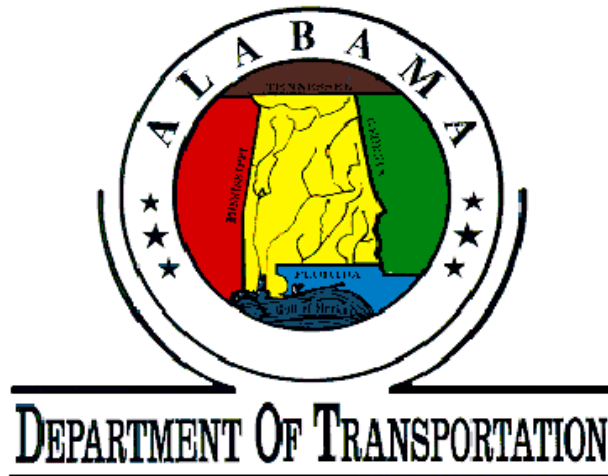


Addendum 14
Additional Site-Wide Investigation

**Coliseum Boulevard
Plume Investigation**



February 23, 2004

Submitted to:
The Alabama Department of Environmental Management
Montgomery, Alabama



Addendum 14

Additional Site-Wide Investigations

February 13, 2004

INTRODUCTION

The following Work Plan is Addendum 14 to the February 2001 Work Plan for Rapid Response, Interim Corrective Measures, and Comprehensive Site Assessment. The purposes of the work elements contained within this Addendum are to:

- Quantify, via aquifer testing, the hydrogeologic characteristics of the first water-bearing zone near the confluence of the west Kilby Ditch with the main Kilby Ditch.
- Quantify, via aquifer testing, the hydrogeologic characteristics of the first water-bearing zone in the southwest quadrant of the Coliseum Boulevard Plume (CBP) Site.
- Construct “nested” monitoring wells to characterize the vertical distributions of TCE and hydraulic gradients in selected areas within the CBP Site.
- Delineate the outmost boundaries of the TCE plume in selected areas.
- Delineate a “lobe” of TCE that is outside the Probehole 12 Area.
- Verify the horizontal extent of the area that has been determined to contain at least 10,000 parts per billion (ppb) of dissolved trichloroethylene (TCE) within the Probehole 12 Area.
- Characterize further the horizontal and vertical distributions of dissolved TCE within the area encompassed by the 10,000 ppb contour of the Probehole 12 Area.
- Evaluate the concentrations of TCE within the 10,000 ppb contour to assess zones and/or areas that might contain residual TCE.



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RATIONALE FOR SITE-WIDE TEST LOCATIONS

Aquifer Tests

Two aquifer tests will be conducted as part of the site-wide investigations. One of the test sites will be approximately 500 feet east-northeast of the original Kilby Ditch aquifer test. The results of this aquifer test are needed to characterize the hydrogeology of the first water-bearing zone in this area because there can be discharge of groundwater containing TCE into the Kilby Ditch. While the TCE concentrations are less than the established action levels at the surface water compliance points, it is important to predict if the concentrations will exceed the action level. Information from the aquifer test will also be used in evaluating relevant remedial alternatives should the TCE exceed the action level at the compliance points.

The second aquifer test will be in the southwest quadrant of the CBP site where there is a general lack of information on the characteristics of the aquifer and where groundwater flow can be affected by pumping from both production wells and borrow pits. These effects may extend as far as the Probehole 12 area. By obtaining more accurate measurements of the aquifer characteristics, the influence of this pumping on the plume behavior can be evaluated, as well as possible changes in plume distribution should the current withdrawal rates change in the future.

Both aquifer test sites will consist of one production well, two nested observation wells, and some existing monitoring wells. The nested wells will consist of up to three wells installed in each borehole. The two nested observation wells for the northeast test well site will consist of two wells: one screened near the top of the shallow aquifer and one screened near the base of the aquifer. The nested observation wells for the southwest test well site will consist of three wells: one screened near the top of the shallow aquifer, one near the middle of the aquifer, and one near the base of the aquifer. Exact screen depths and distances from each production well will be established in the field after the production well is constructed. The estimated construction details of these wells are summarized in Table 1.

For the Kilby Ditch aquifer test, groundwater levels in existing monitoring well clusters MW101/201, MW102/202, and MW103/203 and proposed nested well MW-143/243 will be measured and used in the aquifer test evaluation. Groundwater levels in monitoring wells MW-133 and MW-233 will be measured during the test to document background water level changes outside the influence of the aquifer test.



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For the aquifer test in the southwestern portion of the CBP site, groundwater levels in existing monitoring well clusters MW111/211, and MW117/217 will be measured and used in the aquifer test evaluation. Groundwater levels in monitoring wells MW-123 and MW-223 will be measured during the test to document background water level changes outside the influence of the aquifer test.

