UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JAN 31 2014

REPLY TO THE ATTENTION OF:

LU-9J

Mr. Jason Smith
Corporate Environmental Director
Tecumseh Products Company
2700 West Wood Street
Paris, Tennessee 38242

Re: EPA's response to Tecumseh Products Company's September 30, 2013 Supplemental Submission to the Human Exposure Environmental Indicator Report (MID005049440)

Dear Mr. Smith:

In recent months, soil, soil gas, and groundwater sampling and monitoring results submitted by Tecumseh Products Company (TPC) to the U.S Environmental Protection Agency (EPA) demonstrate that TPC has failed to identify the nature and extent of contamination on and off-site. In addition, the interim measures TPC installed, to either stabilize contaminant migration or control human health exposure to contaminants, appear to have had a limited effectiveness.

Under the Administrative Order on Consent (AOC), effective March 29, 2010, TPC is required, within 18 to 30 months from the effective date of the AOC, to: (1) define the nature and extent of releases of hazardous waste and hazardous constituents at or from the facility; (2) demonstrate that current human exposures at or from the facility are under control and (3) demonstrate that migration of contaminated groundwater at or from the facility is stabilized.

EPA has provided TPC ample opportunities to address its comments, concerns and suggestions regarding the adequacy of the reports TPC has submitted to satisfy these requirements of the AOC. Despite the guidance and extensions of time EPA has provided to TPC to meet deadlines associated with these requirements, TPC is still not meeting the provisions of the AOC. Consequently, to ensure that TPC performs the work it agreed to under the AOC, EPA has identified areas of data deficiencies in the Attachment to this letter and requires that TPC specifically address these issues in order to come into compliance with the AOC. Accordingly, TPC shall develop a workplan for EPA's review to collect soil, soil gas and groundwater samples and data necessary to address the data deficiencies identified in the Attachment. A brief summary of our concerns is outlined below.

SUMMARY OF DEFICIENCIES DESCRIBED IN ATTACHMENT THAT REQUIRE IMMEDIATE ACTION TO CONTROL CURRENT HUMAN EXPOSURE TO CONTAMINANTS

On September 30, 2013, TPC provided to EPA its *Supplement to the Current Human Exposure Environmental Indicator Report* (Human Health EI Supplement), submitted in response to the second extension of time provided to TPC to revise its Environmental Indicator (EI) report relating to current human exposure to contamination, as required under Paragraph 13.a. of the AOC. The second extension was provided to TPC by EPA on March 6, 2013 because, as with the first extension, investigative deficiencies relating to source area assessment, definition and characterization of the extent of impacts in soil and groundwater, assessment of the site's geologic conditions, and adequacy of permanent monitoring locations prevented EPA from approving TPC's submittal. Those deficiencies resulted in an incomplete evaluation of potential exposures in the areas surrounding the site.

The parties had previously met on October 29 and 30, 2012, at EPA's request, to address deficiencies that EPA identified in the September 30, 2012 *Remedial Investigation and Groundwater Environmental Indicator Report* and in anticipation of the revised EI for human health TPC was scheduled to submit in December 2012. As a result of that meeting, TPC agreed to undertake a number of "action items" that the parties believed would assist TPC in establishing that current human exposure to contamination was under control and that migration of groundwater contamination was stabilized. TPC memorialized these action items in a Technical Memorandum, dated December 5, 2012, and subsequently revised on December 19, 2012.

The results of groundwater samples collected between October 2012 and August 2013, which were reported in the July and October 2013 Quarterly Progress Reports, revealed that volatile organic contaminant concentrations in groundwater had increased, especially in the areas northeast and southeast of the TPC site. Since there is a correlation between soil gas concentrations and groundwater concentrations, EPA is concerned that the increasing groundwater concentrations may cause increases in soil vapor concentrations at levels above those reported to date, and as evidenced by increasing trichloroethene (TCE) levels in soil gas at SG-01 and SG-07. As you recall, soil gas sampling locations were previously established in areas where groundwater exceedances were present and it was assumed that the groundwater plume was stable and defined. However, because information you recently submitted shows that the extent of impacts remains undefined and groundwater concentrations are increasing where monitored, EPA does not agree that all current human health exposure to contaminant concentrations at or from the facility via soil vapor and groundwater are under control as you reported in the September 29, 2013 supplement.

