Vinyl chloride	46	J H	18	1	0.046	56	0.088	0.00027	2.51	2.56	1.43	936	2,700,000	N
LAB-SBW-3 (29.1-29.35')	1,1-Dichloroethane	21	J H	17	1	0.021	30	0.088	0.00027	2.51	2.56	1.23	497	510,000	N
LAB-SBW-3 (29.1-29.35')	Trichloroethene	18	J H	9.7	1	0.018	126	0.088	0.00027	2.51	2.56	1.97	266	1,100,000	N
LAB-SBW-4 (25-25.2')	1,1-Dichloroethane	200	J H	17	1	0.2	30	0.088	0.00027	2.51	2.56	1.23	4,730	510,000	N
LAB-SBW-4 (25-25.2')	1,1-Dichloroethene	21	J H	18	1	0.021	65	0.088	0.00027	2.51	2.56	1.50	407	3,350,000	N

TABLE 1A
BEDROCK CORE PROPERTIES AND ESTIMATED POREWATER CONCENTRATIONS
Former Emerson Street Landfill
Rochester, New York

Sample Name and Depth Interval	Analyte	Lab Reported Concentration (wet weight, ug/kg)	Lab Qualifier	LOQ (ug/kg)	Dilution	Rock Concentration (ug/g)	K_{oc} (1) (cm^3/g)	Porosity(1)	f_{oc} (1)	Dry Bulk Density (1) (g/cm^3)	Wet Bulk Density (g/cm^3)	R(1)	Estimated Rock Matrix Pore Water Concentration (ug/L)	Compound Solubility (ug/L)	DNAPL Indicator (Y or N) (2)
LAB-SBW-4 (25-25.2')	cis-1,2-Dichloroethene	2000	H	6.9	1	2	86	0.088	0.00027	2.51	2.56	1.66	35,049	3,500,000	N
LAB-SBW-4 (25-25.2')	Trichloroethene	1200	H	9.7	1	1.2	126	0.088	0.00027	2.51	2.56	1.97	17,720	1,100,000	N
LAB-SBW-4 (25-25.2')	Vinyl chloride	76	J H	18	1	0.076	56	0.088	0.00027	2.51	2.56	1.43	1,546	2,700,000	N
LAB-SBW-5 (24.5-24.75')	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	77	J H	39	1	0.077	200	0.088	0.00027	2.51	2.56	2.54	882	170,000	N
LAB-SBW-5 (24.5-24.75')	1,1-Dichloroethane	180	J H	17	1	0.18	30	0.088	0.00027	2.51	2.56	1.23	4,257	510,000	N
LAB-SBW-5 (24.5-24.75')	cis-1,2-Dichloroethene	480	H	6.9	1	0.48	86	0.088	0.00027	2.51	2.56	1.66	8,412	3,500,000	N
LAB-SBW-5 (24.5-24.75')	trans-1,2-Dichloroethene	15	J H	9.2	1	0.015	59	0.088	0.00027	2.51	2.56	1.45	301	6,300,000	N
LAB-SBW-5 (24.5-24.75')	Trichloroethene	110	J H	9.7	1	0.11	126	0.088	0.00027	2.51	2.56	1.97	1,624	1,100,000	N
LAB-SBW-5 (30.3-30.35')	1,1,1-Trichloroethane	5700	H	260	12.5	5.7	152	0.088	0.00027	2.51	2.56	2.17	76,414	1,300,000	N
LAB-SBW-5 (30.3-30.35')	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	16000	H	490	12.5	16	200	0.088	0.00027	2.51	2.56	2.54	183,250	170,000	Y
LAB-SBW-5 (30.3-30.35')	1,1-Dichloroethane	2200	J H	210	12.5	2.2	30	0.088	0.00027	2.51	2.56	1.23	52,033	510,000	N
LAB-SBW-5 (30.3-30.35')	cis-1,2-Dichloroethene	2100	J H	86	12.5	2.1	86	0.088	0.00027	2.51	2.56	1.66	36,802	3,500,000	N
LAB-SBW-5 (30.3-30.35')	Tetrachloroethene	60000	H	150	12.5	60	364	0.088	0.00027	2.51	2.56	3.80	459,330	200,000	Y
LAB-SBW-5 (30.3-30.35')	Trichloroethene	23000	H	120	12.5	23	126	0.088	0.00027	2.51	2.56	1.97	339,640	1,100,000	N

Notes:
(1) See Notes, Table 1B for references and calculations.
(2) Highlighted cells indicate liklihood of DNAPL presence or DNAPL disappearance through matrix diffusion based on estimated rock core matrix porewater concentration greater than the compound solubility.

TABLE 1B
POREWATER CONCENTRATION REFERENCES AND CALCULATIONS
Former Emerson Street Landfill
Rochester, New York

Formulas and data sources for information on Table 1A:

$$C_{aq} = \frac{C_s \ \rho_{b(wet)}}{\theta R}$$

Where:

C_{aq} is the estimated aqueous concentration (g contaminant/cm^3)
Cs is the total matrix mass concentration (g contaminant/g rock)
$\rho_{b\,(wet)}$ is the wet bulk density (g rock/cm^3)
θ is the matrix porosity
R is the partitioning coefficient

$$R = \frac{1 + \rho_{b(dry)} \ K_{oc} \ f_{oc}}{\theta}$$

Where:

R is the partitioning coefficient
$\rho_{b\,(dry)}$ is the dry bulk density (g/cm^3)
K_{oc} is the soil organic carbon/ water partitioning coefficient (cm^3/g)
f_{oc} is the fraction of organic carbon (g organic carbon/ g bulk)
θ is the matrix porosity

Formulas from: Kennel, J.R. 2008: Advances in Rock Core Analyses for High Resolution Characterization of Chlorinated Solvent Contamination in a Dolostone Aquifer.