Monitoring Wells

Plate 1 shows the proposed locations of seven additional monitoring wells. These locations are based on evaluation of the results of the Addendum 11 probehole sampling that was northeast of the Probehole 12 area. Measurements of groundwater elevations at these sites will provide additional information on the extent of the plume and groundwater gradients at the CBP site. All but one of the monitoring-well locations will contain nested wells. The proposed construction details for these wells are summarized in Table 2.

The proposed location for the single, new, monitoring well is within a cul-de-sac that is south of Gibson Street, east of Barksdale Street, and west of Texas Street. Measurements of groundwater elevations at this location will be used to further assess the location of the groundwater divide in this area, and to calibrate the site-wide groundwater model.

Nested wells will be constructed at the remaining six locations. The three nested wells in the northeast quadrant will consist of only two wells in each borehole because the aquifer thickness in this quadrant is not sufficient to justify three wells per borehole. One well will be screened near the top of the shallow aquifer and the other well will be screened near the base of the shallow aquifer. As discussed below, a minimum three-foot thick layer of bentonite will separate the screened intervals of the nested wells in each borehole. These three well locations will be used to obtain time-trend data on the concentrations of TCE in the groundwater upgradient of the Kilby Ditch.

The three remaining nested wells--located on Ferndale Court, Woodbury Court, and the cul-de-sac south of Powell Lane (between East Street and Fairground Road)--will consist of three wells per borehole. The locations on Ferndale and Woodbury Court are in an area northeast of the Probehole 12 area where TCE concentrations exceed 5 mg/L. These two nested wells will provide time-trend data for the TCE concentrations within this area



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of higher TCE concentrations. The third nested-well location, south of Powell Lane, is generally along the projection of the southern axis of the Probehole 12 Area. This nested well will provide water elevation and quality data in the area south of the southernmost sampling location (LOC-46). Within each borehole, the uppermost well will be constructed in the fine- to coarse-grained sand and gravel unit (Layer 3) that is near the top of the shallow aquifer. The middle well will be constructed in the fine-grained glauconitic sand (Layer 4) and the lower well will be constructed in the fine- to medium-grained glauconitic sand (Layer 5) at the base of the shallow aquifer.

Site-Wide Probeholes

Groundwater samples will be collected from additional probeholes that will be driven outside of the Probehole 12 area (see Plate 1). Table 3 summarizes the approximate locations and expected depths to the water table and to the first restrictive clay at each of these proposed probeholes. Eight of these probeholes will be used to delineate the boundary of the TCE plume: four in the northeast quadrant, three in the southeast quadrant, and one in the northwest quadrant near the Brockway Glass Plant.

The remaining three probeholes are within the plume. One of the probeholes will be northeast of PH-87 (Gardendale Drive) and will provide better definition of the area where TCE concentrations exceed 5 mg/L to the northeast of the Probehole 12 area. The other two probeholes will be on Vandiver Court and Shelly Court, which are northeast of the Probehole 12 area, and will be used to delineate an apparent "lobe" of TCE that exceeds 200 µg/L.

SUPPLEMENTAL PROBEHOLE 12 AREA CHARACTERIZATION

Additional probeholes will be drilled to characterize the Probehole 12 area where TCE concentrations have exceeded 10,000 micrograms per liter (µg/l) (Figure 1). This area is generally on the western side of Fairground Road and between Chisholm and Houser Streets. These additional probeholes will be driven on private property after obtaining access from property owners. Data from these probeholes will be used to better define subsurface conditions and verify concentrations predicted between the samples collected on public right-of-way. A soil conductivity/membrane interface probe (MIP) will be advanced to the top of the first restrictive clay layer, which is approximately 60 to 70 feet



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below ground surface. The MIP results will be used to characterize relative concentrations of TCE in the shallow aquifer and to select locations for probeholes, which will be subsequently drilled to collect depth-discrete soil and groundwater samples for analysis of TCE and other parameters. To correlate MIP results to laboratory analytical results, probehole locations will be selected in areas where MIP results indicate relatively low, moderate, and high TCE concentrations.

At each selected probehole location, groundwater samples will be collected for VOC analysis in continuous, four-foot intervals from the water table to the top of the first restrictive clay layer. Up to two soil samples will be collected in each probehole and analyzed for VOCs, total organic carbon (TOC), and grain-size distribution. The drilling and sampling methods for this supplemental investigation are further discussed below.