EPA Concerns Regarding Areas North and Northeast of the TPC Site

Since the initial sampling of MW-23 in December 2009, concentrations of vinyl chloride in groundwater have been gradually increasing, and those levels are currently almost 30 times the original concentration. The increasing concentration of this degradation product of TCE suggests that associated TCE concentrations in that area are also likely rising and that the contaminant plume is not stable. TPC elected to install MW-23 at a much shallower depth than the

intermediate depths where TCE was found earlier in the groundwater at 1,700 parts per billion (ppb) at B-23, and where vinyl chloride was found earlier in the groundwater at 450 ppb at B-35, 390 ppb at B-31, and 140 ppb at B-26. TCE was later found at 53,000 ppb in the soil at a depth of 35' in NS-18, but there are no wells installed downgradient at this depth to track the migration of TCE off-site towards B-35, where TCE has been found in upgradient soil gas samples. Without additional permanent well data to demonstrate the extent and concentration of TCE migrating off-site, TPC cannot conclusively demonstrate that it has established the extent of TCE contamination or exposures. The current data set from the existing monitoring wells indicates ground water contamination at the site, but the existing wells do not adequately cover the potential vertical and horizontal extent of contamination, as implied by the data.

In addition, TPC reported in the Human Health EI Supplement that TCE concentrations in soil gas are increasing at SG-07 and SG-10. The data from these monitoring points appear to indicate that the soil vapor extraction (SVE) system TPC installed at the north central area of the site is not mitigating the contamination as intended. The EPA suspects that the SVE system is not operating properly and therefore not capturing the vapors, because in part, it was designed to address contamination in the soil, not groundwater. Given these strong indications that the measures in place may not be successfully preventing current human exposure, an **immediate** indoor air investigation is necessary for residences bounded by Cummins, Kilbuck, Ottawa and Maumee Streets to ensure that residents are not being exposed to unacceptable levels of TCE contamination from vapor intrusion.

Based upon data gathered by TPC, EPA believes further delineation and characterization of the extent of groundwater impacts must be performed. Without an accurate understanding of the nature and extent of the groundwater plume, EPA cannot assess whether existing soil gas sampling locations are appropriately located within the area of potential impact. The increasing groundwater and soil gas contamination levels reported suggest that on-site contamination is migrating off-site into the surrounding properties, further than originally assumed. Migration of contamination off site may be due to ineffective source stabilization measures taken by TPC to date. In addition, though TPC has proposed it, TPC has provided insufficient information to evaluate the effectiveness of the native clay units in preventing vapor intrusion into residences in this area.

<u>EPA Concerns Regarding the Area Southeast of the TPC site</u>

In the southeast, TPC has installed a permeable reactive barrier (PRB) and a vapor mitigation system at one residence and maintains that this effectively protects human health. However, TPC reported increasing contaminant concentrations in ground water on either side of the PRB at MW-35I and MW-21 in the July and October quarterly progress reports. There are no monitoring wells along the flow path between these two wells, at the depths that the contaminant source was recently identified; instead, the wells installed are either at the margins of the PRB or at shallower depths than where the heaviest impacts have been seen to date. Therefore, it is difficult to confirm that the barrier is having a positive effect on groundwater at the depth of the source. As groundwater concentrations are increasing, soil gas concentrations may also be increasing off-site to levels that would no longer be protective of human health, and vapor mitigation systems are not present to address potential threats at all of the residential properties in the

affected area. We cannot know what is happening unless appropriate and adequate samples are collected.

The concerns described above demonstrate that TPC has failed to establish that current human exposures to contaminants at or from the facility are under control. In addition, EPA is concerned that TPC's proposal to install an SVE system, in a workplan submitted on November 22, 2013, may not be sufficient to control exposures to the adjacent property because TPC has not identified the extent of contamination. EPA's review of the data TPC has collected and used to develop a site model over the last four years finds that data are incomplete and that the current Site Characterization Model does not provide an accurate picture of site-wide and off-site conditions. Given the strong indications of an expanding plume from increasing groundwater, soil gas, and exhaust sample concentrations and concerns that the measures in place may not be successfully preventing current human exposure, EPA believes that indoor air sampling should **immediately** resume at residences along Mohawk and Maumee Streets east of the site, and vapor intrusion investigation (including sub slab soil gas and indoor air sampling) should begin at the Marten Home Center. Additionally, further delineation and characterization of the extent of groundwater impacts must also be performed for an accurate portrayal of the site, enabling the creation of a mutually acceptable site model.