Summary of Chemical and Rock Properties

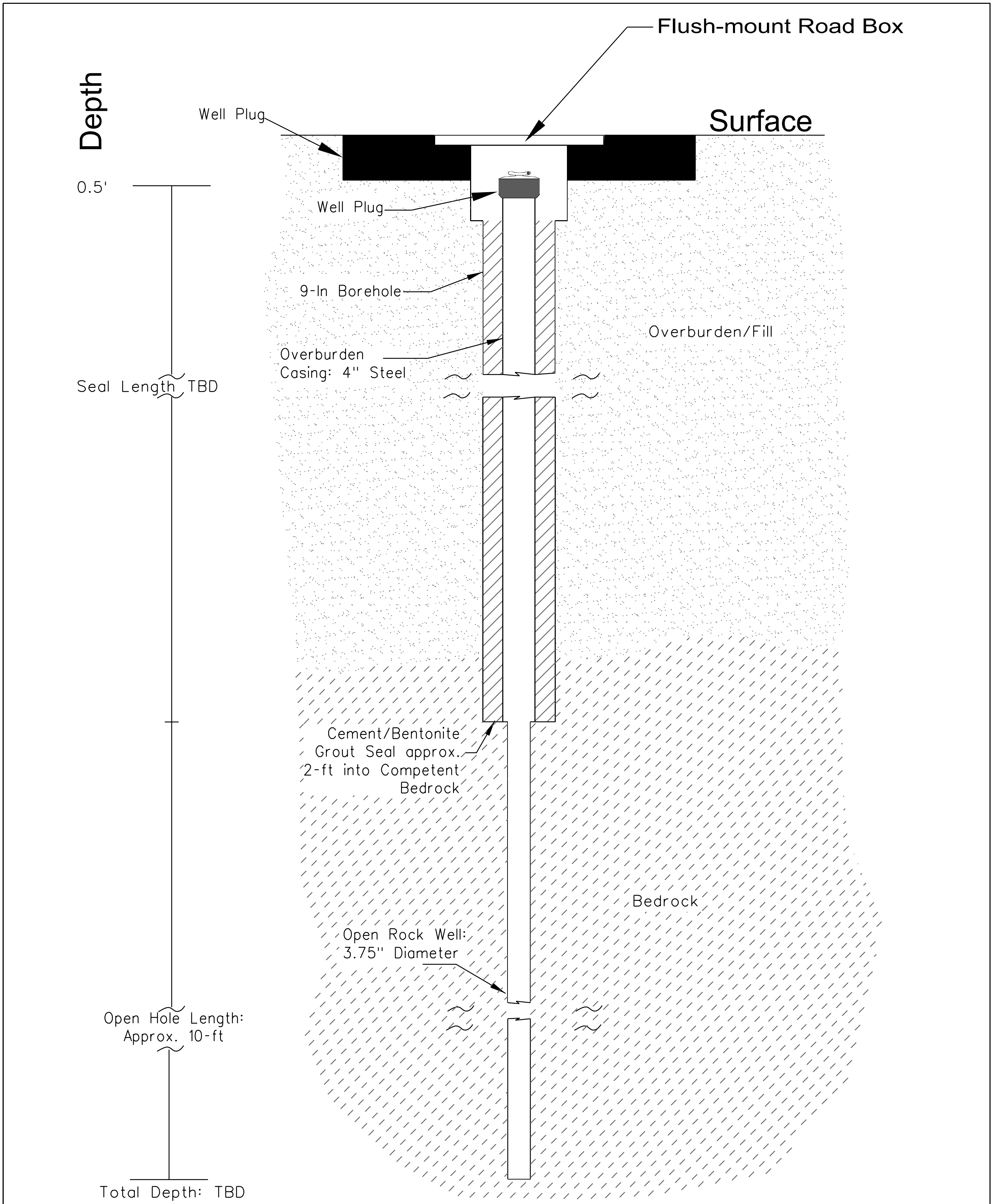
Chlorinated VOC	K_{oc} (mL/g)	Porosity (θ)	f_{oc}	Bulk Density (ρ_b)	R
Sources of Data:	1	2	2	2	calculated
1,1,2-Trichloro-1,2,2-trifluoroethane (3)	200	0.088	0.00027	2.51	2.540
1,1,1-Trichloroethane	152	0.088	0.00027	2.51	2.171
1,1-Dichloroethane	30	0.088	0.00027	2.51	1.231
1,4-Dichlorobenzene	74	0.088	0.00027	2.51	1.570
cis-1,2-Dichloroethene	86	0.088	0.00027	2.51	1.662
Tetrachloroethene	364	0.088	0.00027	2.51	3.803
trans-1,2-Dichloroethene	59	0.088	0.00027	2.51	1.454
Trichloroethene	126	0.088	0.00027	2.51	1.970
Vinyl chloride	56	0.088	0.00027	2.51	1.431

1. From Table A1 - Summary of Physical and Chemical Properties of DNAPL Compounds at 25 ^{o}C Dense Chlorinated Solvents and other DNAPLS in Groundwater (Pankow and Cherry, 1996).

2. Ajmera, T. K., 2010. Site Investigation and Modelling of DNAPL Migration in Fractured Porous Media, University of Waterloo Thesis - Table 2.11 Lockport Group, Lockport Formation, Gasport Member Properties.

3. K_{oc} from National Center for Biotechnology Information (NCBI).

Attachment 1
Well Construction Diagram



FIGURE

TYPICAL MONITORING WELL DESIGN DIAGRAM

PROJECT #: 210173

CLIENT: CITY OF ROCHESTER

DRAWN BY: IPJ

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