This additional work in the Probehole 12 area will include further characterization of the stratigraphy, groundwater flow, and distribution of TCE concentrations to include an area designated "Pilot Test Area A" (Figure 2). This Area has been tentatively identified for a partitioning inter-well tracer test (PITT) and fluid-flushing pilot test. (The basis and scope of the pilot tests, which will be conducted to evaluate corrective measures for the Probehole 12 Area, will be provided under a subsequent Addendum.) A soil-conductivity/MIP probe will be advanced at each of the locations shown on Figure 2. Each probehole will be driven to collect continuous groundwater samples at four-foot intervals from the water table to the top of the first restrictive clay layer. Up to two soil samples will be collected in each of these probeholes and analyzed for VOCs, TOC, and grain size distribution. Based on field observations, at the direction of the field geologist, additional soil samples may be collected. Soil sampling methods are discussed in the following section.

After the probehole work is completed in Pilot Test Area A, nested wells will be installed at two locations in this Area to provide baseline groundwater data and for use in monitoring pilot tests. Figure 3 shows the locations of these nested wells and Table 4 summarizes the estimated material quantities of these wells. The methods for drilling and installing nested monitoring wells are summarized in the following section. The nested wells in Pilot Test Area A will consist of three two-inch PVC wells: one screened across the water table (within the sand and gravel layer); one screened in the upper ten feet of the lower glauconitic silty sand layer; and one screened in the lower ten feet of the first



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water-bearing zone (at the top of the first restrictive clay layer). This clay layer is approximately 55 to 65 feet below ground surface (bgs) in this area.

METHODOLOGY

The procedures for sample collection and data interpretation will be consistent with the ADEM-approved February 2001 Work Plan and subsequent Addenda. Appropriate health and safety protocols, as defined in the February 2001 Work Plan, will be followed while conducting the field activities.

Pumping Wells and Observations Wells

The scope of work for Addendum 14 will include aquifer testing to acquire data with which to support the development of a site-wide groundwater model. Observation wells will be installed for these tests and will be constructed using the procedures in section 3.2 of Addendum 10-Revision 1, which was approved by ADEM. Pumping wells will be constructed in the same manner as Addendum 10 – Revision 1, except that the well material will consist of nominal four-inch (4.28-inch inside diameter) SDR-17 PVC which will permit the use of up to a four-inch diameter pump.

Probeholes

The scope of work for Addendum 14 will include driving additional probeholes at the Coliseum Boulevard Plume Site and in the Probehole 12 area to characterize the geology and to collect groundwater and sediment samples for analyses. The analytical data will be used to further delineate the extent of VOCs in groundwater. Prior to driving probeholes, a soil-conductivity/MIP probe will be advanced using direct-push methods in accordance with the procedures described in the Addendum 03 Scope of Work, which was approved by ADEM. Based on the results of the soil-conductivity/MIP probes, direct-push methods will be used to advance probeholes and collect depth-discrete groundwater and soil samples in accordance with the Addendum 03 Scope of Work. Groundwater samples will be collected in four-foot continuous intervals from the water table to the top of the first restrictive clay layer. A field geologist will describe the lithology of the soil cores and screen them for VOCs with a photoionization detector (PID). Soil sampling intervals will be selected based on MIP results and field



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measurements and observations. The aliquot of each sample to be analyzed for VOCs will be preserved in the field using USEPA Method 5035.

Monitoring Wells

Permanent monitoring wells will be installed to supplement the existing site-wide monitoring well network and obtain initial characterization data in the Pilot Test Area A. The single monitoring well proposed in the southern portion of the CBP site (MW-145A; see Plate 1) will be constructed in accordance with the procedures approved by ADEM in Section 2.4.2 of Addendum 10 – Revision 1. The remaining site-wide wells, the aquifer-test observation wells, and the initial characterization wells in Pilot Test Area A will be constructed as nested wells. These will consist of two or three wells in a single borehole. Compared to cluster wells (with up to three separate boreholes), this well design is a more efficient use of the limited space available in the majority of the proposed locations.

The boreholes for the nested wells will be drilled with sonic methods using a 10-inch temporary casing. Monitoring wells will consist of two-inch diameter Schedule 40 PVC, with 0.01-inch machine-slot screens. Screens that intersect the water table will be a maximum of 10 feet long, and screens that are below and do not intersect the water table will be a minimum of five feet long. The filter pack around each screen will extend a minimum of one-foot above and below the screen openings. A minimum three-foot bentonite seal will be placed above each well screen to limit vertical flow within the borehole annulus. Figure 4 shows a diagram of the proposed nested monitoring well construction. These wells will be developed in accordance with the procedures in Addendum 10 – Revision 1.