Consent Order Compliance

EPA believes that TPC has not identified all releases that may have occurred at the TPC facility. TPC has not collected the necessary soil and groundwater samples from the areas of the site with the highest likelihood of suffering impacts from the release of hazardous waste. Groundwater results with increasing concentrations indicate that contamination may be migrating off-site at higher levels than previously known. As a result, TPC, per the AOC, has failed to:

(1) Completely investigate all potential source areas, solid waste management units or areas of concern at the site, and any other potential areas of impact that may be present;

(2) Adequately assess, characterize or delineate all source area soils as demonstrated by TPC's failure to date to specifically sample target source areas, previously-identified areas of contamination, or the most heavily contaminated soils; and,

(3) Adequately characterize or define groundwater impacts as evidenced by the fact that the zones of heaviest impacts have not been identified as such, and TPC has not used existing data to target likely areas for permanent groundwater monitoring.

Therefore, TPC has not:

(1) Submitted reports and conducted the other activities necessary to demonstrate that all current human exposures at or from the facility are under control as required by Paragraph 13.a of the Consent Order;

(2) Submitted reports and conducted the other activities necessary to demonstrate that migration of contaminated groundwater at and from the facility has stabilized as required by Paragraph 13.b of the Consent Order; and

(3) Identified and defined the nature and extent of releases of hazardous wastes and hazardous constituents at or from the facility as required by Paragraph 11 of the AOC.

Recommended Next Steps

TPC must determine the nature and extent of contamination, both on-site and off-site, to establish whether additional exposures are occurring and whether further remediation of contaminants originating from the site is required. We believe this will be best accomplished using high resolution groundwater site characterization. Ultimately, a meaningful receptor exposure pathway analysis relies on a sufficient Conceptual Site Model (CSM), which is supported by adequate data, that will be used to determine what source removal or groundwater mitigation is necessary. We have outlined in the Attachment areas where data gaps are present and require TPC to address those gaps so that a CSM can be constructed.

TPC has proactively implemented interim actions to address contaminant migration concerns EPA identified to the southeast and north of the site; however, TPC has not adequately demonstrated that these are the only areas with the potential for human exposure to contaminants, or that the controls are effective. EPA believes the fate and transport mechanisms are not thoroughly understood and without this fundamental information, it is simply not possible to develop an adequate Remedial Investigation Report to support the selection of final corrective measures for the facility.

Additional sampling efforts are needed to determine whether active source removal or plume control is necessary. Additional sampling efforts are also needed to determine whether interim measures are operating effectively. These activities must occur immediately.

In order to move the site characterization in the direction EPA believes it needs to go, EPA has developed the attached document that identifies the investigation activities needed to address the deficiencies identified in the data TPC has provided to EPA thus far. TPC shall develop a draft workplan, for EPA review, to satisfactorily address the deficiencies identified in the Attachment, incorporating EPA's suggestions for additional sampling and characterization actions as indicated. TPC shall submit the draft workplan to Joseph Kelly on or before March 1, 2014. Failure to submit a satisfactory draft workplan to conduct the additional site investigation, which is necessary for TPC to demonstrate compliance with the AOC, may subject TPC to remedies or sanctions available to EPA for violation of the terms of the AOC.

EPA encourages TPC to schedule a meeting with EPA to discuss this matter further. However, before scheduling this meeting, we would like a written response to this letter, indicating whether or not TPC intends to provide the draft workplan and supplemental data collection requested and whether it will perform the **immediate** investigation northeast and southeast of the site necessary to ensure that residents are not being exposed to unacceptable levels of contamination, including the potential for vapor intrusion from TCE contamination.

EPA looks forward to receiving your response and working with TPC to resolve our concerns. If you have questions regarding your written response submission, please contact Joe Kelly, of my staff, at (312) 353-2111 or by e-mail at kelly.joseph@epa.gov.

