E.O. Lawrence Berkeley National Laboratory

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REPORT OF ENVIRONMENTAL INVESTIGATIONS IN THE FORMER BUILDING 51 VACUUM PUMP ROOM AND FORMER BUILDING 51A AREAS

for the
Ernest Orlando Lawrence Berkeley National Laboratory
Environmental Restoration Program

August 2012

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VIRONEX MEMBRANE INTERFACE PROBE INVESTIGATION REPORT – B51 SUBSURFACE INVESTIGATION (APRIL 17, 2012)

LIST OF ABBREVIATIONS

Berkeley Lab	Lawrence Berkeley National Laboratory
Cal/EPA	California Environmental Protection Agency
CAP	Corrective Action Program
CHHSLs	California Human Health Screening Levels
DCA	Dichloroethane
DCE	Dichloroethene
DTSC	Cal-EPA Department of Toxic Substances Control
DWR	Department of Water Resources
ECD	Electron Capture Device
DNAPL	Dense Non-Aqueous Phase Liquid
ERP	Environmental Restoration Program
ESL	Environmental Screening Level
FID	Flame Ionization Detector
FY	Fiscal Year (October 1 to September 30)
GAC	Granular Activated Carbon
gpd	gallons per day
ICMs	Interim Corrective Measures
LARWQCB	Los Angeles Regional Water Quality Control Board
mg/kg	milligrams per kilogram
µg/L	micrograms per liter (10^{-6} grams per liter)
MIP	Membrane Interface Probe
msl	mean sea level
PCE	Tetrachloroethylene (Perchloroethene)
PID	Photoionization Detector
RCRA	Resource Conservation and Recovery Act
RPM	Remedial Project Manager
SC	DOE Office of Science
SOP	Standard Operating Procedure
TCA	Trichloroethane
TCE	Trichloroethylene
VOCs	Volatile Organic Compounds
Water Board	San Francisco Bay Region of the Regional Water Quality Control Board

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1. INTRODUCTION

1.1 PURPOSE AND SCOPE

This report provides a comprehensive discussion of the environmental investigations conducted in the Vacuum Pump Room and Building 51A areas of the former Bevatron Complex at the Ernest Orlando Berkeley National Laboratory (Berkeley Lab). The purpose of the report is to document the results of this investigation, provide data to assess whether corrective measures should be required for these two areas, and to help evaluate appropriate remediation alternatives and costs.

1.2 BACKGROUND

Berkeley Lab Building 51, which housed the Bevatron, occupied approximately 2.25 acres in the west-central part of Berkeley Lab. During its operation from 1954 until 1993, the Bevatron was among the world's leading particle accelerators. In October 2003, the Secretary of Energy directed the Office of Science (SC) to develop a plan and a budget estimate for a project to demolish the Bevatron complex. The project (Building 51 and Bevatron Demolition Project) consisted of the demolition, deactivation, and disposal of the Building 51 structure and contents including the shallow foundations, shield blocks, and the Bevatron accelerator housed within the building. It also included backfilling the site to grade with clean soil. These activities were completed in February 2012.

The project area is currently being paved to provide parking, and will not be developed further until another use for the area is proposed, approved, and initiated. Figure 1 is an aerial view of the Building 51 area prior to the start of demolition activities. Figure 2 is a photograph showing the condition of the site in March 2012 prior to paving. The project area is primarily referred to as Building 51 in this workplan, but is also referred to as the Bevatron Complex or simply as the Bevatron. Building 51 included Building 51A, an integral addition.

As part of the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP), the Berkeley Lab Environmental Restoration Program (ERP) investigated all Solid Waste Management Units and Areas of Concern identified in the Building 51 area, including those inside

the building. At the time that the Corrective Measures Implementation (CMI) Report (Berkeley Lab, 2007) was submitted to the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) in 2007, all Berkeley Lab areas of soil contamination that required corrective action had been cleaned up and the required corrective measures for groundwater contamination had been implemented. DTSC approved the CMI Report in July 2007 (DTSC, 2007).

Between September 2010 and April 2011, Berkeley Lab conducted a preliminary investigation of potential subsurface contamination beneath the Building 51 Demolition Project area. This investigation, although not required by a regulatory agency, was conducted in accordance with Berkeley Lab's standard practice of evaluating the potential presence of subsurface contamination at demolition/construction sites as part of a due diligence process.

Requirements for the preliminary investigation were specified in the *Workplan for Initial Characterization of Subsurface Contamination - Demolition of Building 51 and the Bevatron* (Berkeley Lab, 2010). This workplan was provided to the DTSC, the Regional Water Quality Control Board (Water Board), and the City of Berkeley at a Remedial Project Managers (RPM) meeting held at the DTSC's Berkeley office on November 5, 2010. At a second RPM meeting held on April 25, 2011, Berkeley Lab provided the regulatory agencies with an update on the status of the Building 51 investigations.

During the preliminary Bevatron investigation, relatively high concentrations of volatile organic compounds (VOCs) were detected in the soil and groundwater under the Building 51 Vacuum Pump Room (Room 10). In accordance with requirements specified in Berkeley Lab's Hazardous Waste Handling Facility Permit to notify the DTSC orally and in writing of an immediate or potential threat to human health or the environment, this finding was reported to the DTSC on June 6, 2011 by email and in a follow-up telephone conversation on June 7, 2011.

On August 16 2011, Berkeley Lab met with the DTSC at their Berkeley offices to provide an update on the status of the investigations and submitted the *Workplan for Investigation and Interim Corrective Measure in the Vacuum Pump Room Area for The Building 51 and Bevatron Demolition Project*. On August 25, 2011, the DTSC approved the sampling methodology but specified that the Interim Corrective Measure (ICM) needed to be addressed in a separate

document. The document (*Workplan for Investigation in the Vacuum Pump Room Area for The Building 51 and Bevatron Demolition Project)* was resubmitted to the DTSC on September 8, 2011. On September 22, 2011, a meeting was held at the DTSC Berkeley office. At that meeting DTSC provided additional comments on the workplan. The workplan was revised in accordance with the DTSC comments and resubmitted on October 6, 2011 (Berkeley Lab, 2011a). DTSC approved the revised workplan on October 10, 2011 (DTSC, 2011)

On October 14, 2011, DTSC representatives toured the Berkeley Lab site and attended a meeting that included a presentation on the status of the Building 51 investigations. In addition to the Vacuum Pump Room Area, a second area of soil and groundwater contamination (Building 51A area) that had been identified during the Building 51 investigations was discussed. On January 24, 2012, Berkeley Lab submitted a letter report to DTSC titled *Status and Pending Tasks in the Building 51A Area of the Building 51 and Bevatron Demolition Project*. As described in that document, elevated concentrations of VOCs were detected in grab groundwater samples collected from two borings in the Building 51A area and elevated Membrane Interface Probe (MIP) survey results indicated the presence of VOC contaminated soil.

The locations of the former Vacuum Pump Room (Room 10) and the former Building 51A area are shown on Figure 3. The Environmental investigations conducted in both of these areas have been completed. On March 27 2012, Berkeley Lab met with the DTSC at their Berkeley office and presented a summary of the results of the investigations conducted in both areas. A comprehensive presentation of the results is provided in the following sections of this report. Results of the investigation have also been reported in the ERP Quarterly Progress Reports, which are submitted to the DTSC and provided to the Water Board and City of Berkeley. The Quarterly Progress reports are available on line at http://www.lbl.gov/ehs/erp/html/documents.shtml.

1.3 METHODS AND PROCEDURES

The investigation was performed in accordance with requirements of the ERP Quality Assurance Program Plan (Berkeley Lab, 2009a), Berkeley Lab Environmental Services Group Standard Operating Procedures (SOPs), and the Berkeley Lab ERP Health and Safety Program Plan (Berkeley Lab, 2009b). Well construction was conducted in compliance with all Federal and State

guidance including California Department of Water Resources (DWR) Well Standards (DWR, 1991) and the DTSC Guidance Manual for Groundwater Investigations (DTSC, 1994).

Soil vapor sampling was conducted in compliance with Cal/EPA guidance (Cal/EPA 2003, 2004, 2010) and the Los Angeles Regional Water Quality Control Board (LARWQCB, 1997), including methods to minimize sampling apparatus volume, seal sampling apparatus and probes to avoid leaks, and employ leak testing methods to ensure the integrity of the samples.

MIP surveys were also conducted to provide an initial assessment of the potential lateral and vertical extent of VOC contaminated soil. The results of the MIP survey were used to help determine appropriate locations (both horizontally and vertically) for collecting soil samples for analytical testing. The MIP system consists of a heated probe that is pushed into the subsurface. The probe heater volatilizes subsurface VOCs which then pass through a semipermeable membrane and enter a carrier gas stream. The carrier gas stream is conveyed continuously to the surface where it is analyzed using an electron capture detector (ECD), a photoionization detector (PID), and a flame ionization detector (FID). The FID plots and most of the PID plots for the MIP data collected at Building 51 had few values above the baseline, so the data from these two detectors were generally not useful for assessing contamination. The ECD detector provided a relatively good representation of the magnitude and extent of soil contamination as shown by the relatively good correlation of the ECD results with the concentrations of VOCs detected in soil samples that were subsequently collected.

2. SITE DESCRIPTION

2.1 PHYSICAL DESCRIPTION OF THE FACILITY

The Bevatron was a large, weak-focusing synchrotron accelerator that originally produced high intensity proton beams, but later shifted to operations using lower beam intensities. It was constructed inside Building 51 in 1950 and ceased operation in 1993. The original Building 51 was expanded with two high-bay additions (51A and 51B) in the late 1950s and 1960s.

2.2 PHYSIOGRAPHY AND DRAINAGE

Prior to construction of the Bevatron, North Fork Strawberry Creek, which flows through Blackberry Canyon, passed between the current locations of Building 51 and Building 64. South of this area, a broader canyon containing an unnamed north-northwest-trending drainage passed through approximately the center of the present location of Building 51. Cut and fill activities during development significantly transformed the topography and surface runoff patterns. The hillside along the south and east edges of Building 51 was excavated, including the upper reaches of the unnamed northwest-trending drainage. Storm drains were placed in the bottom of Blackberry Canyon northeast of Building 51 and along the unexcavated parts of the unnamed drainage prior to placing fill in the canyons. Since the hillside excavation intercepted the water table, various hillside drains, wells, and building subdrains were installed to convey intercepted groundwater to storm drains. The locations of the active subdrains that currently intercept groundwater are shown on Figure 3.

2.3 GEOLOGY

Two bedrock units (the Orinda Formation and the Great Valley Group) underlie the Bevatron Complex area. Mudstones, sandstones, and shales of the Great Valley Group underlie the western part of Building 51, including the Building 51A area. The strata of the Great Valley Group dip north to north-northeast between 20° to 30° in this area. The Orinda Formation overlies the Great Valley Group along a contact that passes beneath Building 51 and dips approximately 20° to the northeast. The Orinda Formation consists primarily of clayey siltstones

that dip northeast from 25° to 60° and underlie the eastern part of Building 51, including the Vacuum Pump Room area. Geologic cross sections showing contact relationships and soil contamination results in both the Vacuum Pump Room and Building 51A areas are discussed in sections 3 and 4 of this report.

Colluvium several tens of feet thick is present in the former drainages that have been covered with artificial fill. The most extensive colluvial deposits lie along the former location of Blackberry Canyon. Colluvial deposits are also present within a former drainage course under the northwest portion of Building 51.

2.4 HYDROGEOLOGY

Groundwater in the Vacuum Pump Room and Building 51A areas appears to flow mainly within the artificial fill. In general, rocks of the Great Valley Group are extensively fractured and therefore have relatively high permeability in comparison to the clayey siltstones of the Orinda Formation. The Orinda Formation generally has very low permeability and in most cases Orinda Formation rocks encountered in drilling throughout the Bevatron area appear dry, even when located beneath saturated overburden. Geological reports prepared before construction of Building 51 and geotechnical reports prepared during filling and compacting parts of Blackberry Canyon describe several springs at this site (Dames and Moore, 1949).

Groundwater flow beneath Building 51 had been controlled by the Bevatron subdrain systems prior to the demolition of Building 51 and parts of its internal subdrain system. Flow is still controlled to some extent by the remaining exterior components of the system, including the South Perimeter subdrain and hillside drains, and by a subdrain that was installed to replace the demolished Wind Tunnel subdrain system. The locations of the subdrains are shown on Figure 3.

A groundwater elevation contour map for the area is shown on Figure 4. Groundwater in areas uphill from the former Bevatron Complex flows generally northwards and westwards towards Building 51 where shallow groundwater is intercepted by the perimeter subdrains. Downhill from the perimeter subdrain, groundwater is directed generally northwestwards towards a buried former drainage immediately north of the approach tunnel (Figure 4) and then towards the lower, unfilled portion of Blackberry Canyon to the northwest of the Building 51 area. As a result, groundwater is

very shallow along the upslope perimeter of Building 51 and water frequently intruded into the basement area during the wet season, where it was captured by floor drains. Approximately 4,000 to 10,000 gallons of groundwater per day are captured by the drainage system during the wet season.

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3. INVESTIGATION OF VACUUM PUMP ROOM AREA

3.1 INTRODUCTION

Investigation of the Vacuum Pump Room area was started during the latter half of 2010 and completed in early 2012. The investigation consisted of the collection of soil vapor, soil, and groundwater samples, and conducting a MIP survey. The locations of the sampling points and cross sections discussed in the following subsections are shown on Figure 5. Sampling results from the investigation are provided in Table A1 (VOCs in soil vapor), Table A2 (VOCs in soil), and Table A3 (VOCs in groundwater). Sampling locations and sampling result summaries are also provided on the figures that are referenced in the following sections. The results of the MIP investigation are provided in Attachment 1.

It is important to note that due to the configuration of former Building 51, there is significant vertical relief across the Vacuum Pump Room area. The Vacuum Pump room floor lies at an elevation of 710 feet above mean sea level (msl), while the floor of the adjacent Air Duct shafts (prior to backfilling) lay 10 feet lower at an elevation of 700 feet. The exterior cooling tower area to the south lies at an elevation of approximately 725 feet. The elevation of each area is indicated by shading on Figure 5, and is illustrated on the cross sections referenced below

3.2 SOIL VAPOR CONTAMINATION

Several soil vapor probes were installed in the Vacuum Pump Room during early reconnaissance work in 2008. No significant contamination was detected in those samples. An additional sampling point was installed in 2010. Elevated concentrations of trichloroethylene (TCE), vinyl chloride and cis-1,2- dichloroethene (DCE), along with lesser concentrations of trans-1,2-DCE, 1,1-DCE, 1,1-dichloroethane (DCA) and 1,1,1-trichloroethane (TCA) were detected in that sampling point. Concentrations of TCE, vinyl chloride and cis-1,2-DCE detected in the 2010 sample significantly exceeded Cal/EPA California Human Health Screening Levels (CHHSLs) (Cal/EPA, 2005) and/or Water Board Environmental Screening Levels (ESLs) (http://www.swrcb.ca.gov/rwqcb2/esl.shtm) for industrial land use. Soil vapor sampling locations

and concentrations of total VOCs detected in soil vapor samples are shown on Figure 6. Concentrations of individual VOCs detected in the soil vapor samples are listed in Table A1.

To help delineate the distribution of elevated soil vapor concentrations, several additional soil vapor probes were installed in the cooling tower area south of the Vacuum Pump Room (Figure 6). Unfortunately, the artificial fill in the cooling tower area was saturated close to the Vacuum Pump Room walls up to a depth of approximately 3 feet below ground surface (bgs). Therefore, soil vapor could not be recovered from most of the probes and the lateral distribution of elevated soil gas could not be accurately determined. Notably, the two most southerly vapor probes contained VOCs at concentrations substantially higher than the sample collected in 2010 within the Vacuum Pump Room, suggesting that the primary source of contamination might be outside Building 51 in the former cooling tower area to the south. The VOCs detected in soil vapor were a similar suite to that detected in the 2010 sample, though the proportion of TCE and 1,1-DCA was much greater, and both benzene and tetrachloroethylene (PCE) were detected (Table A1). The concentrations of TCE, vinyl chloride, PCE, 1,1-DCA and benzene detected exceeded CHHSLs and/or ESLs for industrial land use.

3.3 MEMBRANE INTERFACE PROBE (MIP) SURVEY

Due to the difficulty encountered collecting soil vapor samples in the cooling tower area, a MIP survey was conducted to help assess the lateral and vertical extent of the soil contamination. The MIP system was not used in the Vacuum Pump Room itself due to the presence of bedrock at shallow depth, which would have prevented significant penetration by the probe. The results of the MIP investigation and a data visualization report depicting 3-dimensional computer-generated contours of the MIP results are presented in Attachment 1. The primary finding of the MIP survey was that a limited area between the southern wall of the Vacuum Pump Room and the northern edge of the cooling tower showed elevated ECD and PID responses. A map showing the area of significantly elevated ECD responses is presented on Figure 7. The greatest magnitude responses were in boring SB51-11-M2, close to the southeast corner of the Vacuum Pump Room. Elevated ECD responses in this boring extended from close to the surface to approximately 15 feet, though the highest responses were observed in the depth interval from 2.5 to 5 feet. This boring was located adjacent to a former concrete sump location. ECD and PID responses in borings

throughout the remainder of the area between the Vacuum Pump Room wall and former cooling tower location had significantly lower magnitudes, and generally only extended to depths of approximately 10 feet or less. MIP borings outside this area generally showed only minor responses above the detector baseline readings and only at limited depth ranges. Two borings located along the Vacuum Pump Room wall to the west of the primary area of elevated responses showed detector responses above baseline at a depth of approximately 14 feet, the same elevation as the South Perimeter subdrain, which contains VOC-contaminated water and runs adjacent to the wall. The location of the subdrain is shown on Figure 3.

3.4 SOIL CONTAMINATION

Soil samples were collected from a large number of temporary groundwater sampling points and soil borings drilled in and adjacent to the Vacuum Pump Room in 2010 and 2011. The primary contaminant detected in all of the samples was TCE, except for the two shallowest samples in the soil boring immediately south of the southeast corner of the Vacuum Pump Room (Table A2). Those two samples contained primarily PCE and were collected adjacent to the concrete sump in the former cooling tower area noted in the previous section. In addition to PCE and TCE, very low concentrations of cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, vinyl chloride, 1,1,1-TCA, 1,1-DCA, benzene, methylene chloride, acetone and Freon 113 were detected in a number of samples. Concentrations of VOCs detected in soil samples are listed in Table A2. Soil sampling locations together with the maximum concentration of TCE and PCE detected at each sampling location are shown on Figure 8. The maximum detected concentration of TCE was 230 mg/kg, which was detected below the Vacuum Pump Room at a depth of 12 feet in SB51-11-9.

As shown on Figure 8, the lateral extent of contamination is well defined throughout the Vacuum Pump Room area by the non-detectable to low concentrations of VOCs detected in borings drilled around the periphery of the area. In the cooling tower area, this interpretation is substantiated by the MIP results, which show generally good correlation to the soil data. In addition, the vertical extent of contamination appears to be well defined throughout the area, as indicated by the analytical results and MIP detector responses shown on cross sections A-A' (Figure 9), B-B' (Figure 10), and C-C' (Figure 11). With the exception of boring SB51-11-31, drilled immediately adjacent to the south wall of the Vacuum Pump Room, significant contamination beneath the

Vacuum Pump Room is only present at depths of approximately 11 feet or greater, close to the base of the artificial fill that was placed behind and adjacent to the Air Duct walls. The general absence of shallow contamination suggests that the contamination did not originate from within the Vacuum Pump Room.

3.5 GROUNDWATER CONTAMINATION

The initial evaluation of groundwater contamination associated with the Vacuum Pump Room area consisted of sampling angled borings drilled through the Bevatron perimeter wall to target groundwater immediately beneath the South Perimeter tile subdrain. The location of the subdrain is shown on Figure 3. Effluent from this subdrain, which is contaminated with VOCs, is captured at a catch basin that was formerly located inside the southwest edge of Building 51A. The water is routed from the catch basin to a GAC treatment system, as part of the DTSC approved corrective measures for the site.

The source of the contamination in the subdrain water had previously been investigated, but could not be located. The purpose of the angled borings was to sample groundwater beneath the subdrain in locations upstream of the catch basin in order to identify where contaminants were entering the subdrain system. Figure 12 is a map showing halogenated VOC concentrations in groundwater throughout the Bevatron area, and includes the results from the angled borings. This map is a composite of results from several different sources including data from the current study, tabulated in Tables A3 (Vacuum Pump Room area) and Table B3 (Building 51A area), and also data reported in ERP quarterly progress reports (Berkeley Lab 2011b, 2011c, 2011d, and 2012). These results indicate that VOC-contaminated groundwater is present beneath the drain system along almost its entire length between the former Building 51A and Vacuum Pump Room areas. Notably, the angled boring immediately upstream of the Vacuum Pump Room did not contain detectable levels of VOCs. These observations suggest that the soil contamination detected in the Vacuum Pump Room area is the primary source of contamination found in the South Perimeter subdrain.

Several temporary groundwater sampling points were installed in and adjacent to the Vacuum Pump Room as part of the current investigation. In addition, grab groundwater samples were

collected from several soil borings. As reported in the preliminary investigation workplan (Berkeley Lab, 2010), water samples collected immediately prior to demolition of the Bevatron from the floor drain system under the Air Duct shafts contained in excess of 1,000 µg/L total VOCs (primarily TCE). Prior to demolition of Building 51, this water drained into a section of the Building 51 floor drain system that was routed to the northern end of the building. Since the early 1990s, the effluent from the floor drain system has been captured and pumped to a GAC groundwater treatment system for treatment and discharge to the sanitary sewer or recirculation into the Building 51/64 plume soil flushing system.

Most of this floor drain system was removed as part of the Demolition Project and the pipe north of the Air Duct shafts was capped. In addition, the Air Duct areas (floor elevation 700 feet) were backfilled with approximately 10 feet of clean soil to the ground surface elevation of approximately 710 feet. Prior to backfilling the Air Ducts, the bottoms of the shafts were covered with gravel and a screened observation well (OC51-11-1) was installed within the gravel to allow water level measurements and sampling of groundwater seeping into the Air Duct. Construction details for OC51-11-1 are shown on Figure 13.

Vacuum Pump Room groundwater sampling locations and a summary of the groundwater analytical results are shown on Figure 14, which is an isoconcentration contour map of total VOCs detected in the groundwater. The primary contaminant detected has been TCE, with significantly lower concentrations of 1,1,1-TCA, 1,1-DCA, carbon tetrachloride, cis-1,2-DCE, trans-1,2-DCE and vinyl chloride (Table A3). The maximum concentration was detected in a sample collected from temporary groundwater sampling point SB51-11-9 shortly after it was installed. A sheen and very high TCE concentration (126,000 µg/L) was observed in the initial sample collected from this sampling point, indicating that dense non-aqueous phase liquid (DNAPL) was likely present. Subsequent groundwater samples have had much lower TCE concentrations (approximately 30,000 µg/L). SB51-11-9 also contained the soil samples with the highest detected VOC concentrations, as described in Section 3.4. Groundwater samples collected from boreholes within several feet of SB51-11-9 contained VOC concentrations orders of magnitude lower (maximum of 400 µg/L).

3.6 INTERPRETATION OF RESULTS

Soil and groundwater contamination is primarily present in the Vacuum Pump Room area adjacent to the former Air Duct locations, with significant soil contamination only present at depths of approximately 10 feet or greater in most of this area (at the same depth as the base of the former Air Duct shafts), though shallow contamination is present immediately adjacent to the south perimeter wall. The general absence of shallow contamination inside the Vacuum Pump Room indicates that the contamination probably did not originate from within this room. Contaminants appear to have migrated downwards from releases that occurred from a sump that was located south of the Vacuum Pump Room next to the retaining wall, as suggested by the moderately high levels of VOCs detected in soil samples collected in that area. This contamination extends downwards within the artificial fill adjacent to the Vacuum Pump Room wall and is also likely the source of contaminants detected in the Bevatron South Perimeter subdrain.