**TABLE 1
PROPOSED ADDENDUM 14 SITE-WIDE MONITORING WELLS
APPROXIMATE MATERIAL QUANTITIES**

Proposed Well ID	Approximate Location	Closest Boring	Approximate Depth to First Restrictive Clay (feet bgs)	Approximate Depth to Water Table (feet bgs)	Estimated Well Depth (feet bgs)	Screen Length (feet)	Estimated Screen Interval (feet bgs)	Well Diameter (inches)	Well Material
MW-139A	Ferndale Ct and Gardendale Dr.	PH-87	39	16	23	10	13 to 23	2	PVC
MW239B					30	5	25 to 30	2	PVC
MW239C					39	5	34 to 39	2	PVC
MW-140A	Woodbury Ct and Gardendale Dr.	PH-116	36	12	19	10	9 to 19	2	PVC
MW240B					28	5	23 to 28	2	PVC
MW240C					36	5	31 to 36	2	PVC
MW-141A	Kilby Ditch and Coliseum Blvd	PH-42 & PH-98	35	18	25	10	15 to 25	2	PVC
MW-241B					35	5	30 to 35	2	PVC
MW-142A	South of East Kilby Ditch - East of Coliseum Blvd.	PH-44	35	13	20	10	10 to 20	2	PVC
MW-242B					35	10	25 to 35	2	PVC
MW-143A	North Side of East Kilby Ditch	PH-111 & PD-105	24	12	19	10	9 to 19	2	PVC
MW-243B					24	5	19 to 24	2	PVC
MW-144A	Culdesac of Powell Lane Between Fairground Road and East St.	LOC-46	65	25	32	10	22 to 32	2	PVC
MW244B					50	10	40 to 50	2	PVC
MW244C					65	10	55 to 65	2	PVC
MW-145A	Culdesac off Gibson St	N/A	60	25	32	10	22 to 32	2	PVC

**TABLE 2
PROPOSED ADDENDUM 14 SITE-WIDE PROBEHOLES
APPROXIMATE MATERIAL QUANTITIES**

Proposed Well ID	Approximate Location	Closest Boring	Approximate Depth to Water Table (feet bgs)	Approximate Depth to First Restrictive Clay (feet bgs)
LOC-46	Ferndale Ct and Gardendale Dr.	PH-88	16	40
LOC-47	North of Northern Blvd. (west location)	PH-50	7	30
LOC-48	North of Northern Blvd. (east location)	PH-50	7	30
LOC-49	East of Emory Folmer Blvd. (north location)	MW-116/2116	9	40
LOC-50	East of Emory Folmer Blvd. (south location)	MW-116/2116	9	40
LOC-51	Texas St.	MW-123/223	23	70
LOC-52	Culdesac north of Yarborough St.	MW-111/211/311	35	80
LOC-53	Culdesac on Cedar Pl.	PH-32 & PZ-15	40	80
LOC-54	Rotary St.	MW-115/215	18	42
LOC-55	Culdesac North of Shelly Ln.	PH-22 & PZ-8	17	44
LOC-56	Vandiver Ct.	PH-22 & PZ-8	17	44


**TABLE 3
PROPOSED ADDENDUM 14 PRODUCTION AND OBSERVATION WELLS
APPROXIMATE MATERIAL QUANTITIES**

Proposed Well ID	Approximate Location	Closest Boring	Approximate Depth to First Restrictive Clay (feet bgs)	Approximate Depth to Water Table (feet bgs)	Estimated Well Depth (feet bgs)	Screen Length (feet)	Estimated Screen Interval (feet bgs)			Nominal Well Diameter (inches)	Well Material
PW-3	South of East Kilby Ditch - East of Coliseum Blvd.	PH-46 and PH-109	26	12	26	10	16	to	26	4	SDR-17 PVC
MW-146A					15	5	10	to	15	2	Schedule 40 PVC
MW-246B					25	5	20	to	25	2	Schedule 40 PVC
MW-147A					15	5	10	to	15	2	Schedule 40 PVC
MW-247B					25	5	20	to	25	2	Schedule 40 PVC
PW-4	South of Broadway Street	MW-117/217	75	37	70	25	45	to	70	4	SDR-17 PVC
MW-148A					40	10	30	to	40	2	Schedule 40 PVC
MW-248B					55	10	45	to	55	2	Schedule 40 PVC
MW-248C					70	10	60	to	70	2	Schedule 40 PVC
MW-149A					40	10	30	to	40	2	Schedule 40 PVC
MW-249B					55	10	45	to	55	2	Schedule 40 PVC
MW-249C					70	10	60	to	70	2	Schedule 40 PVC





**TABLE 4
PROPOSED CHARACTERIZATION BORINGS AND WELLS FOR PILOT TEST AREA A
APPROXIMATE MATERIAL QUANTITIES**

Pilot Test Area	Approximate Location	Proposed Drilling Scope	Footage per Unit	Estimated No. of Units per Area	Estimated Footage
A	Broadway and ALDOT Property at Intersection of Fairground and Broadway	Probeholes	60	13	780
		Nested Monitoring Wells (3 wells in each borehole)	60	2	120