Sincerely,

Jose G. Cisneros, Chief
Remediation and Reuse Branch

Attachment: Investigation Deficiencies & Required Actions

cc: Graham Crockford, TRC Environmental Corporation (TPC Project Manager)
Douglas McClure, Conlin, McKenney & Philbrick, PC
Dale Bridgeford, MDEQ
Kevin Welch, Tecumseh City Manager
Chris DeWetter, Tecumseh Products Company
Stacy Metz, TRC Environmental Corporation
Dave Roberts, Tecumseh Food Manufacturing & Engineering, LLC
Tecumseh District Library – Public Repository

Attachment – Investigation Deficiencies & Required Actions

TPC maintains that all current human exposures to contamination at or from its facility are under control, as evidenced most recently in the *Supplement to the Current Human Exposure Environmental Indicator Report* TPC provided to EPA on September 30, 2013. However, EPA still has significant concerns regarding potential exposures to contamination at or from the facility. EPA believes potential exposures to contamination at or from the facility continue to exist under current conditions, as evidenced by TPC's November 2013 proposal to install a Soil Vapor Extraction (SVE) system to address soil gas concerns along the boundary of the property to the southeast of the facility. EPA believes TPC's investigative deficiencies prevent confirmation that the exposure pathways are incomplete, and as a result, EPA also believes the Human Health evaluation is incomplete.

A "Current Human Exposures Under Control" determination relies on an evaluation of exposures and associated risks. That evaluation relies on an accurate Conceptual Site Model (CSM) that contains four components: (1) accurate source characterization; (2) assessment of primary migration pathways; (3) assessment of secondary migration pathways; and, (4) identification of associated receptor exposures. The deficiencies summarized in this attachment document that TPC failed to perform an adequate assessment of source zones and hydrogeology, which has lead to an incomplete evaluation of the extent of migration of contaminants from the source to different media such as groundwater, soil gas and indoor air, and an incomplete evaluation of potential exposures. An incomplete evaluation has resulted in partial knowledge of the contaminant volume and migration to different media, and the cumulative deficiencies have resulted in the implementation of Interim Measures that do not appear to be working effectively.

A review of the deliverables submitted to EPA beginning in 2009 and the performance evaluation of the interim remedies installed to date demonstrate that unless the CSM is refined with further source characterization and contaminant fate and transport data, TPC cannot successfully demonstrate that the Environmental Indicator (EI) can be achieved for "Current Human Exposures Under Control". In addition, EPA will not be able to evaluate TPC's future proposal for Corrective Measures unless TPC adequately characterizes the risk associated with potential exposure scenarios and submits an adequate Remedial Investigation Report.

In order to develop an accurate and comprehensive approach to cleanup, TPC must develop a work plan that accomplishes the following objectives:

1. Immediately evaluates concerns regarding potential vapor intrusion north of the site and southeast of the site;
2. Characterizes impacts in known/potential source areas using a membrane interface probe (MIP) and/or flame-ionizing detector (FID) for field screening to justify the selection of soils samples from multiple vertical intervals in each soil boring in areas documented or suspected to be the most-heavily impacted potential source areas and depths;
3. Identifies the depths and lateral extent of all potential sources of impacts through further assessment, performing an evaluation of the data using three-dimensional visualization mapping to identify source areas and migration pathways in three dimensions;
4. Determines all locations and depths where soil saturation limit (Csat) exceedances, free product and/or dense non-aqueous phase liquid (DNAPL) are present that require active remediation;

5. Identifies locations and depths for the installation of permanent monitoring wells to monitor all areas and depth intervals of heaviest groundwater impacts on-site and off-site, using prior soil and groundwater data and additional source area investigation results, and after completing a High Resolution Site Characterization (HRSC) analysis; and,
6. Defines the full extent of impacts in three dimensions to evaluate the full potential for human exposure to all contaminants on or emanating from the site.

The following deficiencies should be addressed with the intention of developing 3-dimensional concentration contour maps of 1,1,1-TCA, TCE and degradation products, and other volatile organic compounds (VOCs) in source area soils. Once the maximum impacts in source area soils are characterized, mapped and delineated, TPC must collect the data necessary to develop 3-dimensional concentration contour maps of VOCs in groundwater. Once the maximum extent of groundwater impacts have been characterized, mapped and delineated in three-dimensions, TPC will be able to complete an evaluation of potential human exposures to soil gas by vapor intrusion and to groundwater by groundwater ingestion. The following deficiencies must be addressed to fully evaluate the potential for exposure to contamination and the proposed course of remedial action for at the site:

DEFICIENCY 1: 3-D SOURCE AREA SOIL & GROUNDWATER CHARACTERIZATION

The maximum concentrations and depth of impacts in all source areas must be accurately characterized and delineated in 3-dimensions in order to determine whether source area cleanup is required, and to accurately evaluate the migration pathways by properly positioning monitoring wells to intercept the heaviest impacts. TPC has stated in the September 2012 Remedial Investigation and Groundwater Environmental Indicator Report that concentrations of TCE and 1,1,1-TCA in groundwater suggest that residual sorbed TCE and 1,1,1-TCA in the form of ganglia may be present in the vadose zone and upper aquifer. EPA agrees that that free-phase solvent is likely present, but the locations and depths of the NAPL have not been identified to date.