Migration of contaminants appears to have been entirely within the artificial fill, which is highly permeable in comparison to the underlying relatively impermeable Orinda Formation bedrock. This interpretation is illustrated on Figure 9 and supported by the following lines of evidence:

- The detected contamination is limited almost exclusively to the artificial fill.
- Groundwater samples collected from temporary groundwater sampling point SB51-11-11, which is screened in the bedrock in the former cooling tower area, contains only relatively low concentrations of VOCs (5.5 µg/L total concentration in June 2011).
- The relatively high concentration of TCE (32 mg/kg) detected at a depth of 3 feet bgs in a sample collected from SB51-11-31 near the base of the retaining wall between the former cooling tower area and the Vacuum Pump Room.

Photographs taken during construction of the Bevatron show that a significant area was excavated around the periphery of the Air Duct shafts (Figure 15), as illustrated on cross section B-B' (Figure 10). DNAPL is interpreted to have accumulated in a low point in the vicinity of temporary groundwater sampling point SB51-11-9. At this location, contaminants appear to have migrated approximately 10 feet downwards into the underlying relatively impermeable Orinda Formation. The reason for the penetration of contaminants into the Orinda formation at this location is not known, but may be related to the presence of DNAPL.

As described above, the most likely source of the soil and groundwater contamination detected in the Vacuum Pump Room area were releases from a sump in the former cooling tower area. An additional, though less likely hypothesis, is that the contamination detected beneath the Vacuum Pump Room is from a different source than that detected in the cooling tower area, possibly a release from the Air Duct drain system or a spill in the Air Duct area.

As shown on Figure 12, the extent of groundwater contamination downgradient from the Vacuum Pump Room area has been limited. The limited extent of groundwater contamination downgradient of the Vacuum Pump Room area is likely due to the extremely low hydraulic conductivity of the bedrock, combined with the previous capture of contaminants by the Air Duct and Wind Tunnel floor drain systems and the South Perimeter subdrain.

The Building 51 floor drain system was removed as part of the building demolition project, with the limited exception of the floor drain piping at the east end of the Air Ducts, which was left in place but capped. The groundwater elevation at the west end of the Air Ducts was previously controlled by the subdrain systems beneath the Wind Tunnel and Air Duct floors, which would have served to capture any migrating groundwater that did not enter the floor drain system. That subdrain system was removed to complete the demolition project, but a replacement subdrain was installed at approximately the same location and elevation of the Wind Tunnel system to control the groundwater elevation in the former central Bevatron area. The location of the new subdrain system is shown on Figure 3. Since the Air Duct shafts were backfilled and the Air Duct floor drain system was capped, the groundwater level has risen in the observation casing (OC51-11-1) monitoring the Air Duct backfill. This water is contaminated and as shown on Figure 14, is migrating into the clean Air Duct backfill. However, the replacement Wind Tunnel subdrain system (Figure 3) should help to limit the downgradient extent of this migration.

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4. INVESTIGATION OF BUILDING 51A AREA

4.1 INTRODUCTION

Investigation of the Building 51A area was started during the latter half of 2010 and completed in April 2012. The investigation consisted of the collection of soil vapor, soil, and groundwater samples, and conducting MIP surveys. The investigation focused primarily on an area along an abandoned storm drain segment that has been identified as the most likely source of the contamination detected in the Building 51A area. The segment extended between the active Building 51A catch basin at the south end to the abandoned Building 51A catch basin on the north end, both of which were known to have contained VOCs. The Building 51A area sampling locations and the locations of the catch basins and abandoned storm drain are shown on Figure 16.

Prior to 2002, effluent from the South Perimeter subdrain flowed into the active Building 51A catch basin. The location of the subdrain is shown on Figure 3. At the beginning of 2002, a concrete sump was installed immediately upgradient from the storm drain catch basin inside Building 51A to intercept the contaminated water. Since that time, water has been extracted from the sump and treated by GAC prior to disposal in the sanitary sewer. VOCs were also previously detected both in sediment inside the Building 51A abandoned catch basin and in the soil beneath the catch basin. In November 2006, the abandoned catch basin was therefore removed and the contaminated soil beneath the catch basin excavated to a depth of 37 feet.

Results of sampling in the Building 51A area are provided in Table B1 (VOCs in soil vapor), Table B2 (VOCs in soil), and Table B3 (VOCs in groundwater). The results of the MIP survey and a data visualization report depicting 3-dimensional computer-generated contours of the MIP results is presented in Attachment 1. The Building 51A area adjoins the Building 51L area, which was the subject of a corrective measure that consisted of the excavation and offsite disposal of approximately 1,350 cubic yards of VOC-contaminated soil in 2006. Due to their mutual proximity, and a degree of overlap of contaminated areas, selected data collected from the Building 51L area are presented on the figures referenced below. The area of the Building 51L remedial excavation is shown on Figure 16.

4.2 SOIL VAPOR CONTAMINATION

In September and October 2010, soil vapor samples were collected from 16 locations within the Bevatron Complex for general VOC screening purposes. The results were reported in the ERP Quarterly Progress Report and Annual Status Summary for the Fourth Quarter of FY10 (Berkeley Lab, 2011d). Most of these vapor samples contained either insignificant or nondetectable levels of VOCs. However, a discrete area where elevated concentrations of halogenated VOCs were present in soil vapor was identified at the south end of Building 51A, where 11 of the samples were collected. An additional soil vapor sample was collected in this area in 2011. The results of the 12 soil vapor samples collected in this area are provided in Table B1. Building 51A area soil vapor sampling results are shown on Figure 17, which also includes previously reported soil vapor data collected from the adjacent Building 51L area in 2008.

The primary soil vapor contaminants detected in the Building 51A area were TCE and carbon tetrachloride, with lesser concentrations of PCE, cis-1,2-DCE, and chloroform. Vinyl chloride, 1,1-DCA, 1,1,1-TCA, and toluene were also detected. Concentrations of TCE and carbon tetrachloride detected in the Building 51A area and concentrations of TCE, PCE, vinyl chloride, 1,1-DCA, chloroform, cis-1,2-DCE, trans-1,2-DCE and benzene in the Building 51L area exceeded CHHSLs (Cal/EPA, 2005) and/or Water Board ESLs (http://www.swrcb.ca.gov/rwqcb2/esl.shtm) for industrial land use.

The soil vapor plume is likely derived from volatilization of halogenated VOCs from both the soil and groundwater. The highest concentrations of contaminated soil vapor in the Building 51A area are located in the area close to the active catch basin where soil contamination and the water table are relatively shallow. The highest levels of contaminated soil vapor in the Building 51L area are located in the area between the Building 51L remedial excavation and the former Building 51A outer wall. The Building 51L soil vapor plume is likely derived from volatilization of halogenated VOCs primarily from shallow soil contamination in that area.

4.3 MEMBRANE INTERFACE PROBE (MIP) SURVEY

MIP surveys were conducted to help delineate the lateral and vertical extent of the soil contamination. The results of the MIP investigation are presented in Attachment 1. A data

visualization report depicting 3-dimensional computer-generated contours of most of the MIP results is also presented in Attachment 1, though it should be noted that the three-dimensional contour plots exclude several borings around the periphery of the Building 51A area that were advanced several months after completion of the data visualization analysis. However, the data plots for these later borings are included in Attachment 1 and are also depicted on the cross sections referenced below. A map showing the area where ECD responses were significantly elevated is presented on Figure 18. The primary finding of the MIP surveys was that the entire area along the abandoned storm drain between the two catch basins showed elevated ECD and PID responses but that the responses laterally away from (east and west of) the storm drain were generally minimal to absent. This finding is illustrated on cross sections D-D' (Figure 19), E-E' (Figure 20), F-F' (Figure 21) G-G' (Figure 22), and H-H' (Figure 23). The ECD response indicates that the top of contamination in the vicinity of the active Building 51A catch basin deepens to the north, as illustrated on Figure 19. In addition, elevated detector responses were observed in one MIP boring (SB51A-11-M31) to the east of the abandoned storm drain at depths of 15 to 25 feet, as shown on Figure 20 and Figure 21, although as noted in the following subsection this result was not confirmed by soil sampling. The greatest magnitude and vertical extent of elevated responses were observed in boring SB51A-11-M25 (Figure 19), approximately 15 feet north of the active catch basin along the abandoned storm drain line (Figure 16), although the borings to the north and south (SB51A-11-M18 and SB51A-11-M22) showed only slightly lower responses. The southernmost, easternmost, and westernmost MIP borings had insignificant detector responses, indicating that the lateral extent of contamination in those areas is well defined.

In the area northwest of the Building 51A abandoned catch basin, only MIP boring SB51A-12-M7 showed a significant detector response. This boring was drilled through a previously excavated backfilled trench along the former abandoned storm sewer. An elevated ECD response was observed from the base of the backfill at a depth of 16 feet to approximately 28 feet, although the level of the ECD response was significantly lower than those observed in the borings along the abandoned storm drain to the south of the abandoned catch basin. None of the other MIP borings to the north, west, and east of this boring showed elevated detector responses in this depth interval, as illustrated on cross sections D-D' and H-H' (Figures 19 and 23). However, MIP borings SB51A-11-M8, -M9 and –M10 showed slightly elevated ECD and PID responses at shallower

depths between approximately 3 and 12 feet, indicating the likely presence of some degree of soil contamination in shallow soil in those areas.

4.4 SOIL CONTAMINATION

Soil samples were collected from a large number of temporary groundwater sampling points and soil borings drilled in the Building 51A area during 2011 and early 2012 to assess the magnitude and extent of soil contamination associated with the elevated MIP detector responses. The primary contaminants detected were TCE (26 mg/kg maximum) and carbon tetrachloride (6.4 mg/kg maximum), although low concentrations of PCE, chloroform, and aromatic compounds were also occasionally detected. Soil sampling locations and an isoconcentration contour map of the maximum concentrations of TCE and carbon tetrachloride detected at each boring location are presented on Figure 24 and Figure 25.

As shown on Figures 24 and 25, the lateral extent of contamination is well defined throughout the Building 51A area by non-detectable to very low concentrations of VOCs observed in borings drilled around the periphery of the area. Contaminated soil containing greater than 0.5 mg/kg total VOCs appears to be confined to a narrow band along most of the length of the abandoned storm drain alignment between the Building 51 active and abandoned catch basins. The vertical extent of contamination is also relatively well defined, as illustrated on cross sections D-D' (Figure 19), E-E' (Figure 20), and F-F' (Figure 21). The MIP results show generally good correlation with the soil data.

4.5 GROUNDWATER CONTAMINATION

Temporary groundwater sampling points were installed in seven of the soil borings drilled within and adjacent to the area containing significant soil contamination and elevated MIP detector responses. All of the sampling points except SB51A-12-7 were screened at relatively shallow depth horizons where the maximum concentrations of soil contaminants in the saturated zone had been detected. Sampling point SB51A-12-7 was screened in the bedrock from 34 to 44 feet bgs, beneath the maximum depth of detected soil contamination to assess the vertical extent of the groundwater contamination. A low concentration of TCE (2.3 µg/L) was the only VOC detected in

a groundwater sample collected from SB51-12-7 in April 2012, indicating that the vertical extent of the groundwater contamination is limited.

Groundwater samples collected from all of the sampling points contained halogenated VOCs consisting primarily of TCE and carbon tetrachloride (Table B3), consistent with the soil results. The maximum concentration of total halogenated VOCS was 23,336 µg/L, which was detected in SB51A-12-1, located approximately 25 feet south of the Building 51A active catch basin. Figure 26a is an isoconcentration contour map showing total halogenated VOC concentrations in groundwater in the Building 51A area. The lateral distribution of contaminated groundwater closely mirrors the distribution of soil contamination described above. Notably, the sampling points and wells located to the north, south, east, and west of the area contain substantially lower VOC concentrations than the sampling points located along the abandoned storm drain segment. Since the primary constituent in the groundwater plume is TCE, the distribution of TCE is similar to the distribution of total VOCs, as shown on Figure 26b, which is an isoconcentration map of TCE concentrations in groundwater. This contrasts significantly with the distribution of carbon tetrachloride, which is also a significant plume constituent, as illustrated by the isoconcentration map shown on Figure 26c. Elevated concentrations of carbon tetrachloride are restricted to the vicinity of the Building 51A active catch basin, suggesting that its primary release source was also close to the catch basin.

4.6 INTERPRETATION OF RESULTS

The source of the soil and groundwater contamination under the former location of Building 51A appears to have been releases from the abandoned storm drain segment between the two Building 51A catch basins. This interpretation is supported by the following lines of evidence:

- The highest concentrations of contaminated soil and groundwater and elevated MIP detector responses have been detected along the abandoned storm drain alignment and contamination levels decrease significantly within a few feet laterally (eastwards or westwards) away from the abandoned storm drain.
- The top of contamination appears to be at a depth of 6 to 7 feet, the approximate depth of the abandoned storm drain at its southern end.

Contamination appears to extend down through the entire thickness of the artificial fill and colluvium overlying the bedrock, but does not appear to be present within the bedrock. Based on the regional groundwater flow direction shown on Figure 4, groundwater flows generally northwards in this area. A local groundwater elevation map (Figure 27) was also constructed from data collected from new temporary groundwater sampling points SB51A-12-1, -2, -3, -4, -5, and -6 shortly after their development in February 2012. These data are consistent with the regional groundwater flow direction, but also appear to indicate that the local gradient is steep and directed towards groundwater extraction well EW51A-06-1 and/or the Building 51L remedial excavation. The Building 51L remedial excavation functions as a large extraction trench because the base of the excavation was backfilled with gravel and extraction well EW51L-06-1 was screened within the gravel backfill.

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Figure 27. Local Groundwater Elevation Map of Building 51A Area, February 2012.

MW51-96-16	Groundwater monitoring well
MW90-6	Properly destroyed monitoring well
T SB51-11-1	Temporary groundwater sampling point
T SB64-98-16	Properly destroyed sampling point
	Groundwater extraction well
	Soil boring
	Angled boring
	Membrane interface probe boring
	Groundwater extraction well
	Soil vapor sampling point
GAC	Groundwater treatment system

NOTES:
All other symbols used are explained on the figures.

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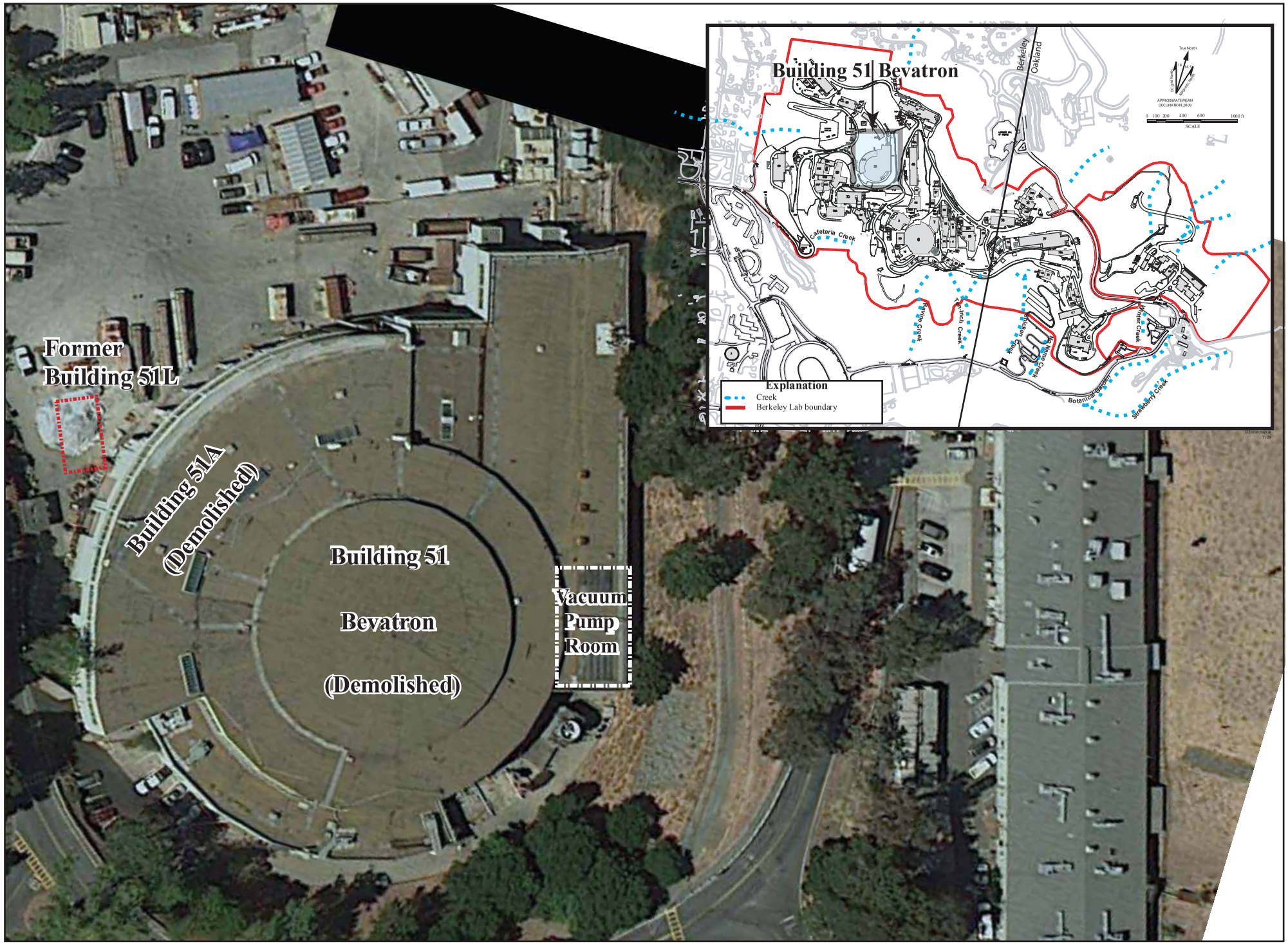
Key to Symbols Used on Figures.



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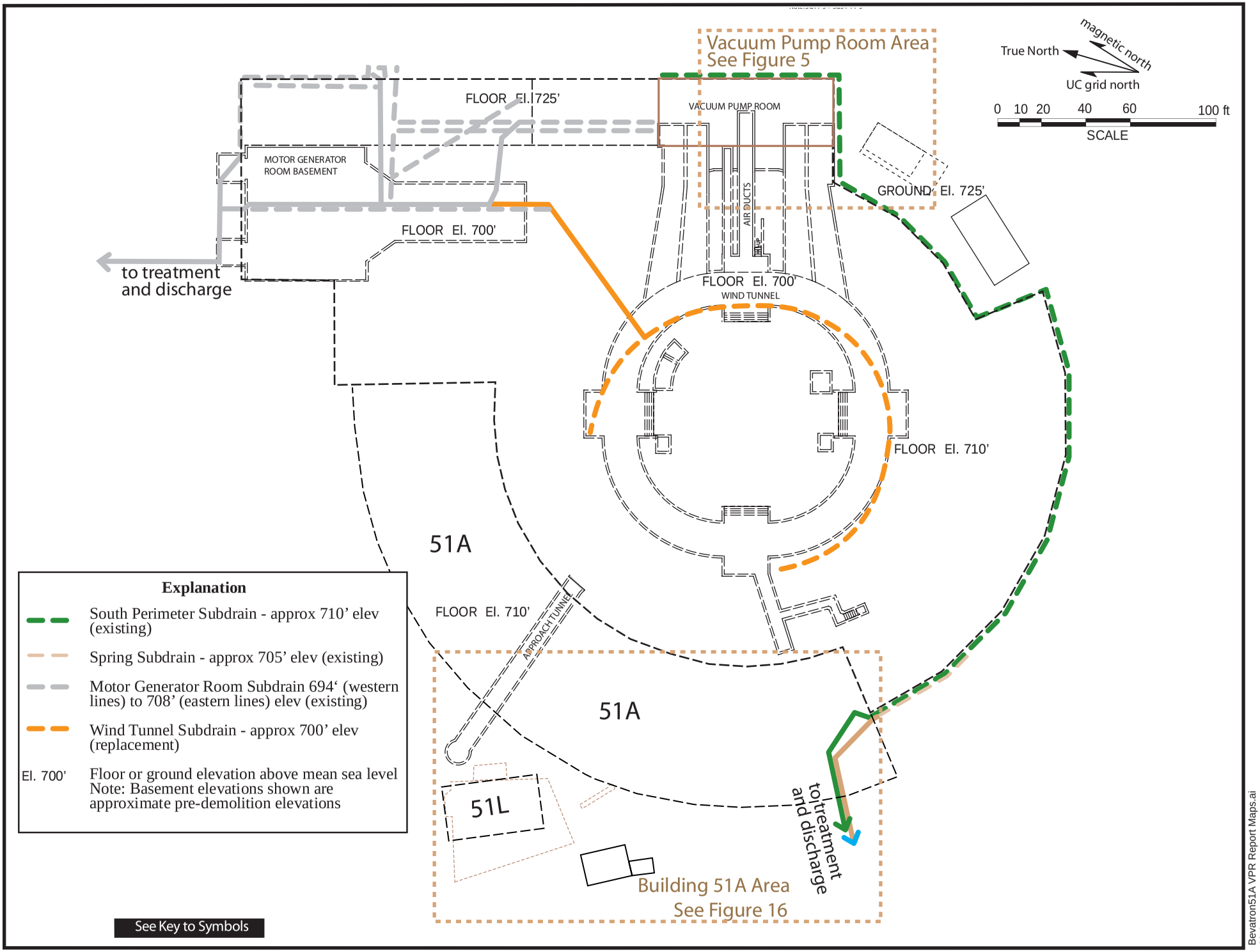

Figure 3. Location of Vacuum Pump Room Area, Building 51A Area and Subdrain Systems, Former Building 51 Site

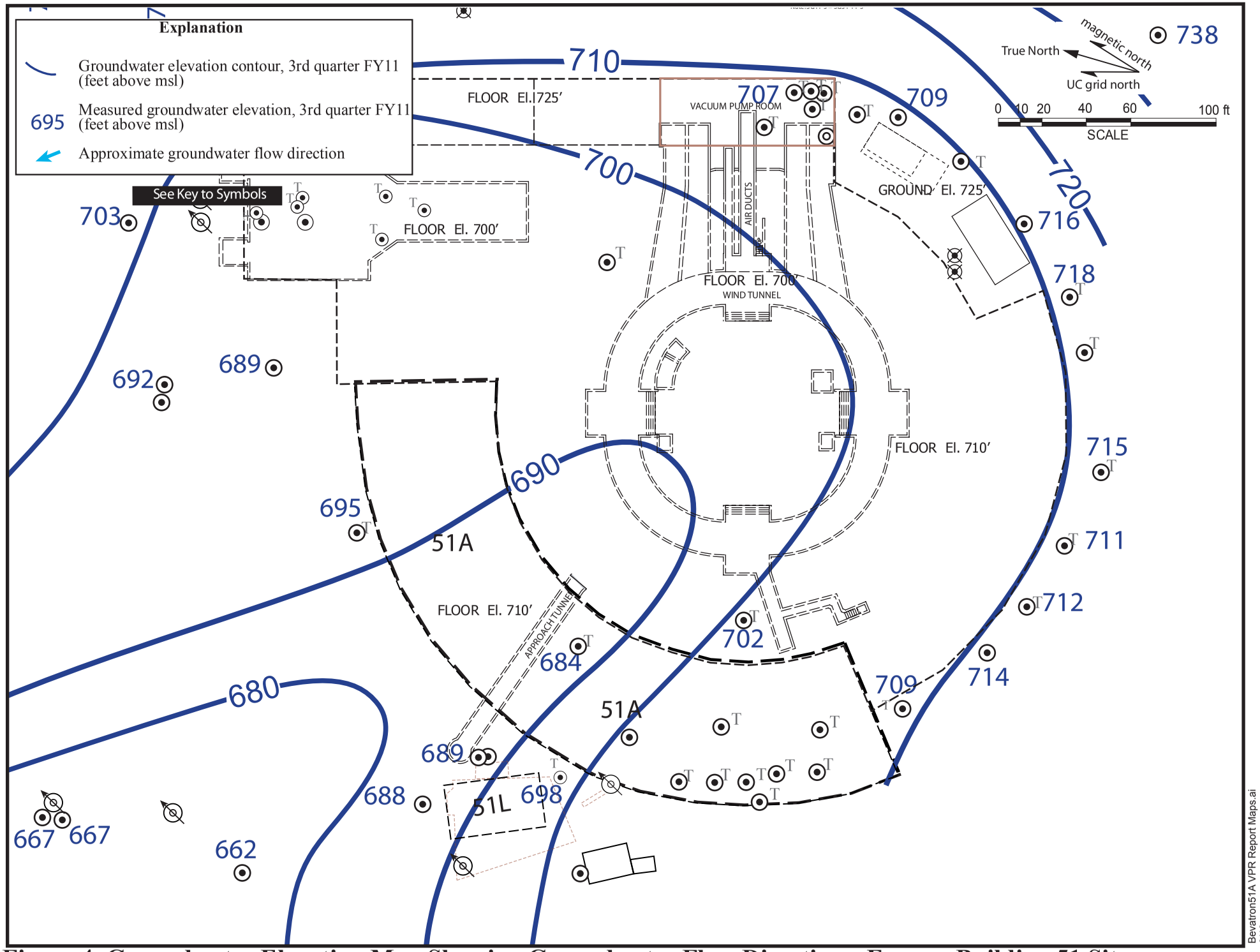

Figure 4. Groundwater Elevation Map Showing Groundwater Flow Directions, Former Building 51 Site