Legend


Pilot Test Area
 Pilot Test Area

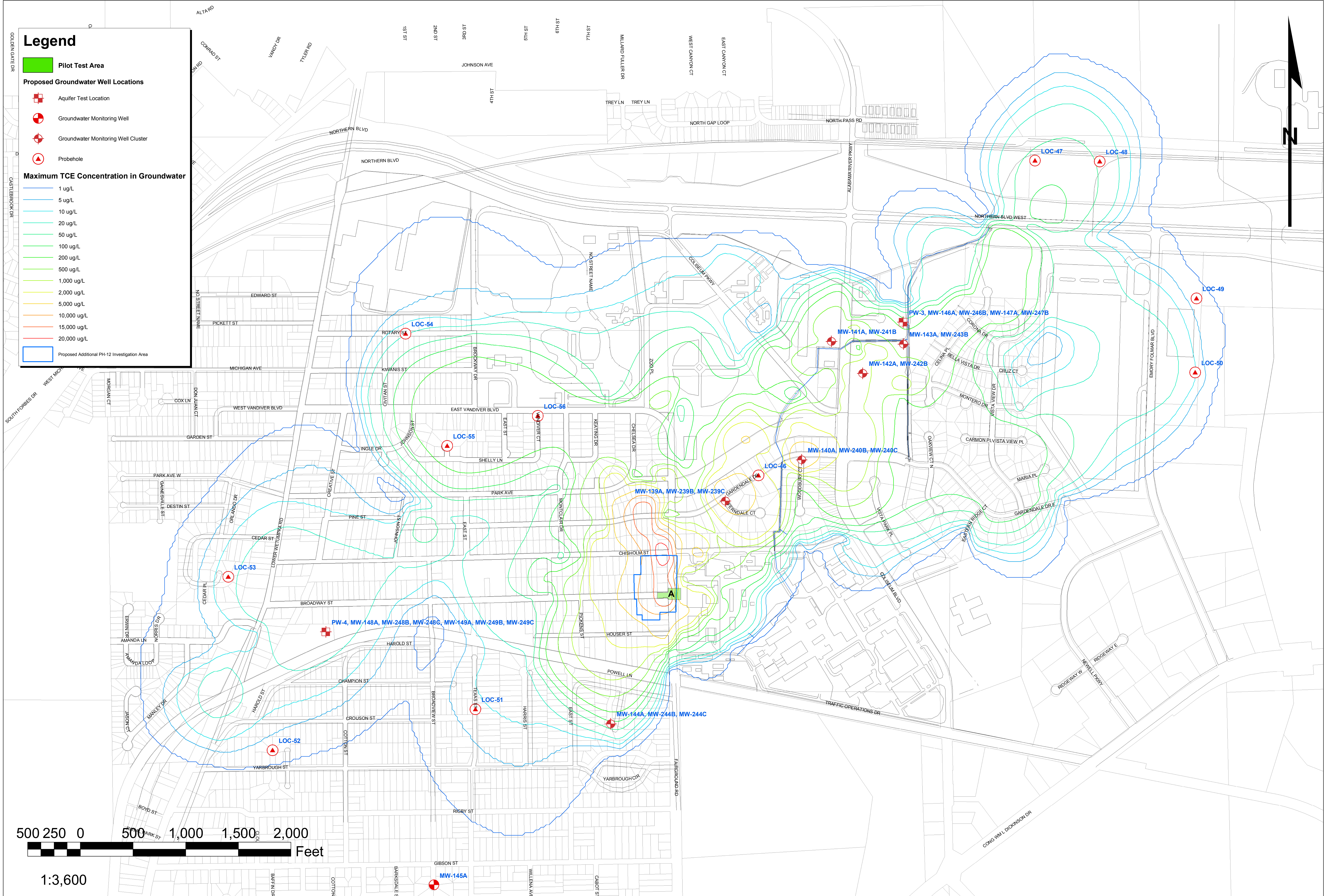
Proposed Groundwater Well Locations

-  Aquifer Test Location
-  Groundwater Monitoring Well
-  Groundwater Monitoring Well Cluster
-  Probehole

Maximum TCE Concentration in Groundwater

-  1 ug/L
-  5 ug/L
-  10 ug/L
-  20 ug/L
-  50 ug/L
-  100 ug/L
-  200 ug/L
-  500 ug/L
-  1,000 ug/L
-  2,000 ug/L
-  5,000 ug/L
-  10,000 ug/L
-  15,000 ug/L
-  20,000 ug/L

 Proposed Additional PH-12 Investigation Area

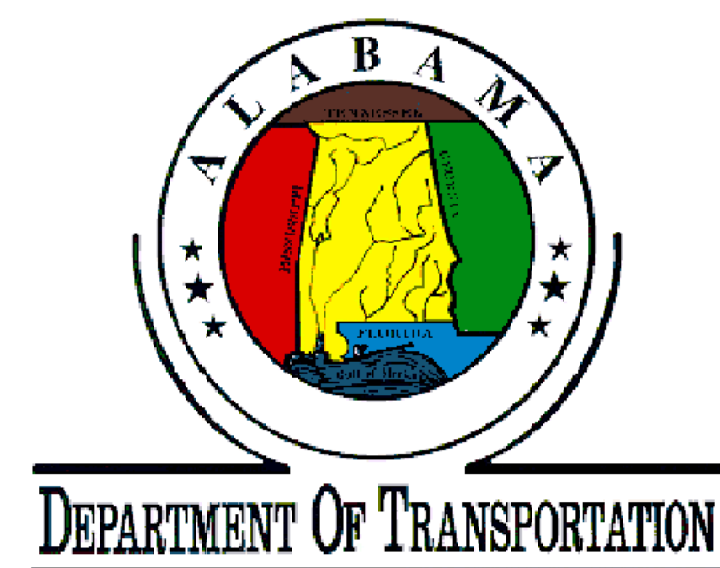


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PROPOSED ADDITIONAL GROUNDWATER SAMPLING AND TEST LOCATIONS








PLATE 1

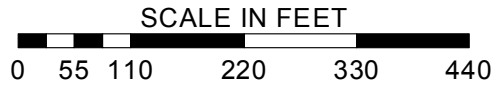
FEBRUARY 2004





LEGEND

-  Proposed Investigation Area
-  Existing CMT Well
-  Existing Monitoring Well
-  Existing Probehole
-  1,000 ug/l TCE Contour
-  5,000 ug/l TCE Contour
-  10,000 ug/l TCE Contour



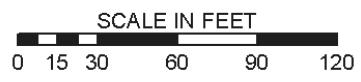
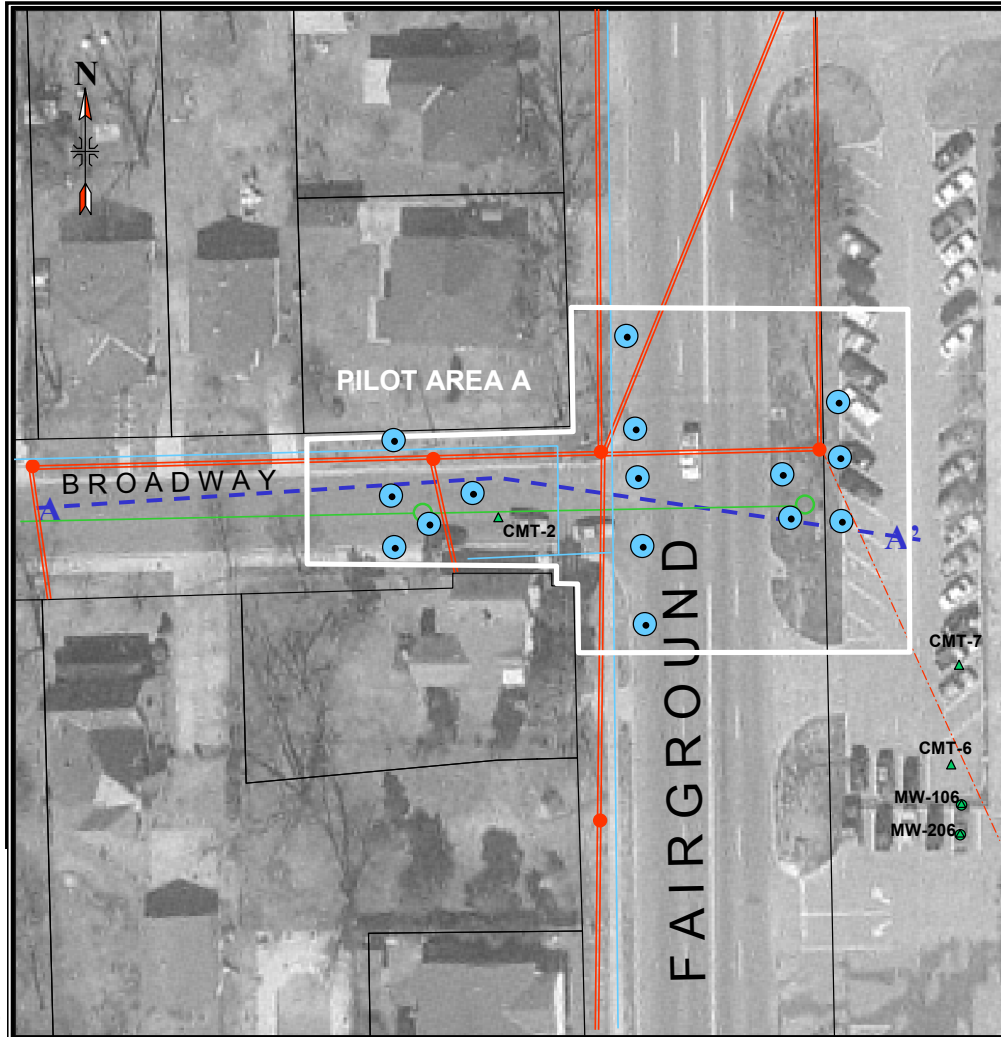
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PROPOSED SUPPLEMENTAL INVESTIGATION AREA IN PROBEHOLE 12 AREA