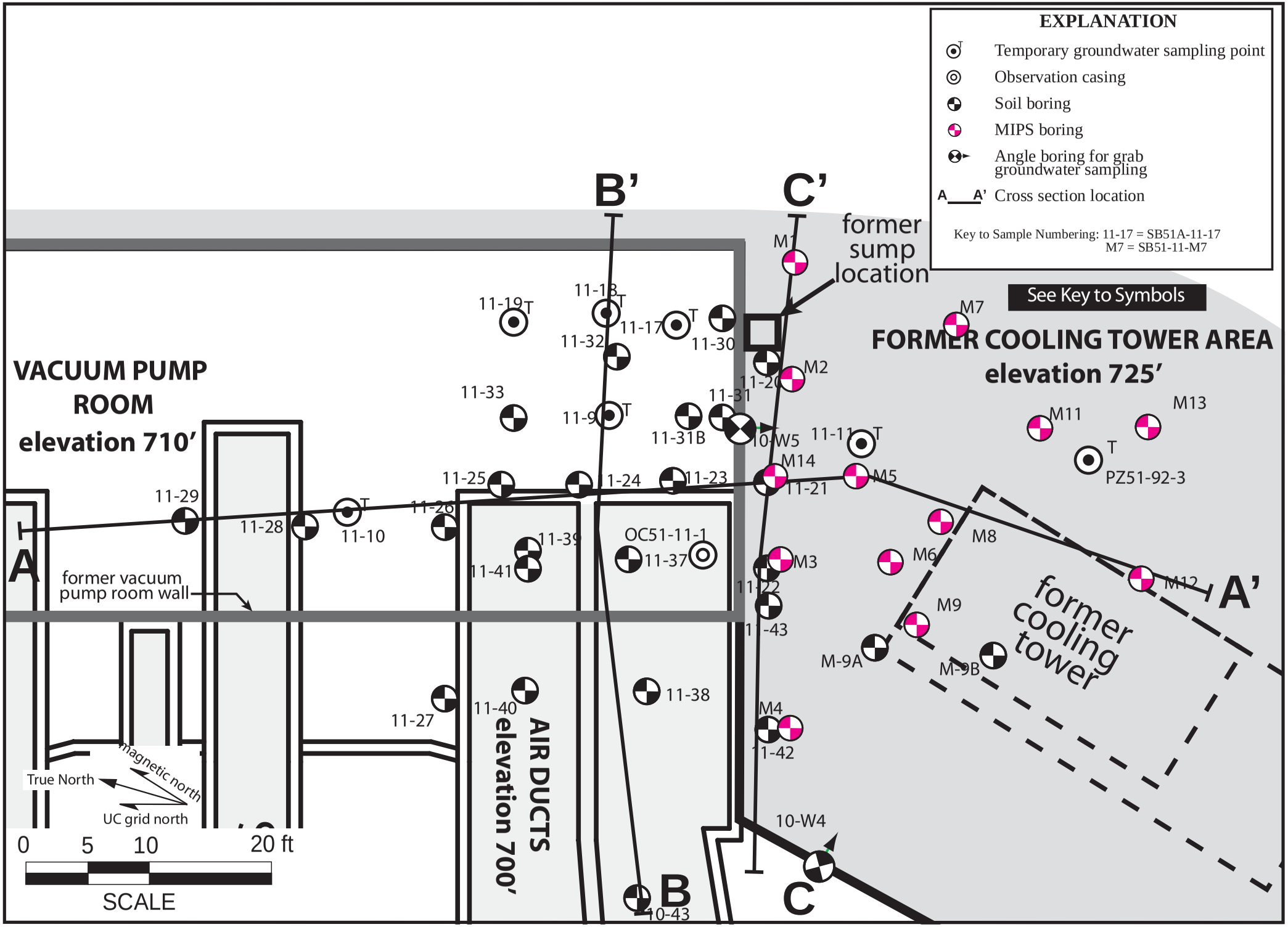

Figure 5. Boring, Well and Cross Section Location Map, Vacuum Pump Room Area.

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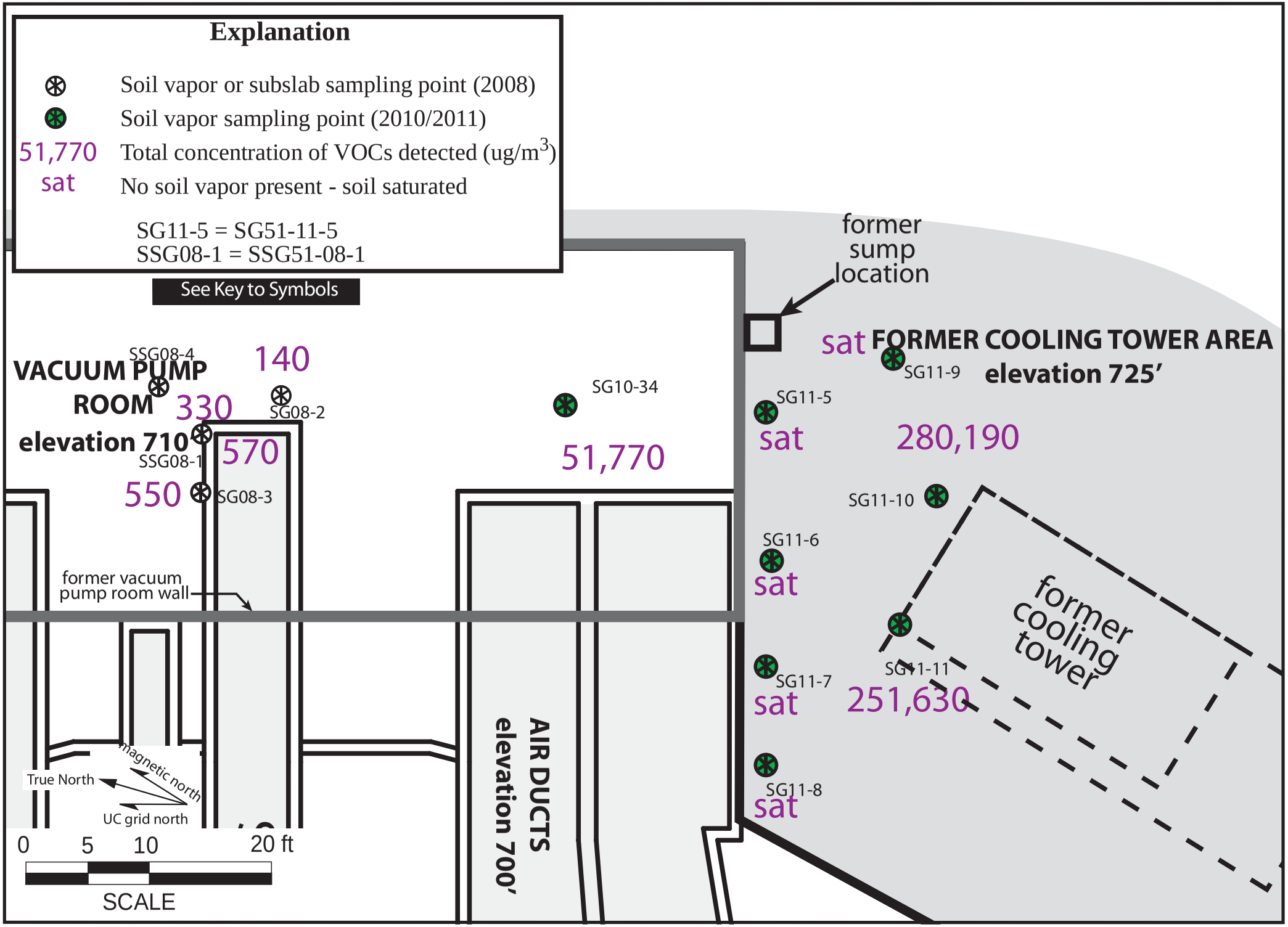

Figure 6. Total Volatile Organic Compounds in Soil Vapor and Subslab Vapor, Vacuum Pump Room Area.

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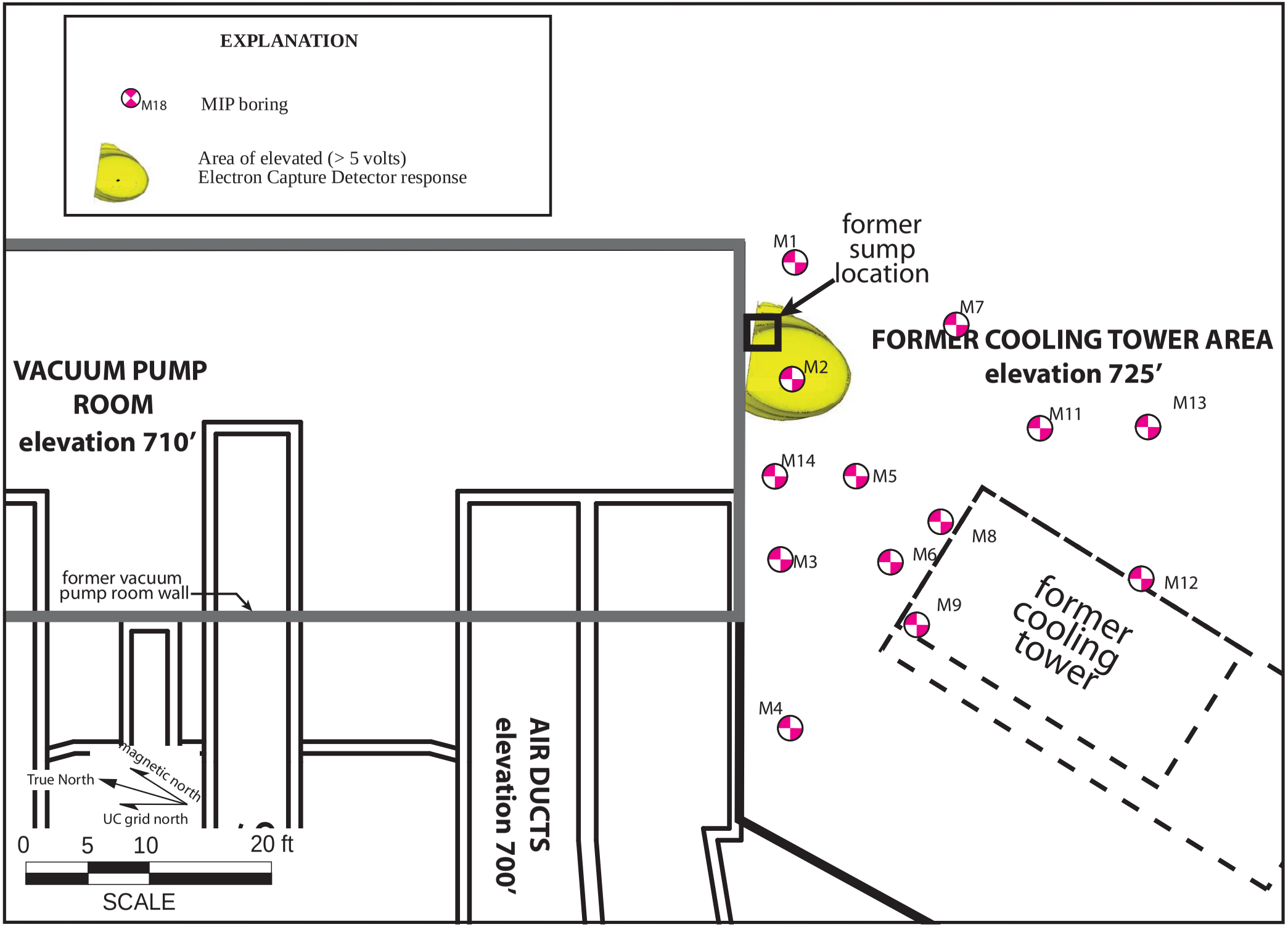

Figure 7. Membrane Interface Probe Electron Capture Detector Response, Building Vacuum Pump Room Area.

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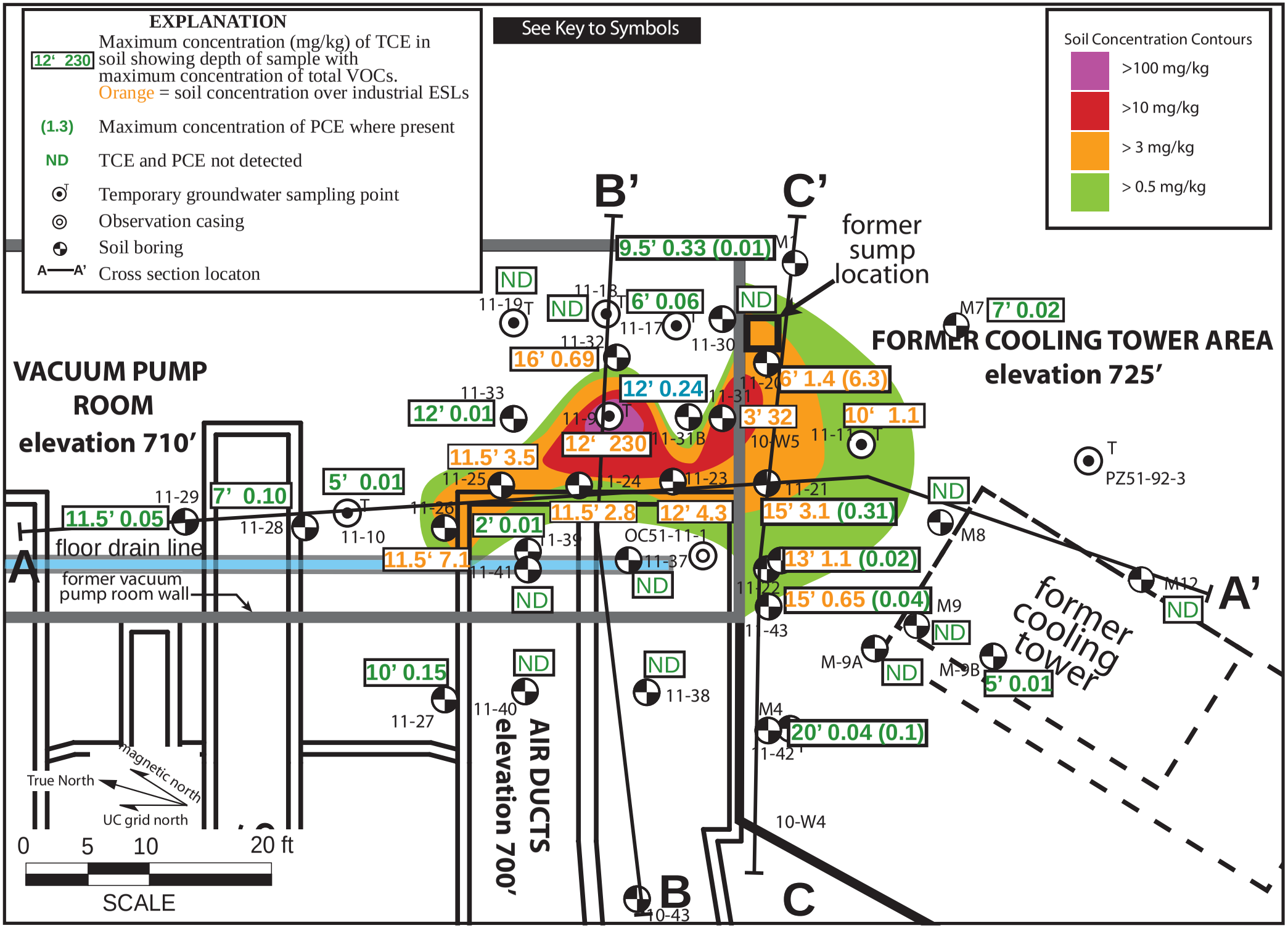

Figure 8. Concentrations of TCE and (PCE) Detected in Soil, Vacuum Pump Room Area.

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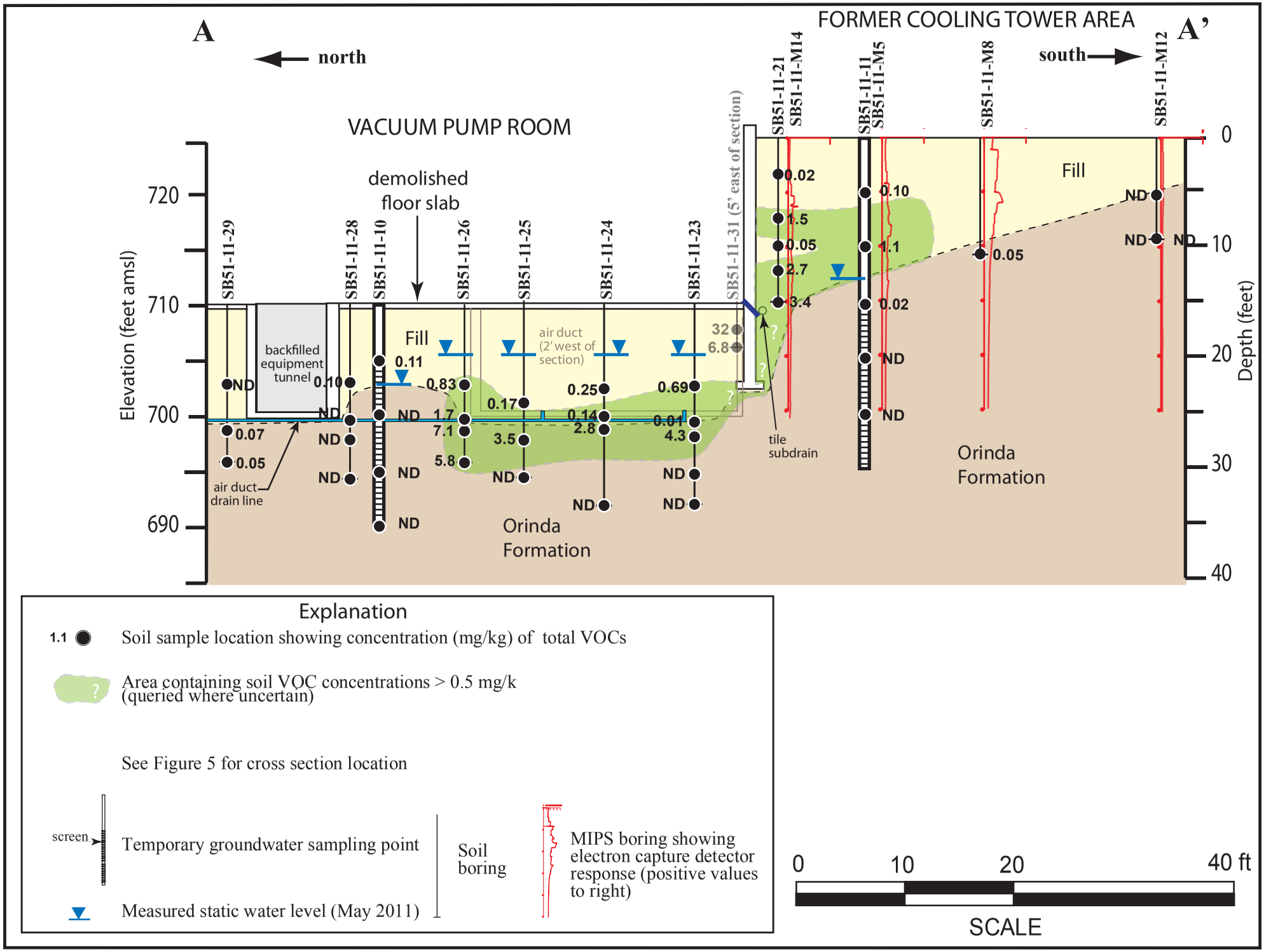
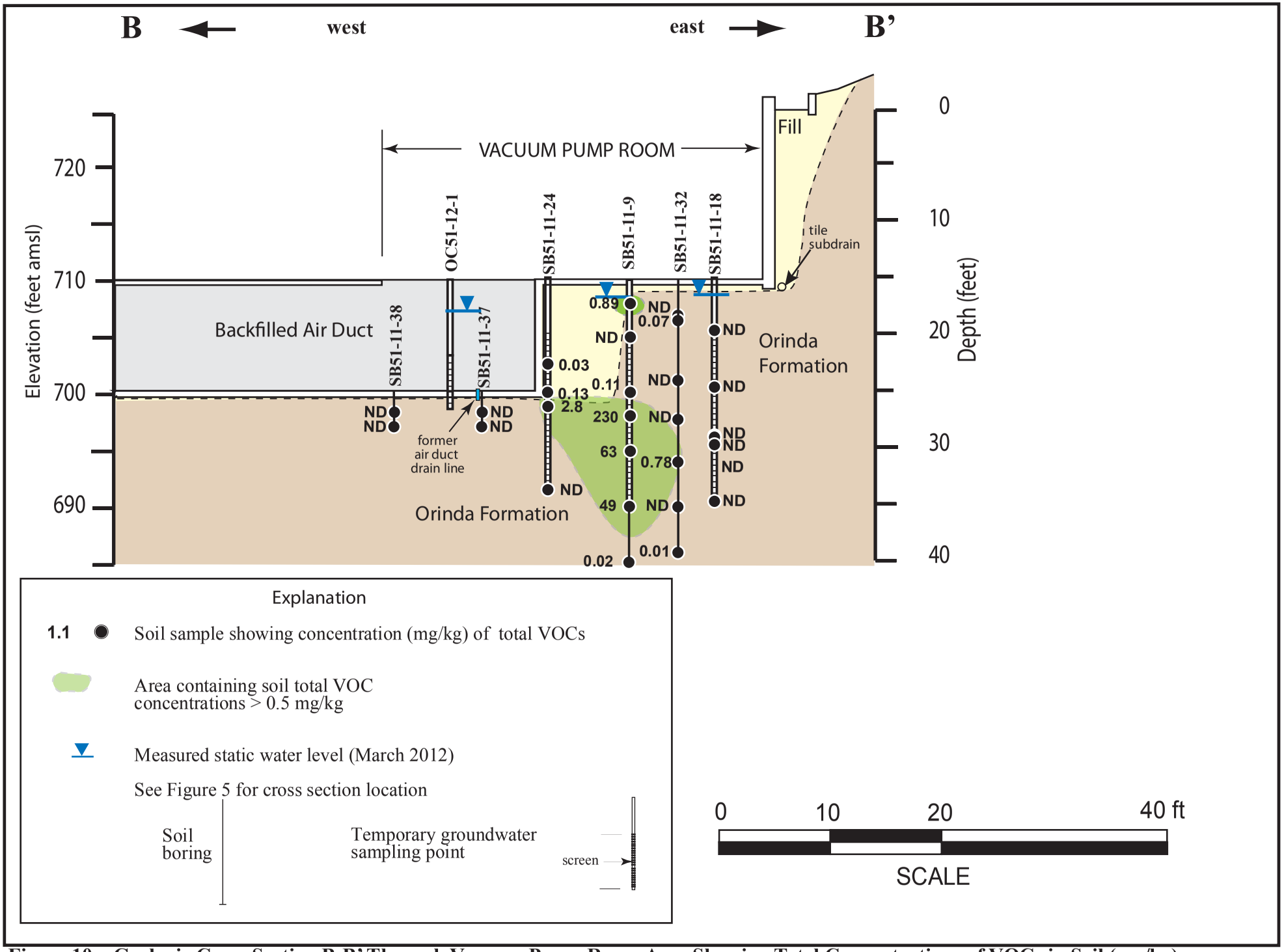


Figure 9. Geologic Cross Section A-A' Through Vacuum Pump Room Area Showing Total Concentrations of VOCs in Soil (mg/kg) and MIP ECD Responses.