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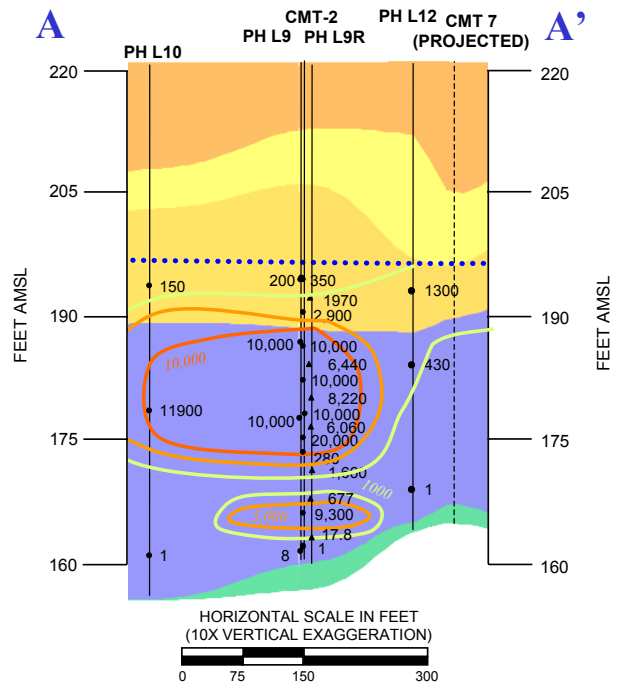
FIGURE 1





LEGEND

- Proposed Probehole
- ▲ Existing CMT Well
- Existing Monitoring Well
- Existing Probehole
- Sanitary Sewer
- Power Line
- - - Underground Conduit
- Water Line
- Power Pole
- Manhole



- | STRATIGRAPHIC LAYERS | TCE ISOCONCENTRATION CONTOURS |
|--|--|
| UPPER CLAY | 1,000 UG/L |
| UPPER SILTY SAND | 5,000 UG/L |
| SAND AND GRAVEL | 10,000 UG/L |
| LOWER SILTY SAND (GLAUCONITIC) | APPROXIMATE WATER TABLE |
| GLAUCONITIC SAND | |

- ▲ 385 TCE CONCENTRATION (UG/L) FROM NOVEMBER 2002 SAMPLING MIDPOINT OF GROUNDWATER SAMPLING INTERVAL
- 385 TCE CONCENTRATION (UG/L) FROM ADDENDUM NO. 3 SAMPLING MIDPOINT OF GROUNDWATER SAMPLING INTERVAL

F:\Project\4808001\Files\Addendum 14\Figure 2.PPT

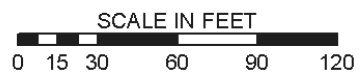
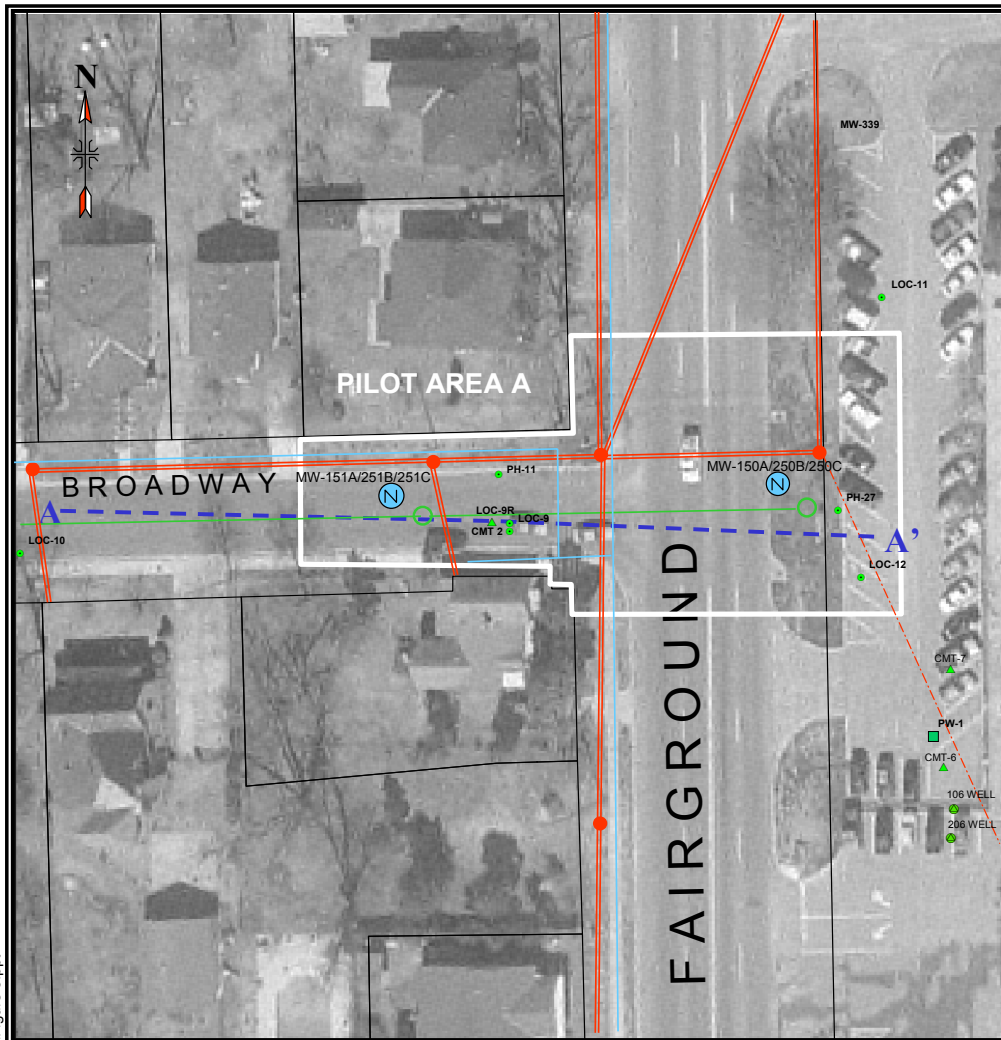


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PROPOSED PROBEHOLES IN PILOT AREA A

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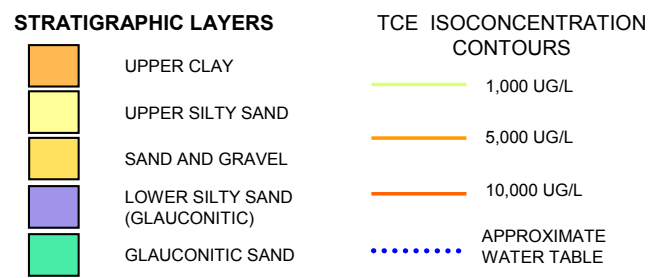
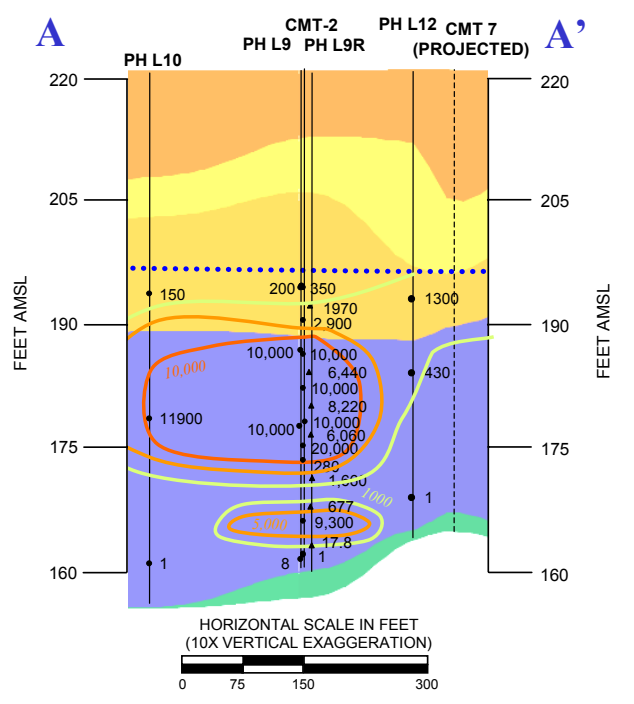
FIGURE 2

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LEGEND

- Ⓝ Proposed Nested Well
- ▲ Existing CMT Well
- Existing Monitoring Well
- Existing Pumping Well
- Existing Probehole
- Sanitary Sewer
- Power Line
- - - Underground Conduit
- Water Line
- Power Pole
- Manhole



- ▲ 385 TCE CONCENTRATION (UG/L) FROM NOVEMBER 2002 SAMPLING MIDPOINT OF GROUNDWATER SAMPLING INTERVAL
- 385 TCE CONCENTRATION (UG/L) FROM ADDENDUM NO. 3 SAMPLING MIDPOINT OF GROUNDWATER SAMPLING INTERVAL

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PROPOSED NESTED WELLS IN PILOT TEST AREA A

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FIGURE 3