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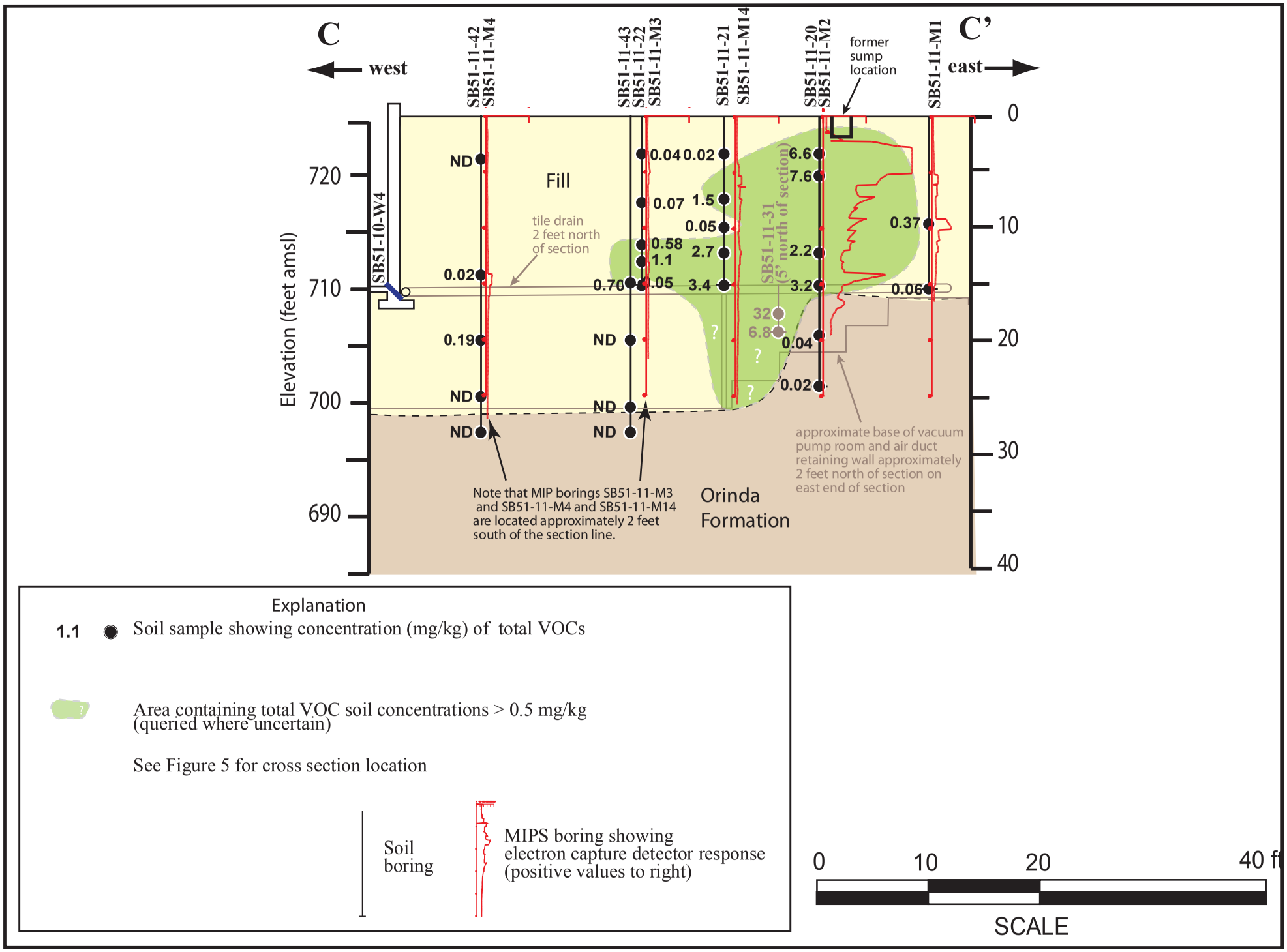


Figure 11. Geologic Cross Section C-C' Through Vacuum Pump Room Area Showing Total Concentrations of VOCs in Soil (mg/kg) and MIP ECD Responses.

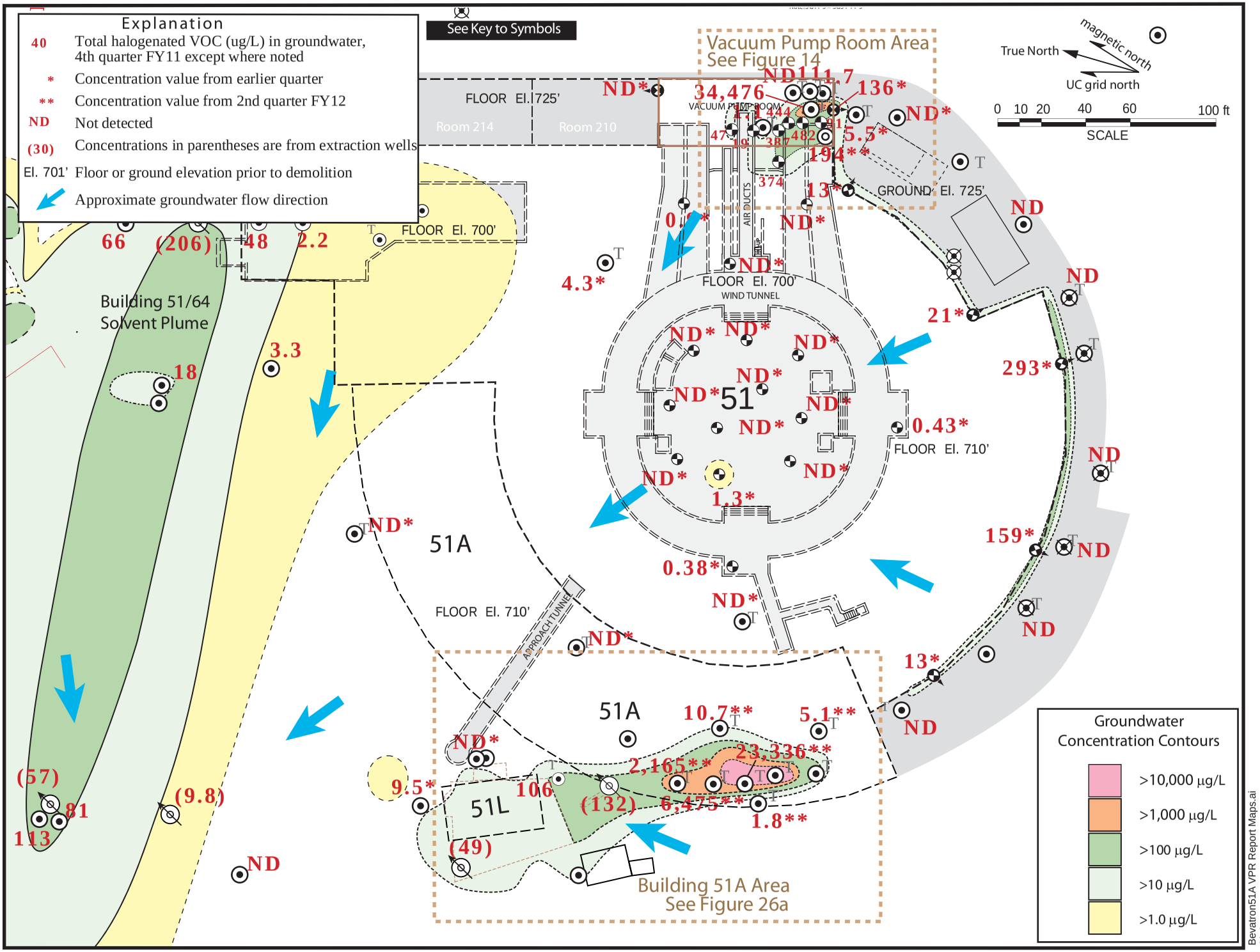
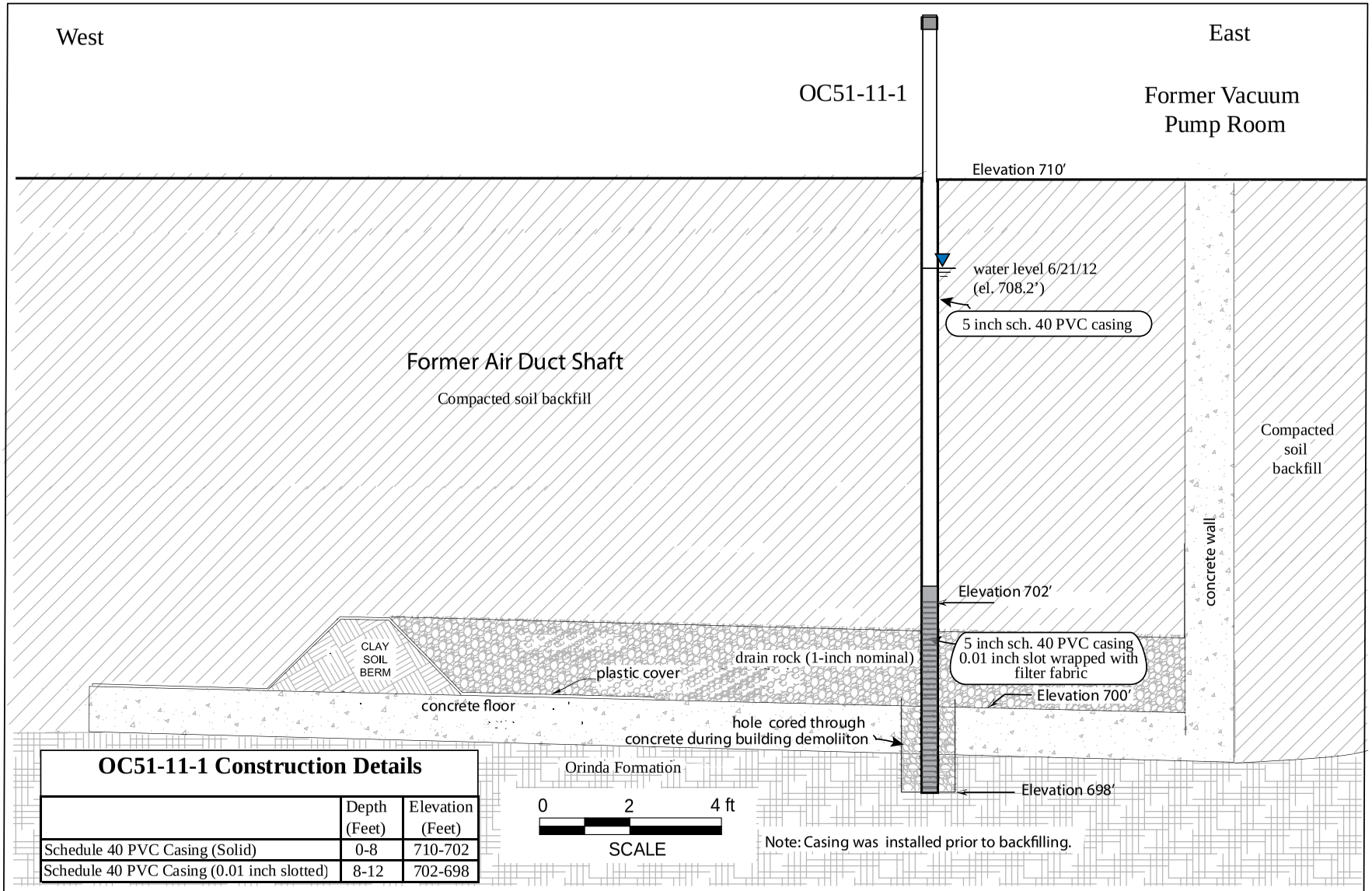


Figure 12. Isoconcentration Contour Map of Total Volatile Organic Compounds Detected in Groundwater During 4th Quarter FY11, Former Building 51 Site



OC51-11-1 Construction Details

	Depth (Feet)	Elevation (Feet)
Schedule 40 PVC Casing (Solid)	0-8	710-702
Schedule 40 PVC Casing (0.01 inch slotted)	8-12	702-698

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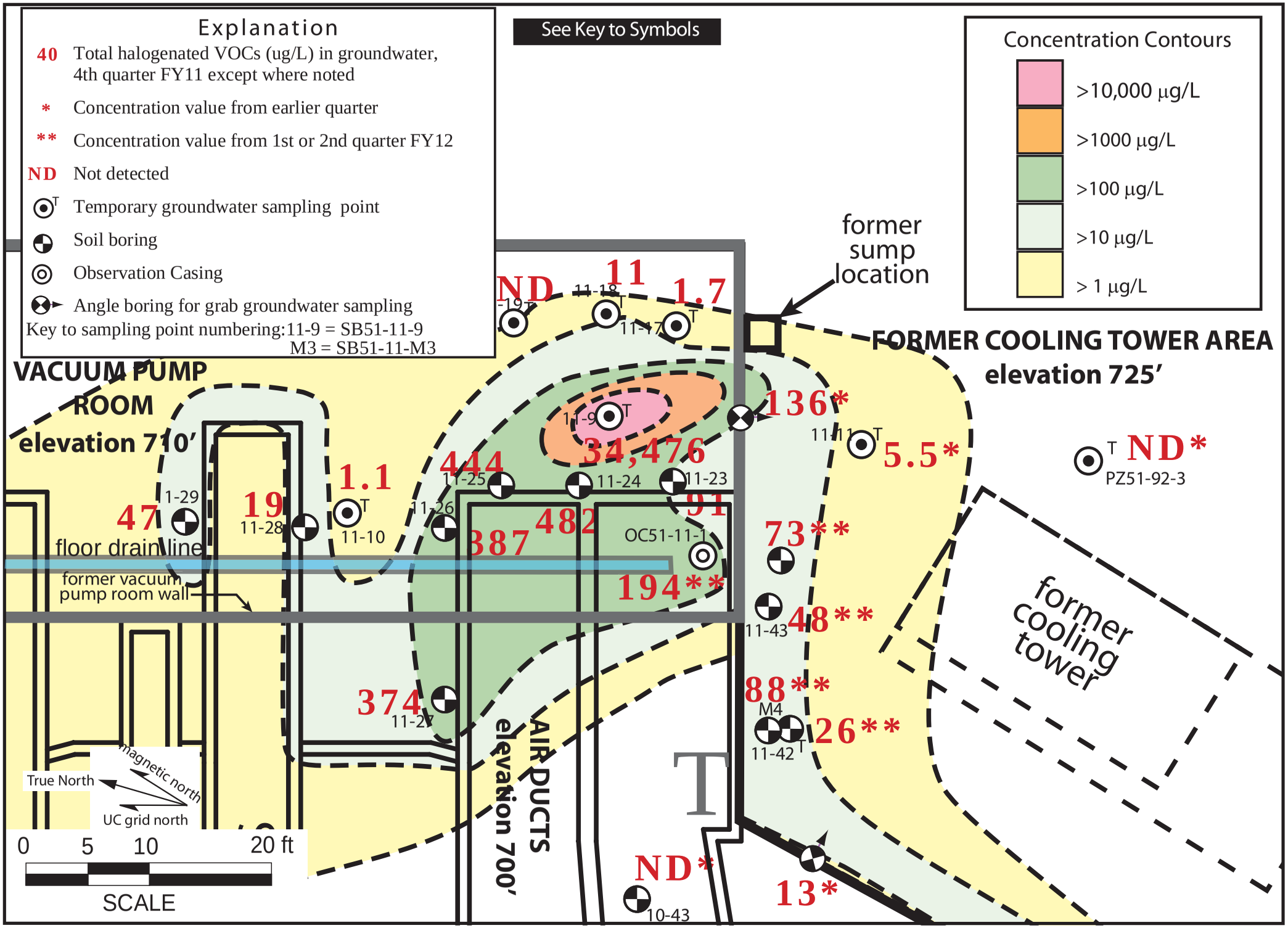
Figure 13. Construction Details for Observation Well OC51-11-1.



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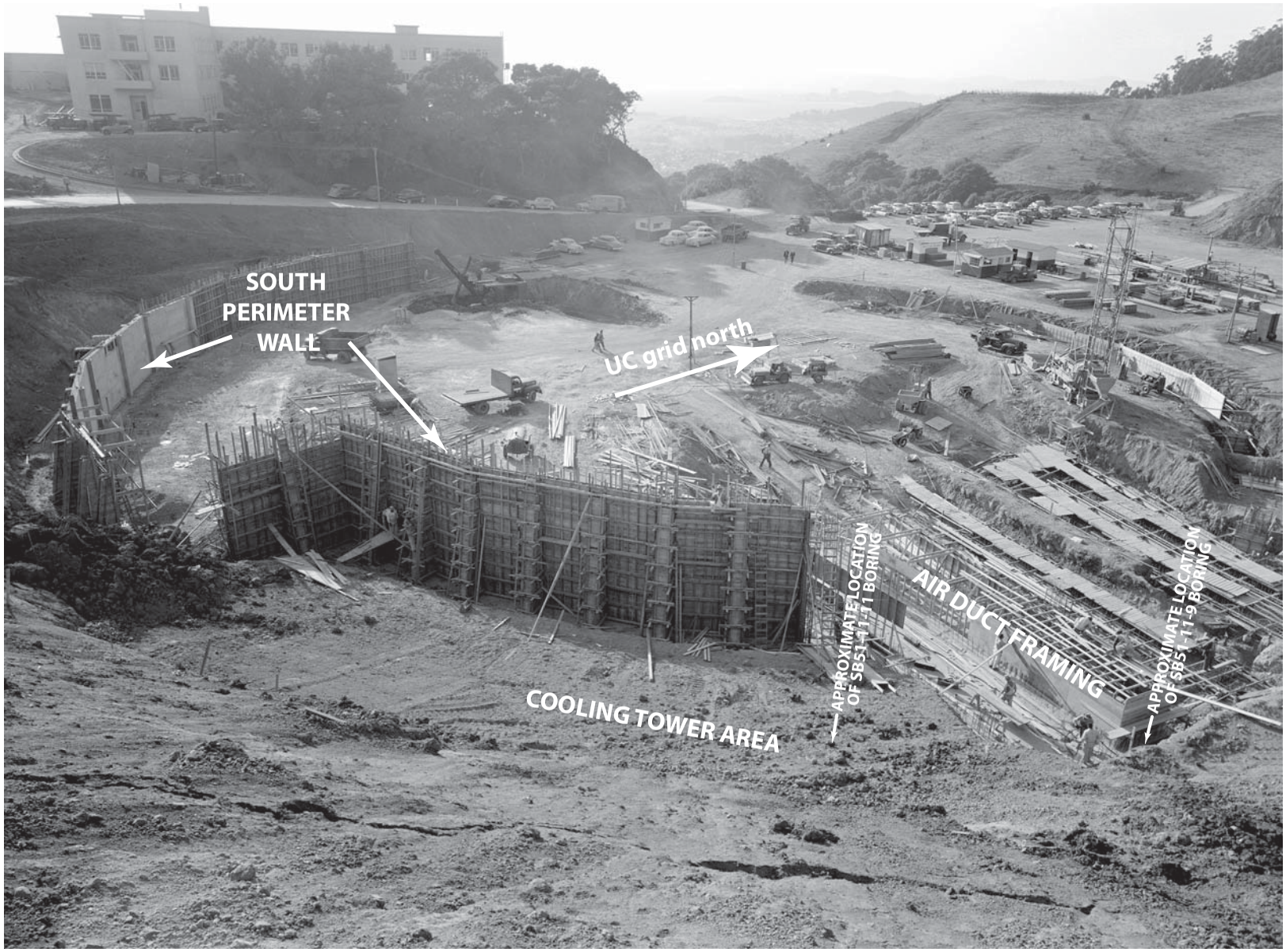


Figure 15. Bevatron Overview During Construction of Air Ducts and South Perimeter Wall.

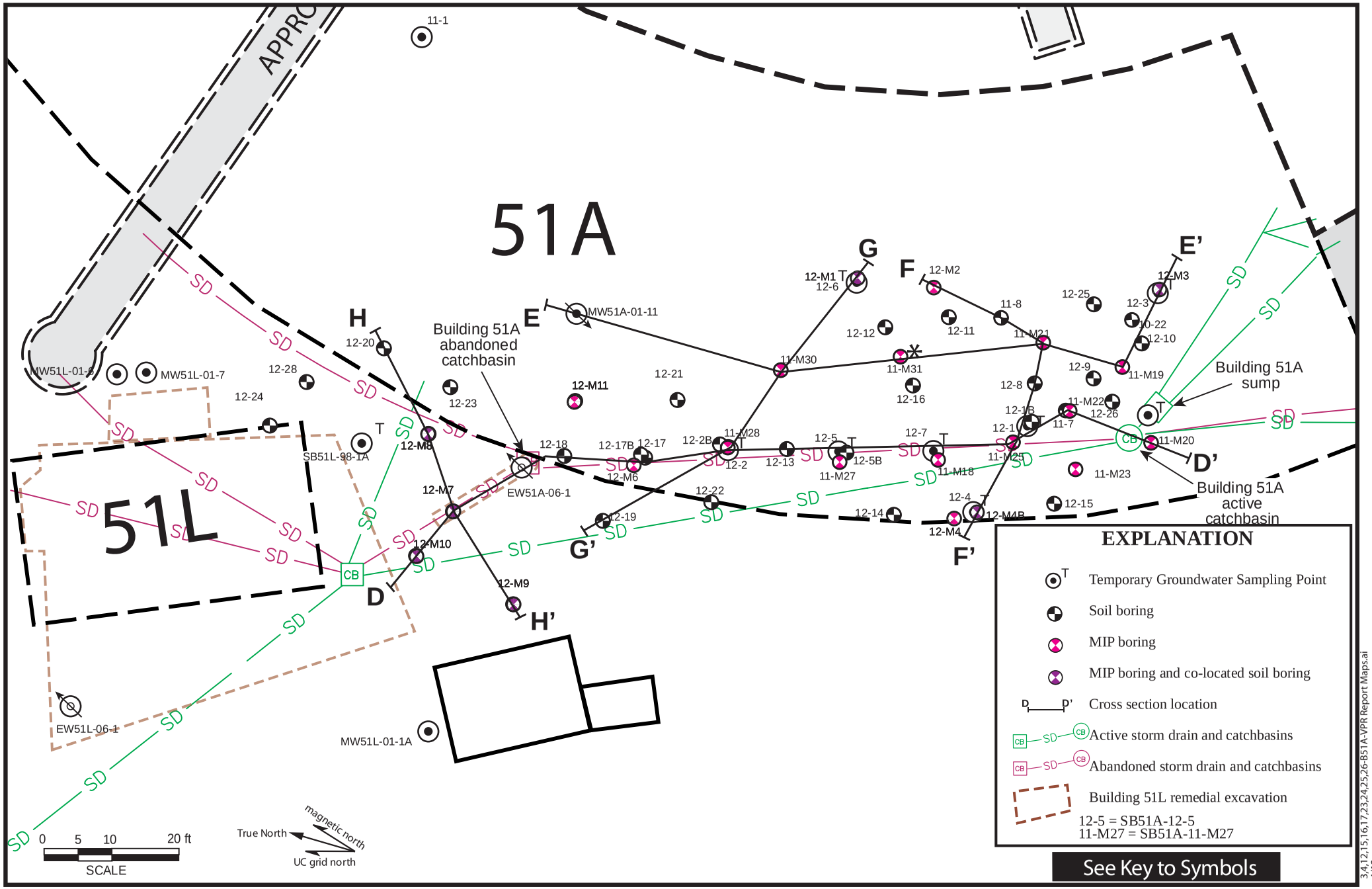


Figure 16. Boring, Well, and Cross Section Location Map, Building 51A Area.

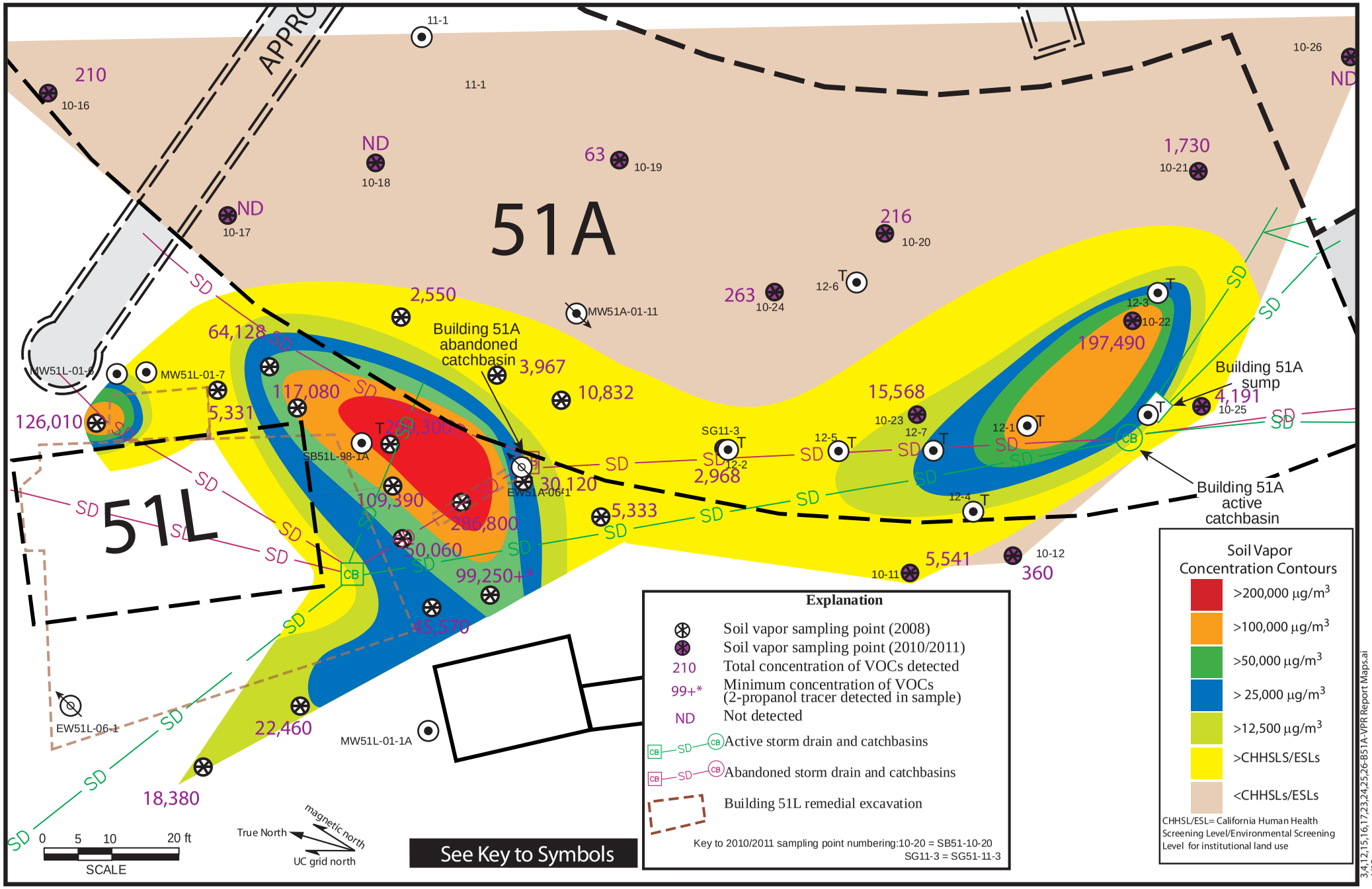


Figure 17. Isoconcentration Contour Map of Total Volatile Organic Compounds Detected in Soil Vapor, Building 51A/51L Area.

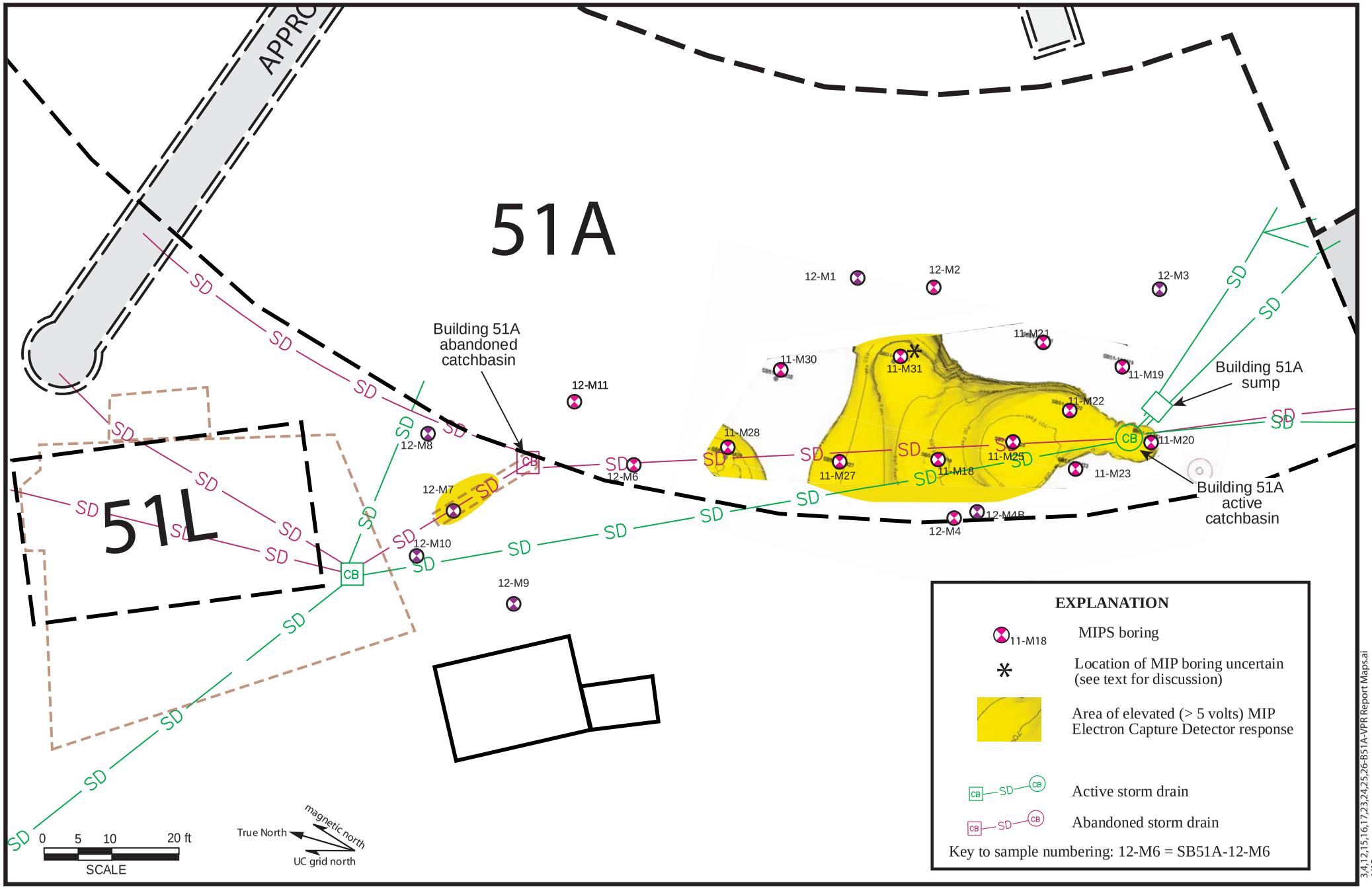


Figure 18. Membrane Interface Probe Electron Capture Detector Response, Building 51A Area.

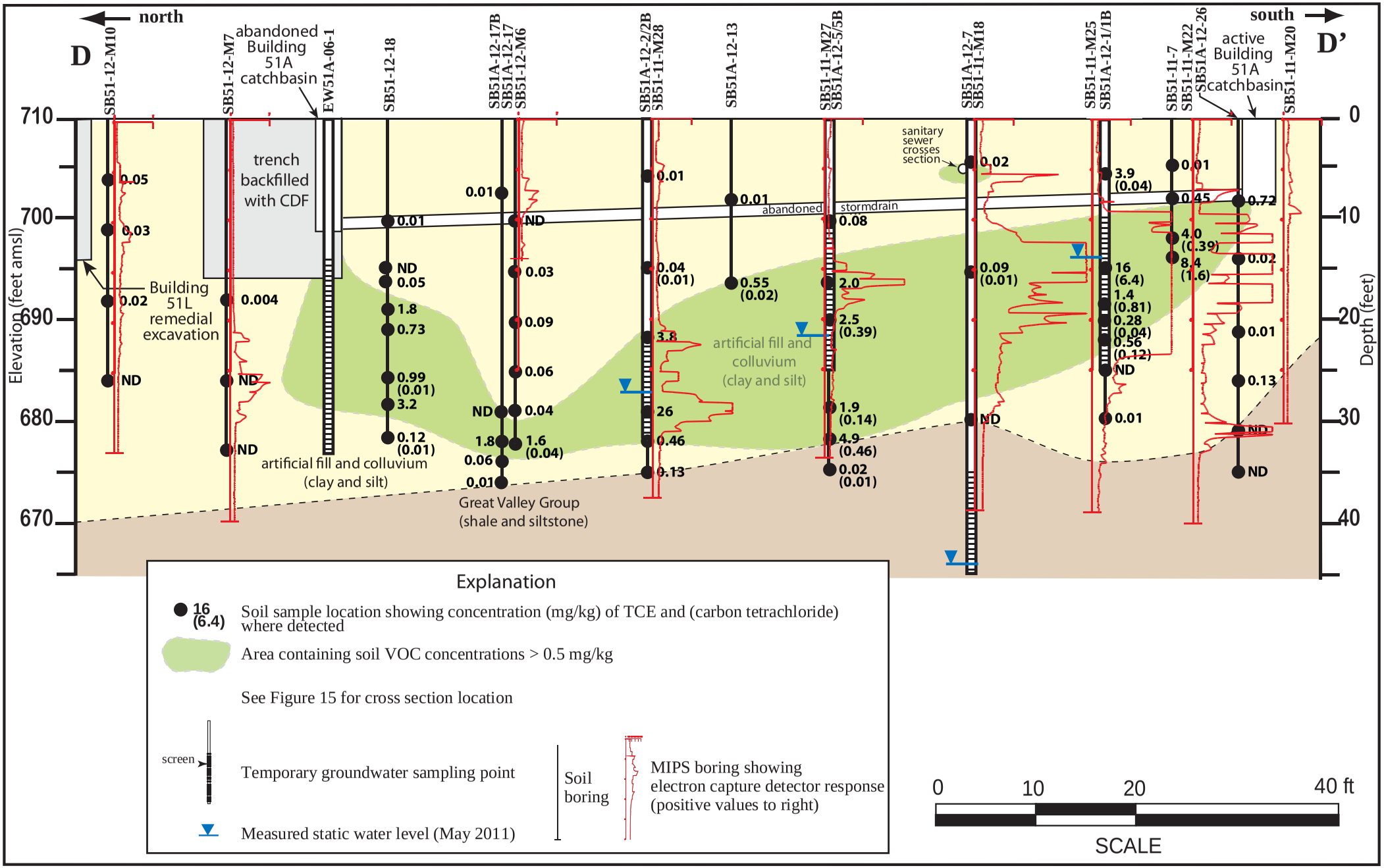
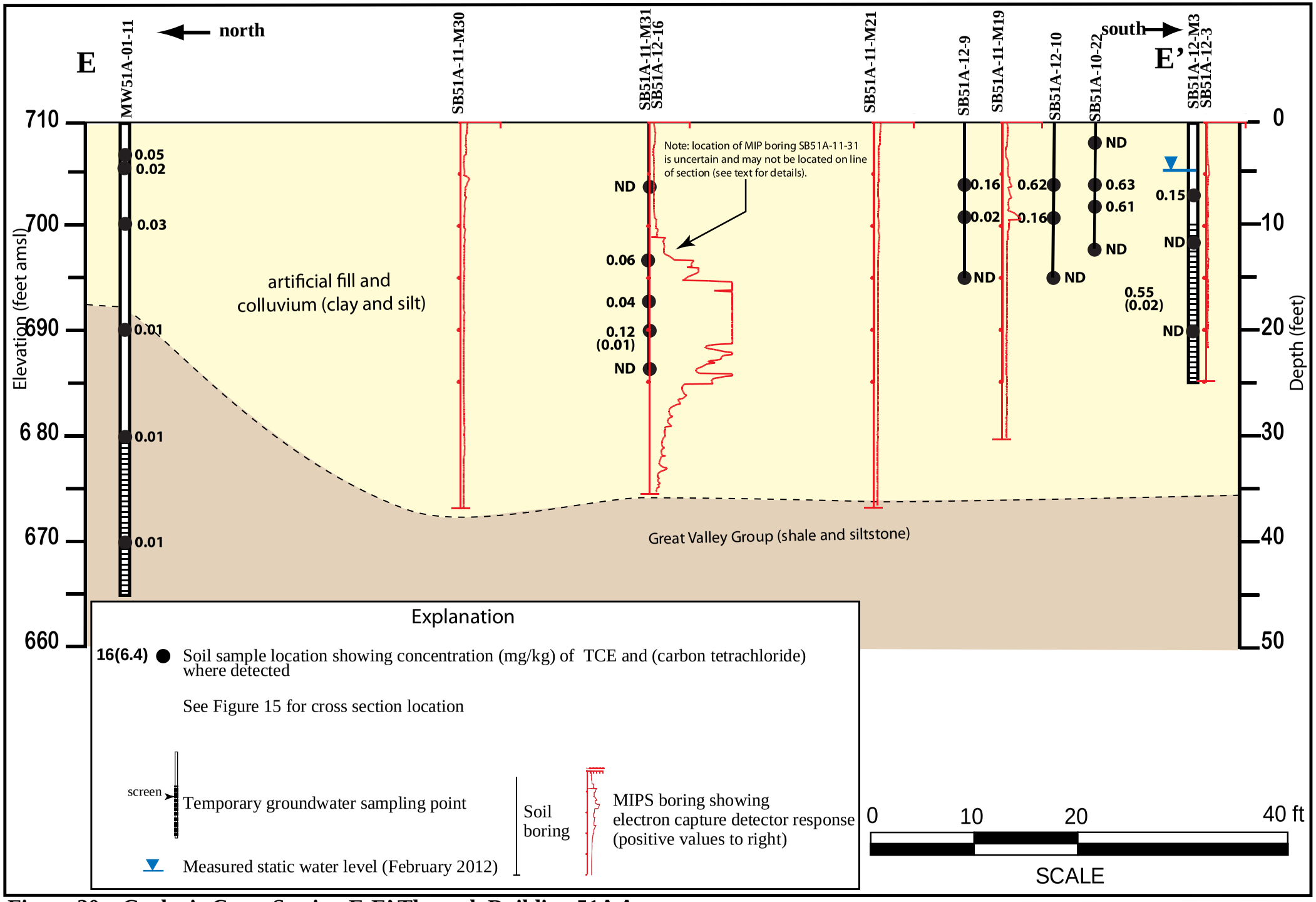


Figure 19. Geologic Cross Section D-D' Through Building 51A Area.



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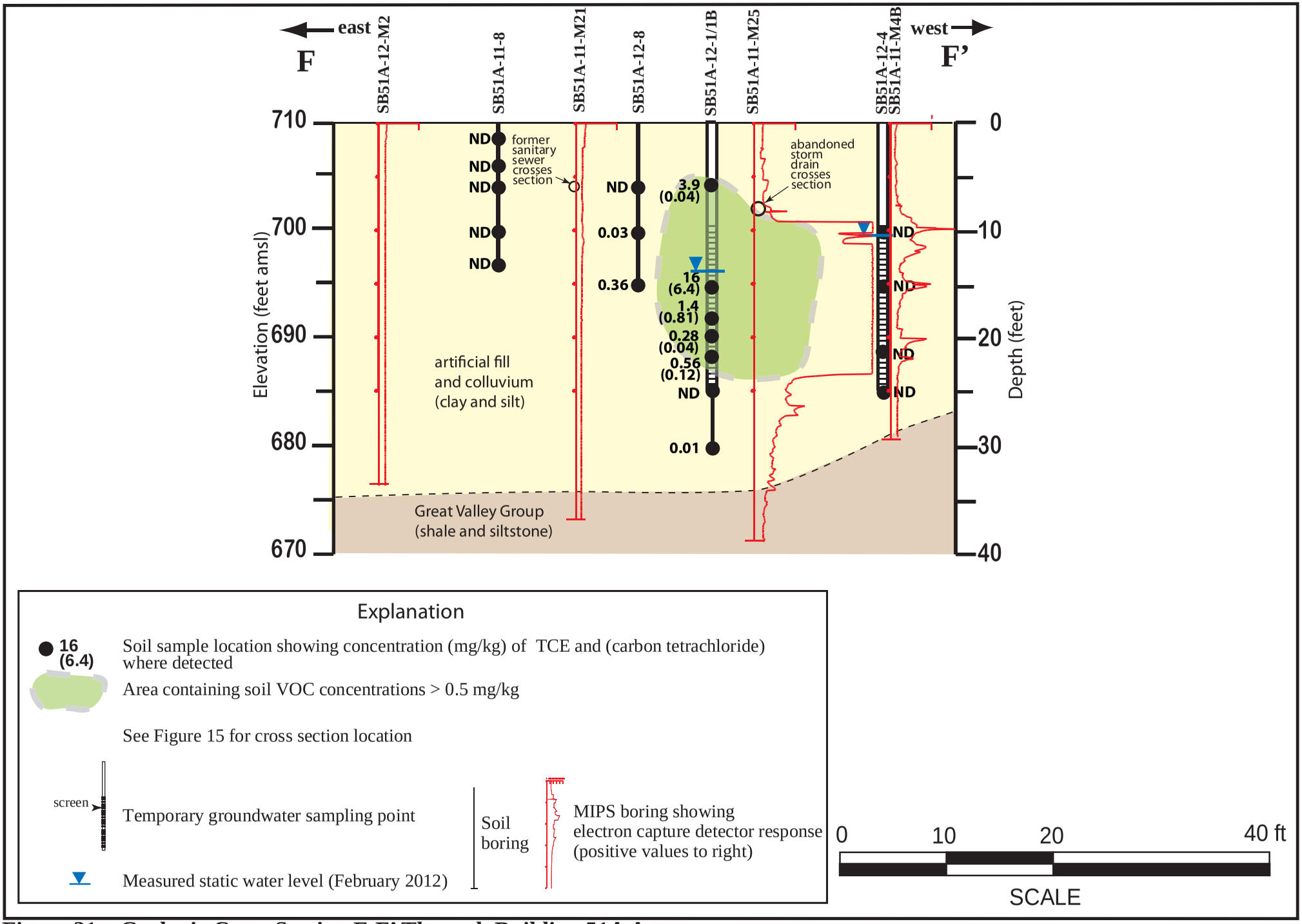

Figure 21. Geologic Cross Section F-F' Through Building 51A Area.

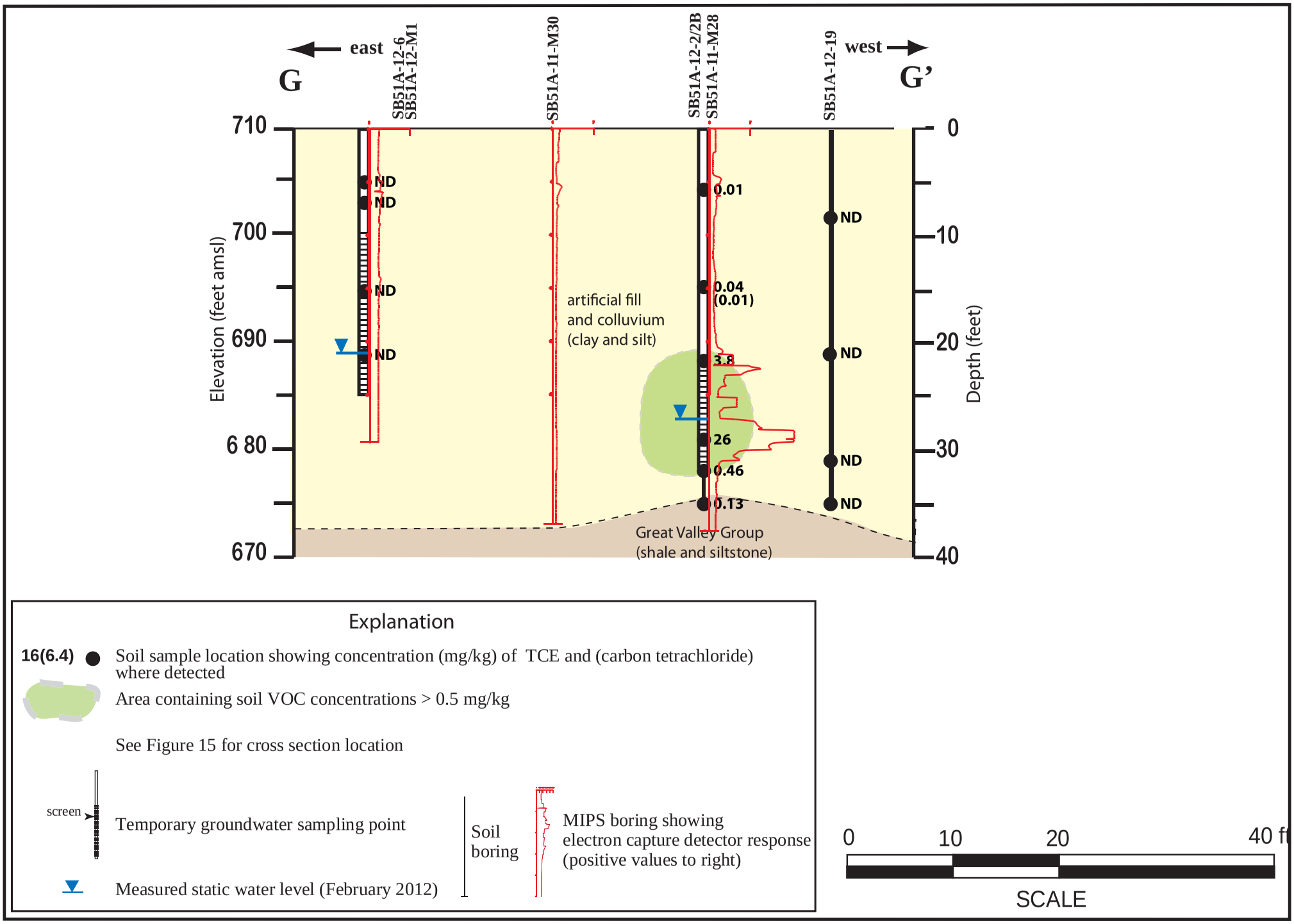

Figure 22. Geologic Cross Section G-G' Through Building 51A Area.

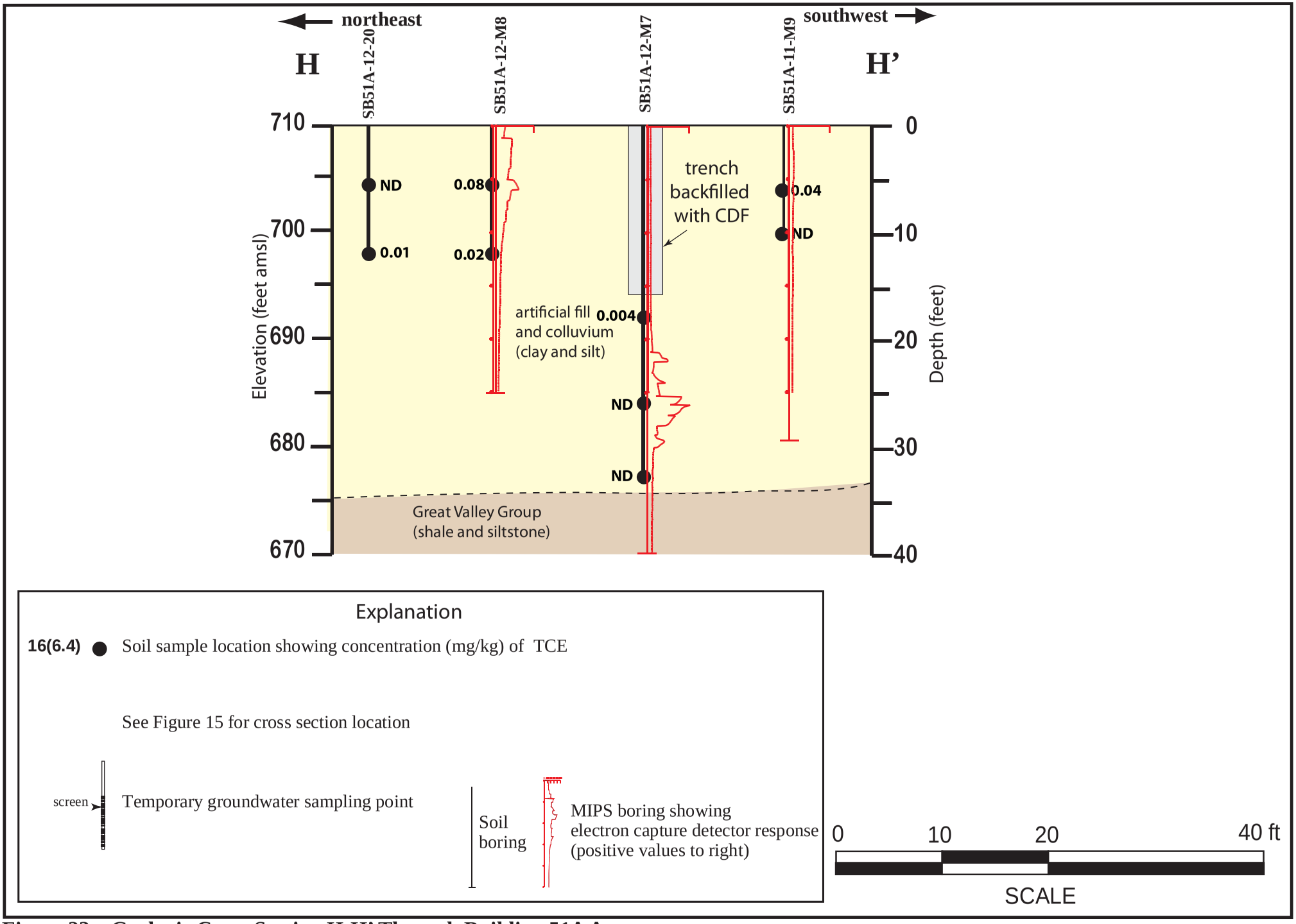

Figure 23. Geologic Cross Section H-H' Through Building 51A Area.

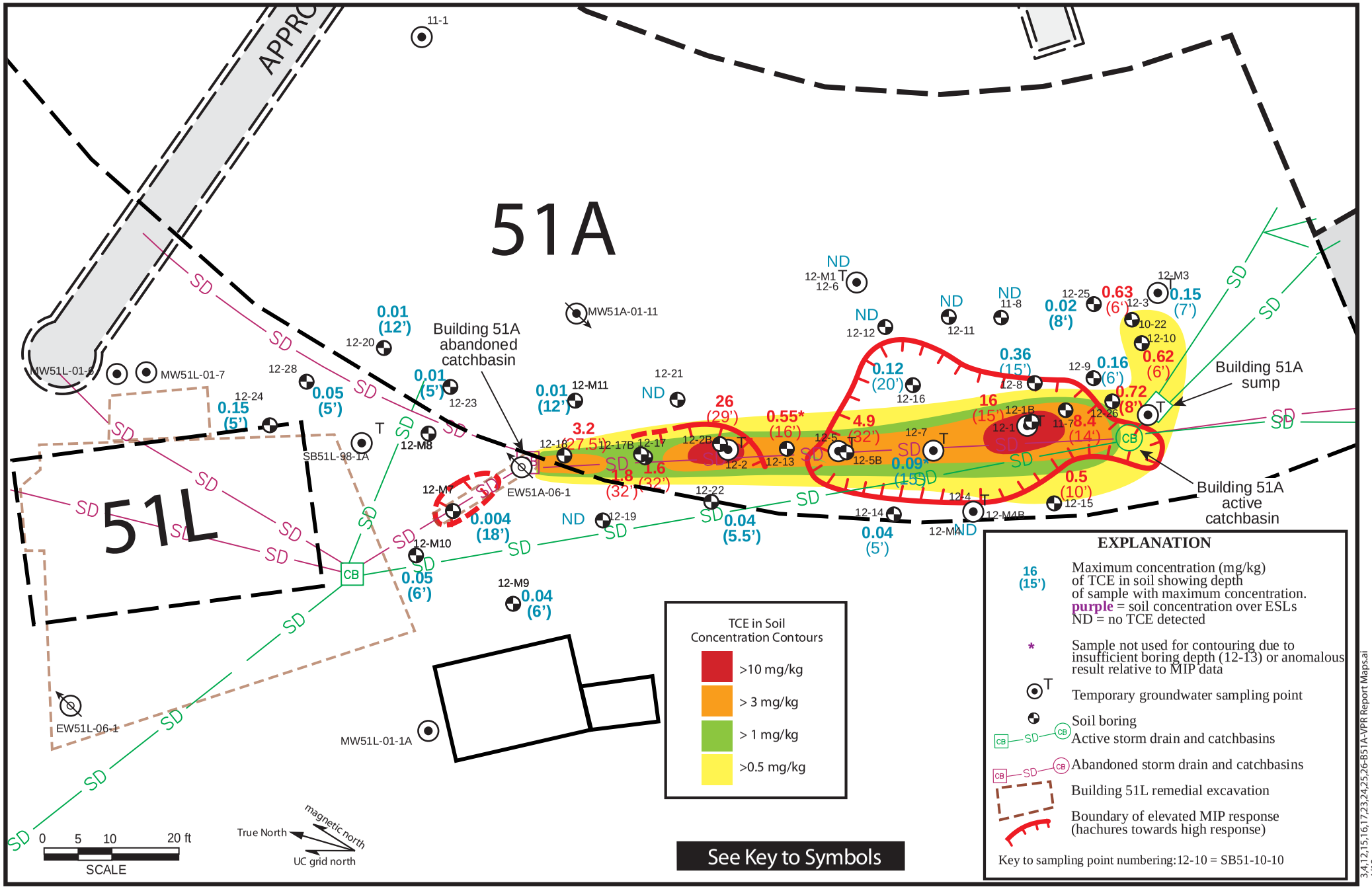

Figure 24. Maximum Concentrations of TCE Detected in Soil, Building 51A Area.

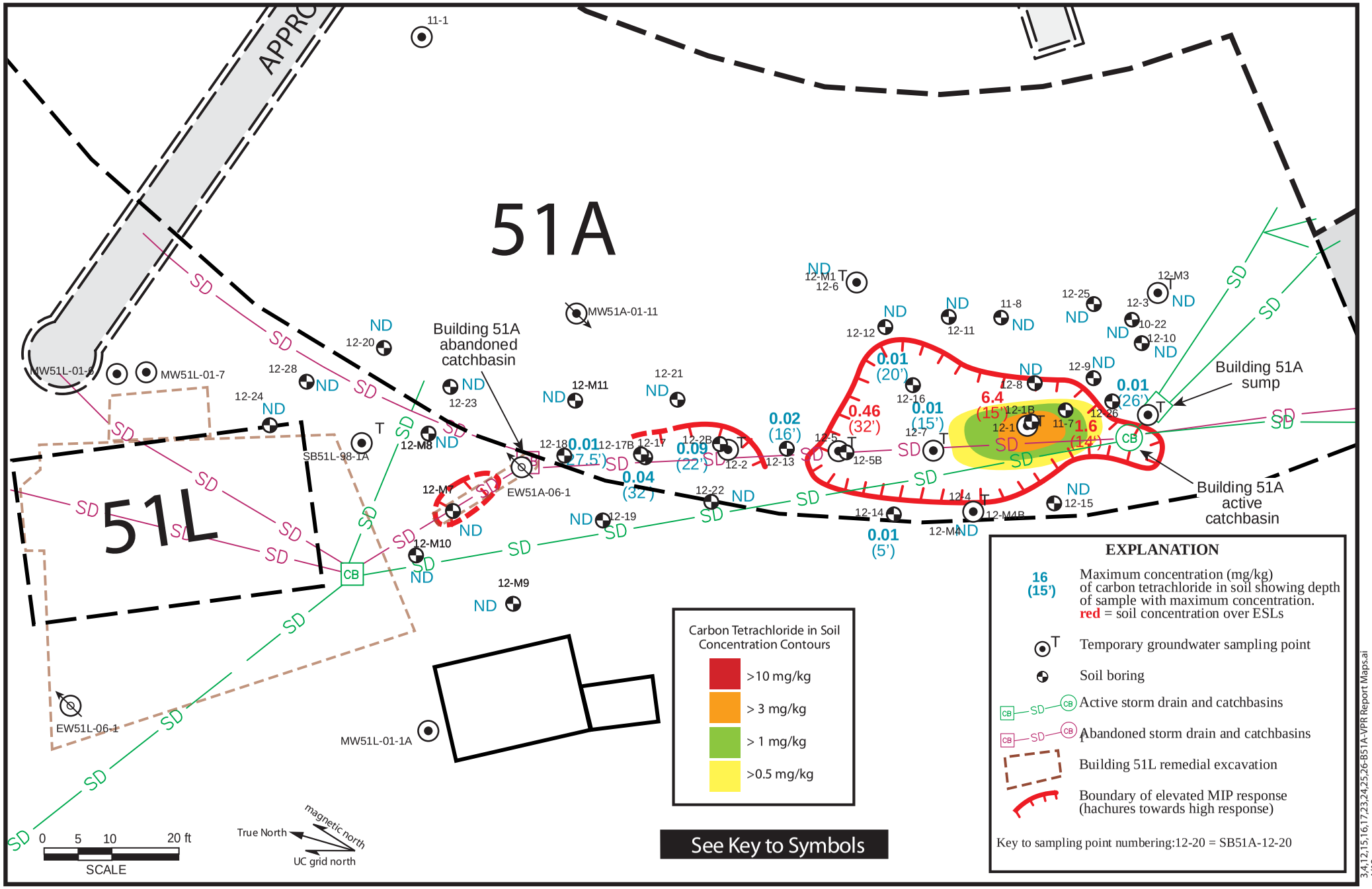

Figure 25. Maximum Concentrations of Carbon Tetrachloride Detected in Soil, Building 51A Area.

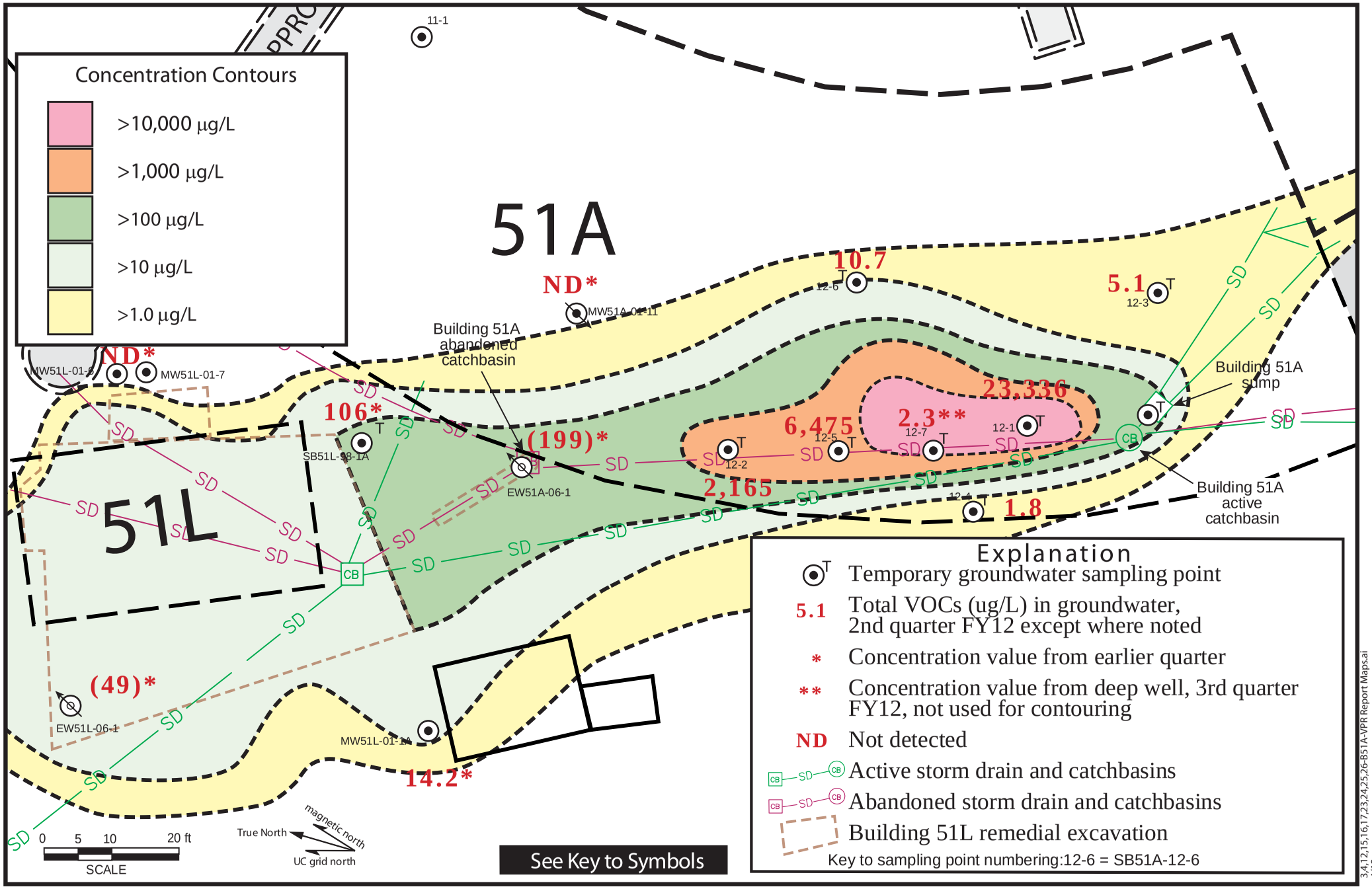

Figure 26a. Isoconcentration Contour Map of Total VOC Concentrations in Groundwater, Building 51A Area.

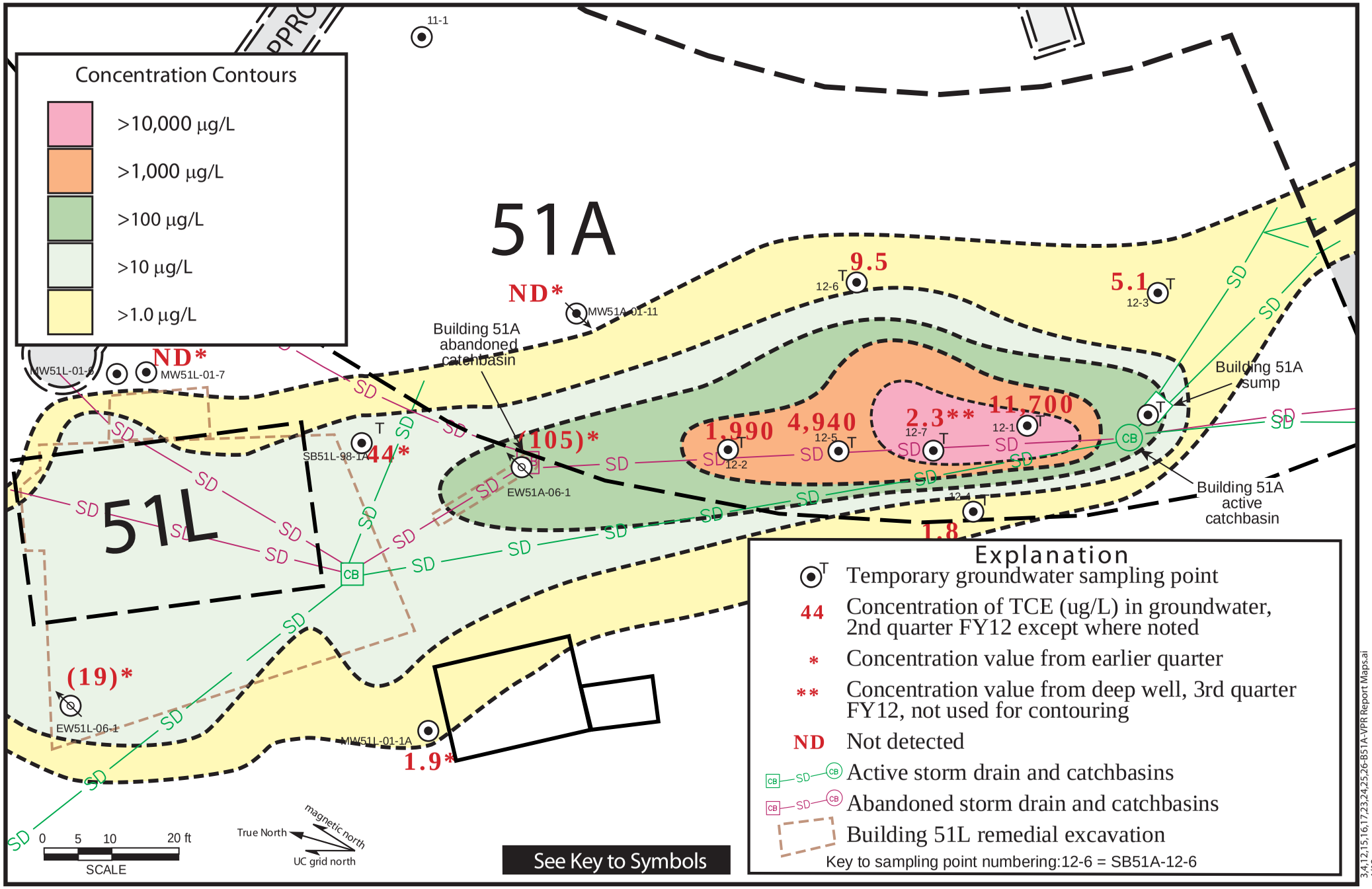

Figure 26b. Isoconcentration Contour Map of TCE Concentrations in Groundwater, Building 51A Area.

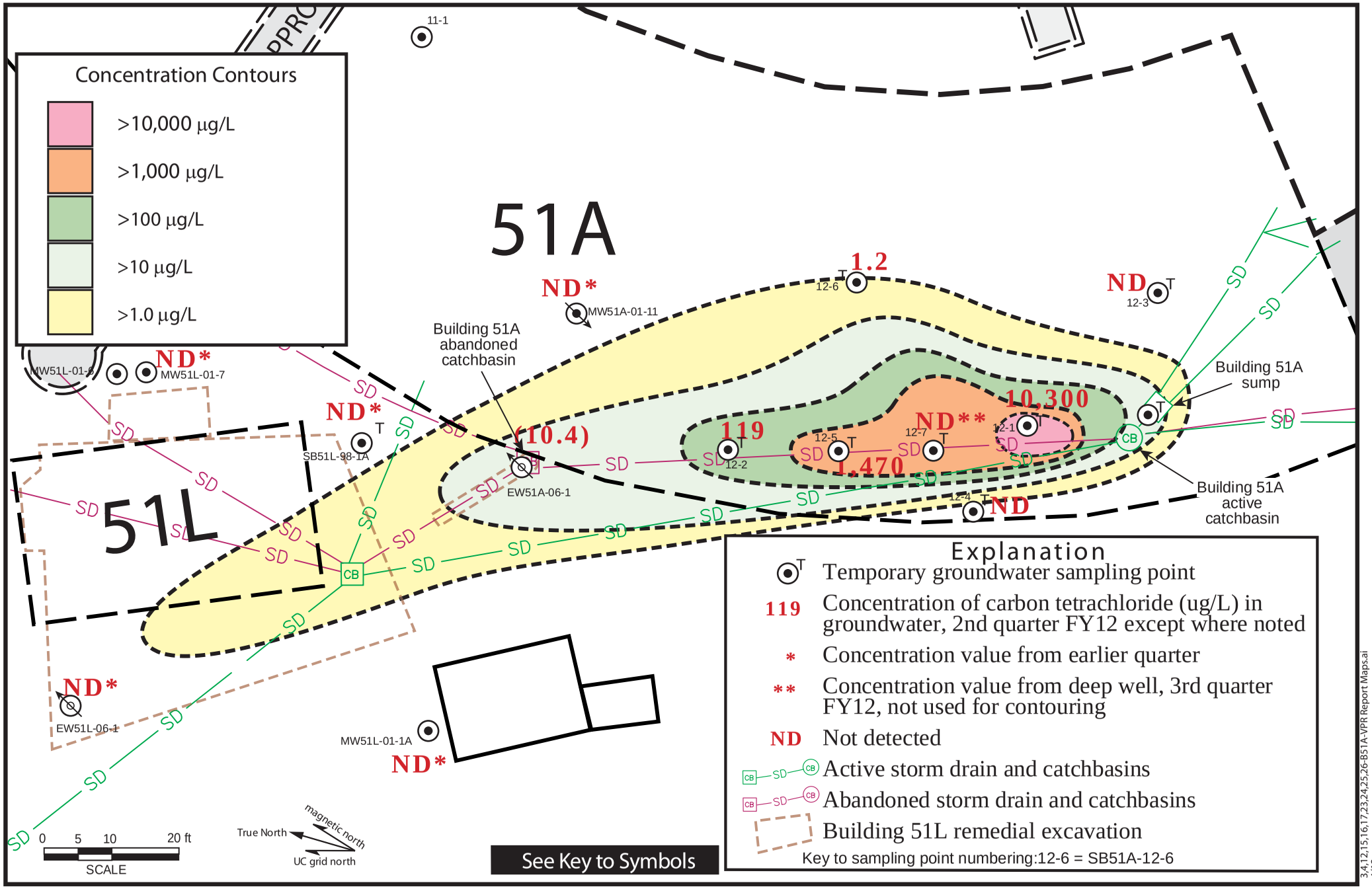

Figure 26c. Isoconcentration Contour Map of Carbon Tetrachloride Concentrations in Groundwater, Building 51A Area.

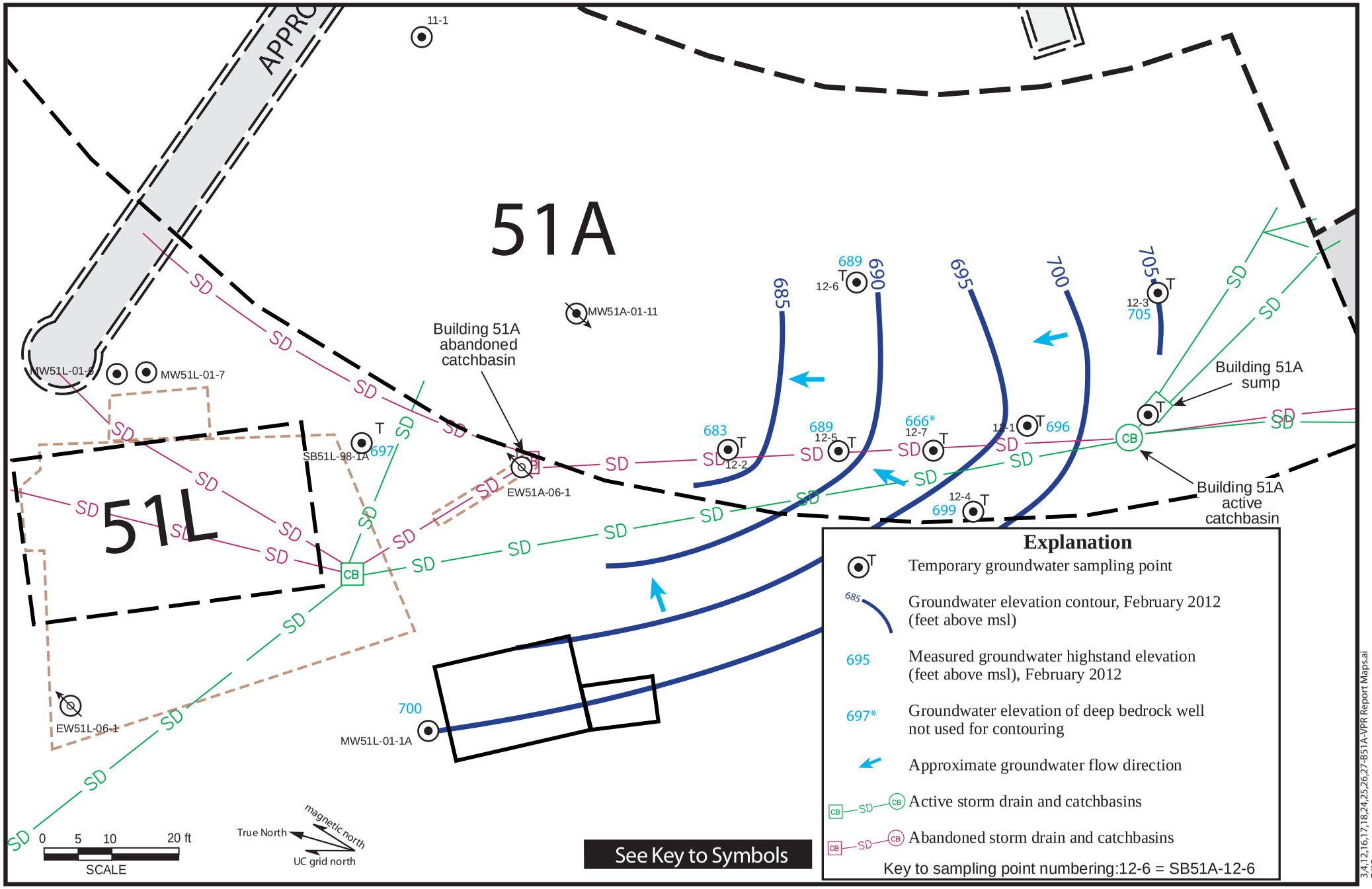

Figure 27. Local Groundwater Elevation Map of Building 51A Area, February 2012.

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Table A3. Groundwater Sampling Results – Vacuum Pump Room Area.

Table B1. Soil Vapor Sampling Results – Building 51A Area.

Table B2. Soil Sampling Results – Building 51A Area,

Table B3. Groundwater Sampling Results – Building 51A Area.

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Table A1
Soil Vapor Sampling Results from Vacuum Pump Room Area
Modified EPA Method TO-14A/15
(concentrations in µg/m^3)

		1,1-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	Chloroform	Carbon Tetrachloride	Methyl tert-butyl ether	PCE	TCE	Toluene	Vinyl Chloride	Benzene	Total VOCs	2-Propanol*
CHHSL for Commercial/Industrial Land Use				44,400	88,700	2,790,000	-	84.6	13,400	603	1,770	378,000	44.8	122	-	
ESL for Commercial/Industrial Land Use		5,100	120,000	20,000	41,000	1,300,000	1,500	63	31,000	1,400	4,100	180,000	100	280	-	
Location	Date															
SG51-08-2	7/31/2008	8.4	5.1	<4.5	<4.5	8.6	<5.6			21	95	150	<2.9	**140**	428	<110
SG51-08-3	7/31/2008	10	<4.5	<4.5	<4.5	180	<5.6			42	570	22	<2.9	<3.6	824	<110
SSG51-08-1	7/31/2008	<45	<44	<44	<44	<61	<55			<61	550	<42	<29	<36	550	<110
SSG51-08-4	7/31/2008	<44	<44	<44	<44	<60	<54			<60	330	<41	<28	<35	330	<110
SG51-10-34	9/28/2010	730	760	**23,000**	730	550	<57	<73	<42	<79	**12,000**	<44	**14,000**	<37	51,770	<110
(D)	9/28/2010	720	730	**23,000**	710	540	<57	<73	<42	<79	**12,000**	<44	**16,000**	<37	53,700	<110
SG51-11-10	8/2/2011	**55,000**	24,000	15,000	32,000	<280	<250	<320	<180	<340	**150,000**	<190	**3,900^J**	**290**	280,190	<500
SG51-11-11	8/2/2011	**26,000**	18,000	9,900	14,000	<260	<230	<300	<160	**2,500**	**180,000**	<180	**990^J**	**240**	251,630	<470

All samples were analyzed by Air Toxics LTD.
CHHSL: California Human Health Screening Level for Commercial/Industrial land use (California EPA, 2005)
ESL: Environmental Screening Level for Commercial/Industrial land use (Water Board, 2008)

< = concentration Less than reporting limit
* 2-Propanol used as leak detection tracer during sampling.
^{J}: Estimated value due to bias in the CCV

Table A2
Soil Sampling Results from Vacuum Pump Room Area
Volatile Organic Compounds
(concentrations in mg/kg)

					VOCs-E8260							
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**1,1,1-TCA**	**Other analytes**
	Groundwater Protection ESLs				**0.2**	**1.0**	**0.19**	**0.67**	**0.7**	**0.46**	**7.8**	
	Direct Contact ESLs				**4.7**	**65**	**22**	**34**	**0.95**	**4.1**	**950**	
	Target Risk-Based MCSs				**1.3**	**8**	**38**	**50**	**0.45**	**2.3**	**690**	
SB51-11-9	SB51-11-9-2'	2	CT	4/29/11	ND	ND	0.55	ND	ND	0.34	ND	ND
	SB51-11-9-5'	5	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-9-10'	10	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	Acetone=0.096 Benzene=0.0097
	SB51-11-9-12'	12	CT	4/29/11	ND	ND	ND	ND	ND	**230**	ND	ND
	SB51-11-9-15'	15	CT	4/29/11	ND	ND	ND	ND	ND	**63**	ND	ND
	SB51-11-9-20'	20	CT	4/29/11	ND	ND	ND	ND	ND	**47**	1.9	ND
	SB51-11-9-25'	25	CT	4/29/11	ND	ND	ND	ND	ND	0.018	ND	ND
SB51-11-10	SB51-11-10-5'	5	CT	4/29/11	ND	ND	0.0056	ND	ND	0.095	ND	ND
	SB51-11-10-10'	10	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-10-15'	15	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-10-20'	20	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	Benzene=0.019
SB51-11-11	SB51-11-11-5'	5	CT	4/29/11	ND	ND	0.021	ND	ND	0.076	ND	ND
	SB51-11-11-10'	10	CT	4/29/11	ND	ND	ND	ND	ND	**1.1**	ND	ND
	SB51-11-11-15'	15	CT	4/29/11	0.012	ND	ND	ND	ND	ND	ND	2-Butanone=0.012
	SB51-11-11-20'	20	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-11-25'	25	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-11-30'	30	CT	4/29/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-17	SB51-11-17-6'	6	CT	5/26/11	0.013	0.013	ND	ND	ND	0.063	0.012	Benzene=0.0068 Freon 113=0.006
	SB51-11-17-10'	10	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-17-15'	15	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-17-20'	20	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-18	SB51-11-18-5'	5	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-18-10'	10	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-18-14'	14	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-18-15'	15	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-18-17'	17	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND

Table A2
Soil Sampling Results from Vacuum Pump Room Area
Volatile Organic Compounds
(concentrations in mg/kg)

					VOCs-E8260							
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**1,1,1-TCA**	**Other analytes**
SB51-11-18	SB51-11-18-20'	20	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-19	SB51-11-19-4.5'	4.5	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-19-10'	10	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	Methylene Chloride=0.011
	SB51-11-19-12.5'	12.5	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-19-14.5'	14.5	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-19-17.5'	17.5	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-19-20'	20	CT	5/26/11	ND	ND	ND	ND	ND	ND	ND	Benzene=0.014
SB51-11-20	SB51-11-20-3'	3	CT	7/12/11	0.023	0.015	0.091	ND	**5.3**	**1.2**	0.0071	ND
	SB51-11-20-6'	6	CT	7/12/11	0.014	0.0086	0.068	ND	**6.3**	**1.3**	0.0044	ND
	SB51-11-20-12'	12	CT	7/12/11	0.0086	ND	0.024	ND	**1.0**	**1.2**	0.0046	ND
	SB51-11-20-15'	15	CT	7/12/11	0.0072	ND	0.063	ND	**1.8**	**1.4**	ND	ND
SB51-11-21	SB51-11-21-3'	3	CT	7/12/11	ND	ND	ND	ND	ND	0.017	ND	ND
	SB51-11-21-7.5'	7.5	CT	7/12/11	0.012	ND	0.0089	ND	0.28	**1.2**	ND	ND
	SB51-11-21-10'	10	CT	7/12/11	ND	ND	ND	ND	0.007	0.044	ND	ND
	SB51-11-21-12'	12	CT	7/12/11	0.023	ND	0.013	ND	0.23	**2.5**	0.0049	ND
	SB51-11-21-15'	15	CT	7/12/11	0.019	ND	0.011	ND	0.31	**3.1**	0.0047	Benzene=0.0074
SB51-11-22	SB51-11-22-3.5'	3.5	CT	7/12/11	ND	ND	ND	ND	ND	0.042	ND	ND
	SB51-11-22-8'	8	CT	7/12/11	ND	ND	ND	ND	0.0041	0.068	ND	ND
	SB51-11-22-11.5'	11.5	CT	7/12/11	0.0065	ND	ND	ND	0.02	**0.55**	ND	Benzene=0.036
	SB51-11-22-13'	13	CT	7/12/11	0.0066	ND	ND	ND	0.015	**1.1**	ND	ND
	SB51-11-22-15'	15	CT	7/12/11	0.008	ND	ND	ND	0.0048	0.04	ND	ND
SB51-11-23	SB51-11-23-7'	7	CT	7/25/11	ND	ND	0.69	ND	ND	ND	ND	ND
	SB51-11-23-10.5'	10.5	CT	7/25/11	0.0072	ND	ND	ND	ND	0.0066	ND	ND
	SB51-11-23-12'	12	CT	7/25/11	0.015	0.0046	0.012	0.021	ND	**4.3**	ND	ND
	SB51-11-23-15'	15	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-23-17.5'	17.5	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-24	SB51-11-24-7.5'	7.5	CT	7/25/11	ND	ND	0.086	ND	ND	0.16	ND	ND
	SB51-11-24-10'	10	CT	7/25/11	ND	ND	0.033	ND	ND	0.11	ND	ND
	SB51-11-24-11.5'	11.5	CT	7/25/11	ND	ND	ND	ND	ND	**2.8**	0.011	ND
	SB51-11-24-18'	18	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-25	SB51-11-25-8'	8	CT	7/25/11	ND	ND	ND	ND	ND	0.017	ND	ND

Table A2
Soil Sampling Results from Vacuum Pump Room Area
Volatile Organic Compounds
(concentrations in mg/kg)

					VOCs-E8260							
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**1,1,1-TCA**	**Other analytes**
SB51-11-25	SB51-11-25-11.5'	11.5	CT	7/25/11	0.0064	ND	0.013	0.0085	ND	**3.5**	0.013	ND
(cont'd)	SB51-11-25-15'	15	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-26	SB51-11-26-7'	7	CT	7/25/11	ND	ND	0.0093	ND	ND	**0.82**	ND	ND
	SB51-11-26-10.5'	10.5	CT	7/25/11	0.0051	ND	0.27	ND	ND	**1.4**	ND	ND
	SB51-11-26-11.5'	11.5	CT	7/25/11	0.012	ND	0.02	0.0052	ND	**7.1**	ND	ND
	SB51-11-26-14'	14	CT	7/25/11	0.019	0.0071	0.06	0.085	ND	**5.7**	0.01	ND
SB51-11-27	SB51-11-27-7'	7	CT	7/25/11	ND	ND	ND	ND	ND	0.076	ND	ND
	SB51-11-27-10'	10	CT	7/25/11	ND	ND	0.01	ND	ND	0.15	0.0041	Benzene=0.01
	SB51-11-27-12'	12	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-27-16'	16	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	Benzene=0.011
SB51-11-28	SB51-11-28-7'	7	CT	7/25/11	ND	ND	0.0047	ND	ND	0.095	ND	ND
	SB51-11-28-10.5'	10.5	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-28-12'	12	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-28-15.5'	15.5	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-29	SB51-11-29-7'	7	CT	7/25/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-29-11.5'	11.5	CT	7/25/11	ND	ND	ND	ND	ND	0.047	ND	ND
	SB51-11-29-14'	14	CT	7/25/11	ND	ND	0.0053	ND	ND	0.028	ND	Methylene Chloride=0.01
SB51-11-30	SB51-11-30-3'	3	CT	8/8/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-31	SB51-11-31-3'	3	CT	8/8/11	ND	ND	**2.2**	ND	ND	**32**	ND	ND
	SB51-11-31-4.5'	4.5	CT	9/6/11	0.005	ND	0.09	ND	ND	**6.2**	ND	ND
SB51-11-31B	SB51-11-31B-6.5'	6.5	CT	8/30/11	0.047	0.0098	0.023	ND	ND	ND	ND	ND
	SB51-11-31B-9'	9	CT	8/30/11	ND	ND	ND	ND	ND	0.033	ND	Toluene=0.0049
	SB51-11-31B-12'	12	CT	8/30/11	**0.24**	0.025	ND	ND	ND	ND	ND	ND
	SB51-11-31B-15'	15	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-31B-20'	20	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-31B-24'	24	CT	8/30/11	ND	ND	ND	ND	ND	0.008	ND	ND
SB51-11-32	SB51-11-32-2'	2	CT	8/8/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-32-2.5'	2.5	CT	8/30/11	0.0064	ND	0.0088	ND	ND	0.054	ND	2-Butanone=0.01
	SB51-11-32-8'	8	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-32-12'	12	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND

Table A2
Soil Sampling Results from Vacuum Pump Room Area
Volatile Organic Compounds
(concentrations in mg/kg)

					VOCs-E8260							
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**1,1,1-TCA**	**Other analytes**
SB51-11-32 (cont'd)	SB51-11-32-16'	16	CT	8/30/11	ND	0.059	0.013	ND	ND	**0.69**	ND	Vinyl Chloride=0.034
	SB51-11-32-20'	20	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-32-24'	24	CT	8/30/11	ND	ND	ND	ND	ND	0.0048	ND	ND
SB51-11-33B	SB51-11-33B-8'	8	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-33B-12'	12	CT	8/30/11	ND	ND	ND	ND	ND	0.0093	ND	ND
	SB51-11-33B-16'	16	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-33B-20'	20	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-33B-24'	24	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-37	SB51-11-37-2'	2	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-37-3'	3	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-38	SB51-11-38-2'	2	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-38-3'	3	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-39	SB51-11-39-2'	2	CT	11/4/11	ND	ND	ND	ND	ND	0.0079	ND	ND
	SB51-11-39-3.5'	3.5	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-40	SB51-11-40-2'	2	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	Benzene=0.012 Toluene=0.0064
	SB51-11-40-3'	3	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	Benzene=0.014
SB51-11-41	SB51-11-41-2'	2	CT	11/4/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-42	SB51-11-42-4'	4	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-42-14'	14	CT	12/15/11	ND	ND	ND	ND	0.0078	0.012	ND	ND
	SB51-11-42-20'	20	CT	12/15/11	0.027	0.02	ND	ND	0.10	0.039	ND	ND
	SB51-11-42-25'	25	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-42-28'	28	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-43	SB51-11-43-15'	15	CT	12/15/11	0.016	ND	ND	ND	0.037	**0.65**	ND	ND
	SB51-11-43-20'	20	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-43-26'	26	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-43-28'	28	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-M1	SB51-11-M1-9.5'	9.5	CT	8/30/11	0.0069	0.0043	0.0046	0.0045	0.0093	0.33	0.009	ND
	SB51-11-M1-16'	16	CT	8/30/11	0.0042	ND	ND	ND	0.0054	0.055	ND	Benzene=0.012
SB51-11-M2	SB51-11-M2-19.5'	19.5	CT	8/30/11	0.021	0.015	ND	ND	ND	0.0061	ND	ND
	SB51-11-M2-24'	24	CT	8/30/11	0.013	0.0059	ND	ND	ND	ND	ND	ND
SB51-11-M7	SB51-11-M7-3.5'	3.5	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND

Table A2
Soil Sampling Results from Vacuum Pump Room Area
Volatile Organic Compounds
(concentrations in mg/kg)

					VOCs-E8260							
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**1,1,1-TCA**	**Other analytes**
	SB51-11-M7-7'	7	CT	8/30/11	ND	ND	ND	ND	ND	0.021	ND	ND
SB51-11-M8	SB51-11-M8-11'	11	CT	12/15/11	0.022	0.025	ND	ND	ND	ND	ND	ND
SB51-11-M9	SB51-11-M9-4'	4	CT	8/30/11	ND	0.0058	ND	ND	ND	ND	ND	ND
	SB51-11-M9-13'	13	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	Benzene=0.012 Toluene=0.0048
SB51-11-M9A	SB51-11-M9A-5'	5	CT	12/15/11	ND	ND	ND	ND	ND	ND	ND	ND
SB51-11-M9B	SB51-11-M9B-5'	5	CT	12/15/11	ND	ND	ND	ND	ND	0.0046	ND	ND
SB51-11-M12	SB51-11-M12-6'	6	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-M12-19'	19	CT	8/30/11	ND	ND	ND	ND	ND	ND	ND	ND

CT= Analysis by Curtis & Tompkins Ltd

ND = Not Detected

Table A3
Groundwater Sampling Results - Building 51 Vacuum Pump Room Area
Volatile Organic Compounds - EPA Method 8260
(concentrations in µg/L)

Constituent	MCL	SB51-10-W5		OC51-11-1		SB51-11-5	SB51-11-6	SB51-11-9		SB51-11-10	SB51-11-11	SB51-11-12	SB51-11-14	SB51-11-15	SB51-11-16	SB51-11-17	SB51-11-18	SB51-11-19
		Oct-10^	Mar-11	Dec-11	Jan-12	Feb-12	Feb-12	Jul-11	Jan-12	Jul-11	Dec-11	Jul-11^	Jul-11^	Jul-11^	Jul-11^	Jul-11	Jul-11	Jul-11
Aromatic or Non-Halogenated Hydrocarbons																		
Benzene	1	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
n-Butylbenzene			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
sec-Butylbenzene			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
ter-Butylbenzene			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
Chlorobenzene	70	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Ethylbenzene	300	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Isopropylbenzene			<2	<2	<2	<2	<2	<200	<400	<2	<2					<2	<2	<2
p-Isopropyltoluene			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
Naphthalene			<2	<2	<2	<2	<2	<400	<400	<2	<2					<2	<2	<2
n-Propylbenzene			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
Toluene	150	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
1,2,4-Trimethylbenzene			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
Xylenes, total	1750	<1	<2	<2	<2	<2	<2	<200	<400	<2	<2	<1	<1	<1	<1	<2	<2	<2
Total Aromatic Hydrocarbons																		
Halogenated Non-Aromatic Hydrocarbons																		
Bromodichloromethane	80	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Bromomethane	80	<1	<10	<10	<10	<10	<10	<1000	<2000	<10	<10	<1	<1	<1	<1	<10	<10	<10
Carbon Tetrachloride	0.5	<0.5	<1	<1	<1	<1	<1	121	121	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Chloroethane		<1	<30	<30	<30	<30	<30	<3000	<6000	<30	<30	<1	<1	<1	<1	<30	<30	<30
Chloroform	80	<0.5	<3	<3	<3	<3	<3	<300	<600	<3	<3	<0.5	<0.5	<0.5	<0.5	<3	<3	<3
Chloromethane		<1	<10	<10	<10	<10	<10	<1000	<2000	<10	<10	<1	<1	<1	<1	<10	<10	<10
1,1-Dichloroethane	5	19	1.5	7.6	7.2	<1	<1	484	341	<1	<1	<0.5	<0.5	<0.5	<0.5	1.7	2.3	<1
1,2-Dichloroethane	0.5	<0.5	<2	<2	<2	<2	<2	<200	<400	<2	<2	<0.5	<0.5	<0.5	<0.5	<2	<2	<2
1,1-Dichloroethene	6	1.8	<1	1.5	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
cis-1,2-Dichloroethene	6	6.4	<1	51.6	41.8	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
trans-1,2-Dichloroethene	10	1.2	<1	8.1	4.2	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
1,2-Dichloropropane	5	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Methylene Chloride	5	<10	<1	<1	<1	<1	<1	<100	<200	<1	<1	<10	<10	<10	<10	<1	<1	<1
1,1,1,2-Tetrachloroethane		<0.5	<2	<2	<2	<2	<2	<200	<400	<2	<2	<0.5	<0.5	<0.5	<0.5	<2	<2	<2
1,1,2,2-Tetrachloroethane	1	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Tetrachloroethene	5	5.1	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
1,1,1-Trichloroethane	200	2.8	<1	4.5	4.2	<1	<1	971	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
1,1,2-Trichloroethane	5	<0.5	<1	<1	<1	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
2,2-Dichloropropane			<1	<1	<1	<1	<1	<100	<200	<1	<1					<1	<1	<1
Trichloroethene	5	100	7.5	189	220	<1	<1	32900	17500	1.1	<1	<0.5	<0.5	<0.5	<0.5	<1	8.7	<1
Freon-113	1200	<2	<1	<1	<1	<1	<1	<100	<200	<1	<1	<2	<2	<2	<2	<1	<1	<1
Vinyl Chloride	0.5	<0.5	<1	1.8	1.5	<1	<1	<100	<200	<1	<1	<0.5	<0.5	<0.5	<0.5	<1	<1	<1
Total Halogenated Hydrocarbons		136	9.0	264	279			34,476	17,962	1.1						1.7	11	
Total Concentration of VOCs		136	9.0	264	279			34,476	17,962	1.1						1.7	11	

Table A3 (Cont'd)
Groundwater Sampling Results - Building 51 Vacuum Pump Room Area
Volatile Organic Compounds - EPA Method 8260
(concentrations in µg/L)

Constituent	MCL	SB51-11-23		SB51-11-24	SB51-11-25		SB51-11-26	SB51-11-27		SB51-11-28	SB51-11-29	SB51-11-42	SB51-11-43	SB51-11-M2	SB51-11-M3	SB51-11-M4
		Jul-11	Sep-11	Jul-11^	Jul-11^	Sep-11	Jul-11^	Jul-11^	Sep-11	Jul-11^	Jul-11^	Dec-11	Dec-11	Dec-11	Dec-11	Dec-11
Aromatic or Non-Halogenated Hydrocarbons																
Benzene	1	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
n-Butylbenzene		<1	<1			<1			<1			<1	<1	<1	<1	<1
sec-Butylbenzene		<1	<1			<1			<1			<1	<1	<1	<1	<1
ter-Butylbenzene		<1	<1			<1			<1			<1	<1	<1	<1	<1
Chlorobenzene	70	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Ethylbenzene	300	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Isopropylbenzene		<2	<2			<2			<2			<2	<2	<2	<2	<2
p-Isopropyltoluene		<1	<1			<1			<1			<1	<1	<1	<1	<1
Naphthalene		<2	<2			<2			<2			<2	<2	<2	<2	<2
n-Propylbenzene		<1	<1			<1			<1			<1	<1	<1	<1	<1
Toluene	150	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
1,2,4-Trimethylbenzene		<1	<1			<1			<1			<1	<1	<1	<1	<1
Xylenes, total	1750	<2	<2	<5	<2.5	<2	<7.1	<2.5	<2	<1	<1	<2	<2	<2	<2	<2
Total Aromatic Hydrocarbons																
Halogenated Non-Aromatic Hydrocarbons																
Bromodichloromethane	80	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Bromomethane	80	<10	<10	<5	<2.5	<10	<7.1	<2.5	<10	<1	<1	<10	<10	<10	<10	<10
Carbon Tetrachloride	0.5	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Chloroethane		<30	<30	<5	<2.5	<30	<7.1	<2.5	<30	<1	<1	<30	<30	<30	<30	<30
Chloroform	80	<3	<3	<2.5	<1.3	<3	<3.6	<1.3	<3	0.8	0.6	<3	<3	<3	<3	<3
Chloromethane		<10	<10	<5	<2.5	<10	<7.1	<2.5	<10	<1	<1	<10	<10	<10	<10	<10
1,1-Dichloroethane	5	5.5	5.1	9.6	8.7	9.6	9.4	9.2	4.5	0.8	3.0	10.1	7.3	11.1	9.4	4.2
1,2-Dichloroethane	0.5	<2	<2	<2.5	<1.3	<2	<3.6	<1.3	<2	<0.5	<0.5	<2	<2	<2	<2	<2
1,1-Dichloroethene	6	<1	<1	<2.5	1.3	<1	<3.6	1.6	<1	<0.5	<0.5	<1	<1	1.1	<1	1.3
cis-1,2-Dichloroethene	6	4.3	3.1	57	32	14.4	55	47	21.9	3.1	12	8.4	2.7	2.6	3.9	1.8
trans-1,2-Dichloroethene	10	1.4	<1	3.5	3.1	<1	9.9	3.9	1.7	<0.5	5.3	<1	<1	<1	<1	<1
1,2-Dichloropropane	5	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Methylene Chloride	5	<1	<1	<50	<25	<1	<71	<25	<1	<10	<10	<1	<1	<1	<1	<1
1,1,1,2-Tetrachloroethane		<2	<2	<2.5	<1.3	<2	<3.6	<1.3	<2	<0.5	<0.5	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	1	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Tetrachloroethene	5	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	1.7	4.9	1.7	9.4	2.6
1,1,1-Trichloroethane	200	1.6	1.9	12	10	4.6	9.6	9.8	2.2	0.9	<0.5	1.5	1.3	<1	1.8	<1
1,1,2-Trichloroethane	5	<1	<1	<2.5	<1.3	<1	<3.6	<1.3	<1	<0.5	<0.5	<1	<1	<1	<1	<1
2,2-Dichloropropane		1.3	<1			1.3			1.4			<1	<1	<1	<1	<1
Trichloroethene	5	76.9	47.7	400	330	287	360	300	58.5	13	26	65.8	31.5	27.5	48.9	16.1
Freon-113	1200	<1	<1	<10	<5	<1	<14	<5	<1	<2	<2	<1	<1	<1	<1	<1
Vinyl Chloride	0.5	<1	<1	<2.5	1.7	<1	<3.6	2.0	<1	<0.5	<0.5	<1	<1	<1	<1	<1
Total Halogenated Hydrocarbons		91	58	482	387	317	444	374	90	19	47	88	48	44	73	26
Total Concentration of VOCs		91	58	482	387	317	444	374	90	19	47	88	48	44	73	26

MCL: Maximum contaminant level for drinking water (determined by CDPH)
All analyses by LBNL EML unless otherwise noted

< = Less than Quantitation Limit
= Compound not included in analysis

Table B1
Soil Vapor Sampling Results from Building 51A Area
Modified EPA Method TO-14A/15
(concentrations in µg/m^3)

		1,1-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	Chloroform	Carbon Tetrachloride	Methyl tert-butyl ether	PCE	TCE	Toluene	Vinyl Chloride	Benzene	Total Halogenated VOCs	2-Propanol*
CHHSL for Commercial/Industrial Land Use				44,400	88,700	2,790,000	-	84.6	13,400	603	1,770	378,000	44.8	122	-	
ESL for Commercial/Industrial Land Use		5,100	120,000	20,000	41,000	1,300,000	1,500	63	31,000	1,400	4,100	180,000	100	280	-	
Location	Date															
SG51-10-11	9/30/2010	53	<44	3500	330	<61	<54	<70	99	<76	76	63	1300	120	5,541	<120
SG51-10-12	9/30/2010	<45	<44	<44	<44	<61	<55	<70	<40	<76	360	<42	<29	<36	360	<120
SG51-10-16	9/30/2010	<48	<47	<47	<47	<65	210	<74	<43	<80	<64	<45	<30	<38	210	<120
SG51-10-17	10/1/2010	<49	<48	<48	<48	<66	<59	<76	<44	<82	<65	<46	<31	<39		<120
SG51-10-18	10/1/2010	<41	<41	<41	<41	<56	<50	<64	<37	<70	<55	<39	<26	<33		<100
SG51-10-19	10/1/2010	<45	<44	<44	<45	<60	63	<70	<40	<75	<59	<42	<28	<35	63	<110
SG51-10-20	9/30/2010	<43	<42	<42	<42	<58	76	<67	<38	140	<57	<40	<27	<34	216	<100
SG51-10-21	9/28/2010	<51	<50	130	<50	<69	<62	<79	<45	<85	**1,600**	<47	<32	<40	1,730	<120
SG51-10-22	10/1/2010	<170	<160	7,200	<160	<230	<200	<260	<150	<280	**190,000**	290	<110	<130	197,490	<410
SG51-10-23	9/30/2010	68	<43	80	<43	110	810	**3,000**	<39	500	**11,000**	<41	<28	<34	15,568	<110
SG51-10-24	9/30/2010	<44	<43	65	<43	<59	160	<68	<39	<73	<58	<40	38	<34	263	<100
SG51-10-25	10/1/2010	<49	<48	91	<48	<66	<59	<76	<44	400	**3,700**	<46	<31	<39	4,191	<120
SG51-10-26	9/28/2010	<47	<46	<46	<46	<64	<57	<73	<42	<79	<63	<44	<30	<37		<110
SG51-11-3	2/10/11	<52	<51	340	<51	<70	68	<81	<45	260	**2,300**	<49	<33	<41	2,968	<130

All samples were analyzed by Air Toxics LTD.
CHHSL: California Human Health Screening Level for Commercial/Industrial land use (California EPA, 2005)
ESL: Environmental Screening Level for Commercial/Industrial land use (Water Board, 2008)
ESL: Environmentl Screening Level for Commercial/Industrial land use (Water Board, 2008)

< = concentration Less than reporting limit
* 2-Propanol used as leak detection tracer during sampling.
^{J}: Estimated value due to bias in the CCV

Table B2
Soil Sampling Results from Building 51A Area
Organic Analytes
(concentrations in mg/kg)

					VOCs-E8260								
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**carbon tetrachloride**	**vinyl chloride**	**Other analytes**
	Groundwater Protection ESLs				**0.2**	**1.0**	**0.19**	**0.67**	**0.7**	**0.46**	**0.11**	**0.085**	
	Direct Contact ESLs				**4.7**	**65**	**22**	**34**	**0.95**	**4.1**	**0.044**	**0.047**	
	Target Risk-Based MCSs				**1.3**	**8**	**38**	**50**	**0.45**	**2.3**	**0.05**	**0.0035**	
SB51-10-22	SB51-10-22-2'	2	CT	2/18/11	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-10-22-6'	6	CT	2/18/11	ND	ND	0.016	ND	ND	**0.63**	ND	ND	ND
	SB51-10-22-8'	8	CT	2/18/11	ND	ND	0.0083	ND	ND	**0.61**	ND	ND	Methylene Chloride=0.0088
	SB51-10-22-12'	12	CT	2/18/11	ND	ND	0.0047	ND	ND	0.057	ND	ND	ND
SB51-11-7	SB51-11-7-5'	5	CT	2/18/11	ND	ND	ND	ND	ND	0.01	ND	ND	ND
	SB51-11-7-8'	8	CT	2/18/11	ND	ND	0.028	ND	0.0072	0.45	ND	ND	ND
	SB51-11-7-12'	12	CT	2/18/11	ND	ND	0.063	ND	0.027	**4.0**	**0.39**	**0.013**	Chloroform=0.052
	SB51-11-7-14'	14	CT	2/18/11	ND	ND	0.05	ND	0.016	**8.4**	**1.6**	**0.015**	Chloroform=0.055
SB51-11-8	SB51-11-8-2'	2	CT	2/18/11	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-8-4'	4	CT	2/18/11	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-8-6'	6	CT	2/18/11	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-8-10'	10	CT	2/18/11	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51-11-8-13'	13	CT	2/18/11	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-1	SB51A-12-1-6'	6	CT	1/31/12	ND	ND	ND	ND	0.021	**3.9**	0.043	ND	ND
	SB51A-12-1-15'	15	CT	1/31/12	ND	ND	ND	ND	**0.73**	**16**	**6.4**	ND	ND
	SB51A-12-1-25'	25	CT	1/31/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-1-30'	30	CT	1/31/12	ND	ND	ND	ND	ND	0.0088	ND	ND	ND
SB51A-12-1B	SB51A-12-1B-18'	18	CT	2/16/12	ND	ND	0.0061	ND	0.0077	**1.4†**	**0.81†**	ND	Chloroform=0.0095
	SB51A-12-1B-20'	20	CT	2/16/12	ND	ND	ND	ND	ND	0.28	0.039	ND	Chloroform=0.012
	SB51A-12-1B-22'	22	CT	2/16/12	ND	ND	ND	ND	ND	**0.56**	0.12	ND	ND
SB51A-12-2	SB51A-12-2-6'	6	CT	1/31/12	ND	ND	ND	ND	ND	0.012	ND	ND	ND
	SB51A-12-2-15'	15	CT	1/31/12	ND	ND	ND	ND	0.0068	0.04	ND	ND	ND
	SB51A-12-2-22'	22	CT	1/31/12	ND	ND	0.0055	ND	ND	**3.8**	0.086	ND	Chloroform=0.0087
	SB51A-12-2-29'	29	CT	1/31/12	ND	ND	ND	ND	ND	**26**	ND	ND	ND
SB51A-12-2B	SB51A-12-2B-32'	32	CT	2/16/12	ND	ND	0.0049	ND	0.007	**0.46**	0.021	ND	Chloroform=0.0044
	SB51A-12-2B-35'	35	CT	2/16/12	ND	ND	ND	ND	ND	0.13	ND	ND	ND
SB51A-12-3	SB51A-12-3-7'	7	CT	2/1/12	ND	ND	ND	ND	ND	0.15	ND	ND	ND
	SB51A-12-3-11.5'	11.5	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-3-20'	20	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-4	SB51A-12-4-10'	10	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-4-15'	15	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-4-21'	21	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table B2
Soil Sampling Results from Building 51A Area
Organic Analytes
(concentrations in mg/kg)

					VOCs-E8260								
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**carbon tetrachloride**	**vinyl chloride**	**Other analytes**
	SB51A-12-4-25'	25	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-5	SB51A-12-5-10'	10	CT	1/31/12	ND	ND	ND	ND	ND	0.082	ND	ND	ND
	SB51A-12-5-16'	16	CT	1/31/12	ND	ND	ND	ND	ND	**2.0**	0.017	ND	Chloroform=0.017
	SB51A-12-5-29'	29	CT	1/31/12	ND	ND	ND	ND	ND	**1.9**	**0.14**	ND	Chloroform=0.015
SB51A-12-5B	SB51A-12-5B-20'	20	CT	2/16/12	ND	ND	0.0063	ND	ND	**2.5**	**0.39**	ND	Chloroform=0.012
	SB51A-12-5B-32'	32	CT	2/16/12	ND	ND	ND	ND	ND	**4.9**	0.46	ND	Chloroform=0.046
	SB51A-12-5B-35'	35	CT	2/16/12	ND	ND	ND	ND	ND	0.024	0.0081	ND	ND
SB51A-12-6	SB51A-12-6-5'	5	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	Benzene=0.029 Freon113=0.0093
	SB51A-12-6-6.5'	6.5	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-6-15'	15	CT	2/1/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-6-21'	21	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-7	SB51A-12-7-4.5'	4.5	CT	2/2/12	ND	ND	0.014	ND	ND	0.022	ND	ND	ND
	SB51A-12-7-15''	15	CT	2/2/12	ND	ND	0.006	ND	ND	0.09	0.012	ND	ND
	SB51A-12-7-30'	30	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	Benzene=0.0047
SB51A-12-8	SB51A-12-8-6'	6	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-8-10'	10	CT	2/2/12	ND	ND	ND	ND	ND	0.026	ND	ND	ND
	SB51A-12-8-15'	15	CT	2/2/12	ND	ND	0.035	ND	ND	0.36	ND	ND	ND
SB51A-12-9	SB51A-12-9-6'	6	CT	2/2/12	ND	ND	0.023	ND	ND	0.16	ND	ND	ND
	SB51A-12-9-9'	9	CT	2/2/12	ND	ND	0.014	ND	ND	0.024	ND	ND	ND
	SB51A-12-9-15'	15	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-10	SB51A-12-10-6'	6	CT	2/2/12	ND	ND	0.021	ND	ND	**0.62**	ND	ND	ND
	SB51A-12-10-9'	9	CT	2/2/12	ND	ND	0.012	ND	ND	0.16	ND	ND	ND
	SB51A-12-10-15'	15	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-11	SB51A-12-11-15'	15	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-11-20'	20	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-11-24'	24	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-12	SB51A-12-12-6'	6	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-12-13'	13	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-12-17'	17	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-12-20'	20	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-12-24'	24	CT	2/2/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-13	SB51A-12-13-8'	8	CT	2/2/12	ND	ND	ND	ND	ND	0.0056	ND	ND	ND
	SB51A-12-13-16'	16	CT	2/2/12	ND	ND	ND	ND	ND	**0.55**	0.016	ND	ND
SB51A-12-14	SB51A-12-14-5'	5	CT	2/2/12	ND	ND	ND	ND	0.0069	0.035	0.012	ND	Chloroform=0.0054
	SB51A-12-14-10'	10	CT	2/2/12	ND	ND	ND	ND	ND	0.015	0.005	ND	ND

Table B2
Soil Sampling Results from Building 51A Area
Organic Analytes
(concentrations in mg/kg)

					VOCs-E8260								
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**carbon tetrachloride**	**vinyl chloride**	**Other analytes**
	SB51A-12-14-16'	16	CT	2/2/12	ND	ND	ND	ND	ND	0.03	ND	ND	ND
SB51A-12-15	SB51A-12-15-7'	7	CT	2/2/12	ND	ND	ND	ND	ND	0.09	ND	ND	ND
	SB51A-12-15-10'	10	CT	2/2/12	ND	ND	ND	ND	ND	**0.5**	ND	ND	ND
	SB51A-12-15-16'	16	CT	2/2/12	ND	ND	ND	ND	ND	0.0056	ND	ND	ND
SB51A-12-16	SB51A-12-16-6'	6	CT	2/16/12	ND	ND	0.032	ND	ND	ND	ND	ND	ND
	SB51A-12-16-13'	13	CT	2/16/12	ND	ND	0.0081	ND	ND	0.057	ND	ND	ND
	SB51A-12-16-17'	17	CT	2/16/12	ND	ND	0.0089	ND	ND	0.041	ND	ND	ND
	SB51A-12-16-20'	20	CT	2/16/12	ND	ND	ND	ND	ND	0.12	0.011	ND	Chloroform=0.0053
	SB51A-12-16-24'	24	CT	2/16/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-17	SB51A-12-17-10'	10	CT	2/16/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-17-15'	15	CT	2/16/12	ND	ND	0.0077	ND	ND	0.025	ND	ND	ND
	SB51A-12-17-20'	20	CT	2/16/12	ND	ND	0.0069	ND	0.009	0.09	0.0053	ND	ND
	SB51A-12-17-25'	25	CT	2/16/12	ND	ND	ND	ND	0.0076	0.064	0.0076	ND	ND
	SB51A-12-17-29'	29	CT	2/16/12	ND	ND	0.008	ND	ND	0.042	ND	ND	ND
	SB51A-12-17-32'	32	CT	2/16/12	ND	ND	ND	ND	ND	**1.6**	0.035	ND	ND
SB51A-12-17B	SB51A-12-17B-8'	8	CT	3/22/12	ND	ND	0.014	ND	ND	0.0093	ND	ND	ND
	SB51A-12-17B-29'	29	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-17B-32'	32	CT	3/22/12	ND	ND	ND	ND	ND	**1.8**	ND	ND	ND
	SB51A-12-17B-34'	34	CT	3/22/12	ND	ND	ND	ND	ND	0.055	ND	ND	ND
	SB51A-12-17B-36'	36	CT	3/22/12	ND	ND	ND	ND	ND	0.0061	ND	ND	ND
SB51A-12-18	SB51A-12-18-9.5'	9.5	CT	2/16/12	ND	ND	0.035	ND	ND	0.0056	ND	ND	ND
	SB51A-12-18-14.5'	14.5	CT	2/16/12	ND	ND	0.012	ND	ND	ND	ND	ND	ND
	SB51A-12-18-16.5'	16.5	CT	2/16/12	ND	ND	0.0089	ND	0.004	0.046	ND	ND	ND
	SB51A-12-18-18.5'	18.5	CT	2/16/12	ND	ND	0.094	ND	0.018	**1.8**	ND	ND	ND
	SB51A-12-18-20.5'	20.5	CT	2/16/12	ND	ND	0.049	ND	0.0097	**0.73**	ND	ND	ND
	SB51A-12-18-25.5'	25.5	CT	2/16/12	ND	ND	0.015	ND	0.018	**0.99**	0.0057	ND	ND
	SB51A-12-18-27.5'	27.5	CT	2/16/12	ND	ND	0.0072	ND	0.054	**3.2**	ND	ND	ND
	SB51A-12-18-31.5'	31.5	CT	2/16/12	ND	ND	ND	ND	0.0044	0.12	0.014	ND	ND
SB51A-12-19	SB51A-12-19-8'	8	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-19-22'	22	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-19-32'	32	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-19-35'	35	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-20	SB51A-12-20-5.5'	5.5	CT	3/22/12	ND	ND	ND	ND	0.0082	ND	ND	ND	ND
	SB51A-12-20-12'	12	CT	3/22/12	ND	ND	ND	ND	ND	0.0097	ND	ND	ND
SB51A-12-21	SB51A-12-21-6'	6	CT	3/22/12	ND	ND	0.021	ND	ND	ND	ND	ND	ND
	SB51A-12-21-13'	13	CT	3/22/12	ND	ND	0.026	ND	ND	ND	ND	ND	ND

Table B2
Soil Sampling Results from Building 51A Area
Organic Analytes
(concentrations in mg/kg)

					VOCs-E8260								
Location	**Sample ID**	**Depth (ft)**	**Lab**	**Date**	**1,1-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**TCE**	**carbon tetrachloride**	**vinyl chloride**	**Other analytes**
SB51A-12-21	SB51A-12-21-22'	22	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
(cont'd)	SB51A-12-21-29'	29	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-22	SB51A-12-22-5.5'	5.5	CT	3/22/12	ND	ND	ND	ND	0.066	0.038	ND	ND	ND
	SB51A-12-22-12'	12	CT	3/22/12	ND	ND	ND	ND	0.0068	0.027	ND	ND	ND
SB51A-12-23	SB51A-12-23-5'	5	CT	3/22/12	ND	ND	ND	ND	0.0088	0.0056	ND	ND	ND
	SB51A-12-23-12'	12	CT	3/22/12	ND	ND	0.028	0.013	ND	0.0058	ND	ND	ND
SB51A-12-24	SB51A-12-24-5'	5	CT	3/22/12	0.02	0.0052	0.16	0.0049	0.018	0.15	ND	ND	ND
	SB51A-12-24-8'	8	CT	3/22/12	0.006	ND	0.016	0.0086	ND	0.029	ND	ND	ND
	SB51A-12-24-12'	12	CT	3/22/12	0.0061	ND	0.011	ND	ND	0.023	ND	ND	ND
SB51A-12-25	SB51A-12-25-5'	5	CT	3/22/12	ND	ND	ND	ND	ND	0.013	ND	ND	ND
	SB51A-12-25-8'	8	CT	3/22/12	ND	ND	ND	ND	ND	0.017	ND	ND	ND
	SB51A-12-25-12'	12	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-26	SB51A-12-26-8'	8	CT	3/22/12	ND	ND	0.03	ND	ND	**0.72**	ND	ND	ND
	SB51A-12-26-14'	14	CT	3/22/12	ND	ND	ND	ND	ND	0.016	ND	ND	ND
	SB51A-12-26-22'	22	CT	3/22/12	ND	ND	ND	ND	ND	0.013	ND	ND	ND
	SB51A-12-26-26'	26	CT	3/22/12	ND	ND	0.0053	ND	ND	0.13	0.0087	ND	ND
	SB51A-12-26-31'	31	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-26-35'	35	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-28	SB51A-12-28-5'	5	CT	3/22/12	ND	ND	ND	ND	0.03	0.045	ND	ND	ND
	SB51A-12-28-12'	12	CT	3/22/12	ND	ND	ND	ND	ND	0.013	ND	ND	ND
SB51A-12-M7	SB51A-12-M7-18'	18	CT	3/21/12	ND	ND	ND	ND	ND	0.0044	ND	ND	ND
	SB51A-12-M7-26'	26	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB51A-12-M7-33'	33	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-M8	SB51A-12-M8-5.5'	5.5	CT	3/21/12	ND	ND	0.016	ND	0.048	0.076	ND	ND	ND
	SB51A-12-M8-12'	12	CT	3/21/12	0.0079	0.0087	0.26	ND	ND	0.023	ND	ND	ND
SB51A-12-M9	SB51A-12-M9-6'	6	CT	3/21/12	ND	ND	0.0077	ND	0.05	0.037	ND	ND	ND
	SB51A-12-M9-10'	10	CT	3/21/12	ND	ND	0.039	0.009	ND	ND	ND	ND	ND
SB51A-12-M10	SB51A-12-M10-6'	6	CT	3/21/12	ND	ND	0.0052	ND	0.055	0.049	ND	ND	ND
	SB51A-12-M10-11'	11	CT	3/21/12	ND	ND	ND	ND	0.061	0.025	ND	ND	ND
	SB51A-12-M10-18'	18	CT	3/21/12	ND	ND	0.06	ND	ND	0.015	ND	ND	ND
	SB51A-12-M10-26'	26	CT	3/21/12	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB51A-12-M11	SB51A-12-M11-12'	12	CT	3/22/12	ND	ND	0.053	0.012	ND	0.011	ND	ND	ND
	SB51A-12-M11-19'	19	CT	3/22/12	ND	ND	0.014	ND	ND	ND	ND	ND	ND
	SB51A-12-M11-22'	22	CT	3/22/12	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not Detected

CT= Analysis by Curtis & Tompkins Ltd

† = result exceeds instrument's linear range

Table B3
Groundwater Sampling Results - Building 51A Area
Volatile Organic Compounds - EPA Method 8260
(concentrations in µg/L)

Constituent	MCL	SB51A-12-1	SB51A-12-2		SB51A-12-3	SB51A-12-4	SB51A-12-5	SB51A-12-6	SB51A-12-7
		06-Feb-12	06-Feb-12	14-Feb-12	06-Feb-12	06-Feb-12	06-Feb-12	06-Feb-12	12-Apr-12
Aromatic or Non-Halogenated Hydrocarbons									
Benzene	1	<1	<1	<1	<1	<1	<1	<1	<1
n-Butylbenzene		<1	<1	<1	<1	<1	<1	<1	<1
sec-Butylbenzene		<1	<1	<1	<1	<1	<1	<1	<1
ter-Butylbenzene		<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	70	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	300	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene		<2	<2	<2	<2	<2	<2	<2	<2
p-Isopropyltoluene		<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene		<2	<2	<2	<2	<2	<2	<2	<2
n-Propylbenzene		<1	<1	<1	<1	<1	<1	<1	<1
Toluene	150	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-Trimethylbenzene		<1	<1	<1	<1	<1	<1	<1	<1
Xylenes, total	1750	<2	<2	<2	<2	<2	<2	<2	<2
Total Aromatic Hydrocarbons									
Halogenated Non-Aromatic Hydrocarbons									
Bromodichloromethane	80	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	80	<10	<10	<10	<10	<10	<10	<10	<10
Carbon Tetrachloride	0.5	10300	118	10.4	<1	<1	1470	1.2	<1
Chloroethane		<30	<30	<30	<30	<30	<30	<30	<30
Chloroform	80	46.2	48.4	10.7	<3	<3	44.8	<3	<3
Chloromethane		<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	5	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	0.5	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethene	6	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene	6	20	6.3	1.5	<1	<1	8.2	<1	<1
trans-1,2-Dichloroethene	10	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	5	<1	<1	<1	<1	<1	<1	<1	<1
Methylene Chloride	5	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-Tetrachloroethane		<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	5	1270	2.5	<1	<1	<1	9.4	<1	<1
1,1,1-Trichloroethane	200	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	5	<1	<1	<1	<1	<1	<1	<1	<1
2,2-Dichloropropane		<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	5	11700	1990	397	5.1	1.8	4940	9.5	2.3
Freon-113	1200	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl Chloride	0.5	<1	<1	<1	<1	<1	3.0	<1	<1
Total Halogenated Hydrocarbons		23,336	2,165	420	5.1	1.8	6,475	11	2.3
Total Concentration of VOCs		23,336	2,165	420	5.1	1.8	6,475	11	2.3

MCL: Maximum contaminant level for drinking water (determined by CDPH)
All analyses by LBNL EML unless otherwise noted

<	= Less than Quantitation Limit
	= Compound not included in analysis

ATTACHMENT 1 (CD)

VIRONEX MEMBRANE INTERFACE PROBE INVESTIGATION REPORT – B51 SUBSURFACE AREA

(April 17, 2012)