Northern Source Area Characterization Deficiencies

- Past testing in northern source areas included a combination of methods, but was restricted to certain areas based on TPC's assertions regarding the presumed source areas. A comprehensive assessment of all of the data collected from source areas has not been provided because data from different testing methods has never been condensed and presented in a cumulative summary.
- Data gaps exist because field screening of soils was performed inconsistently. Many borings lacked field screening, were sampled on 5-foot centers, or were "blind drilled" based on logs provided in the September 2012 Remedial Investigation and Groundwater Environmental Indicator Report, which prevents an accurate analysis and leaves EPA with significant questions regarding the information TPC provided.
- Many boring locations were installed at distances of 100 feet or more from apparent source areas identified by TPC (*see*, **Figures 1 & 2**).

- Boring logs for NS-05 through NS-09, installed near heavy impacts in the northern source areas, were omitted from reports, preventing interpretation of conditions and sample selection criteria.
- Soil sampling targeted primarily only two intervals: the shallow soil (0-4 feet), and the water table (approximately 20-22 feet), leaving the majority of the soil column unassessed and the vertical distribution of contaminants undetermined and undelineated (*see*, **Figures 2 & 3**).
- Soils between the ground surface and water table with high field screening results were not analyzed, potentially resulting in a selection bias towards lower concentrations, and leaving exceedances of Csat undetermined. Refer to sampling from NS-12 for an example, in which case the sample from 0-2 feet was analyzed where the PID reading was 47 ppm, instead of the sample from 2-5 feet where the PID reading was 2,700 ppm. Concerns related to a potential selection bias towards low concentrations for soil sampling are highlighted on **Figure 2**, and shown in the cross section in **Figure 3**.
- Many areas identified as source areas were never revisited for delineation sampling. For example, GP-14 was identified as a source area in the September 2009 Current Conditions Report but there are no borings within 100 feet of this location; NS-17 was identified as a local soil source in the September 2012 Remedial Investigation and Groundwater Environmental Indicator Report but no further sampling was conducted; NS-15 was installed in a source area identified by passive soil gas sampling but no borings were installed within 100 feet of this boring; high concentrations of contaminants were found in shallow soils at GP-14, GP-15, GP-25, NS-15 and NS-17, and in deeper soil at NS-14, NS-15, NS-16, NS-18, NS-19, NS-20, MW-32 and MW-33 that have not been delineated.
- The figures developed by EPA using TPC's field screening data and sampling results show an apparent lack of delineation across the two source areas near NS-18 and NS-19 (*see*, **Figure 2**).
- EPA discussed with TPC in October 2012 the apparent migration of contaminants from shallow to deep intervals (greater than 35 feet at NS-18 and NS-19). EPA also highlighted that field screening data and soil sampling results indicate the residual impacts are undefined downgradient and off-site. The three borings (NS-18, NS-19 and NS-20) installed by TPC during the last phase of source area assessment did not adequately address EPA's request to define the lateral and vertical extent of impacts. The majority of the saturated soil zone remains unassessed for those free-phase contaminants that are sinking below the water table, and only the last three borings targeted soils at depth with no further work completed. Contamination extends undefined to beyond B-35 from this area (*see*, **Figure 1**).
- Potential sources of contamination in the area of the former USTs #1-6, the former spent TCE solvent tank (SWMU 10), the former wastewater treatment area and associated USTs (SWMU 1), former metal solids bin (SWMU 2), the former wastewater treatment USTs 8-10 (SWMU 3), the waste oil storage tank (SWMU 11), and a possible in-place UST identified during a GPR survey by the purchaser's consultant (ATC, 2009) have not been adequately assessed. These SWMUs were assessed with only four cursory due diligence borings (GP-16, GP-17, GP-28 and GP-29). It is presumed that a due diligence assessment is not intended to characterize or define the extent of impacts. No borings were installed at SWMU 10 even though one boring (NS-17) installed by TPC approximately 50 feet northwest of the former TCE tank contained the highest level of TCE measured in facility soils to date. The the majority of the area was also excluded from the northern passive soil gas survey by TPC

without explanation, and no additional work has been performed to characterize or define the extent.

- TPC suggested that a hydrocarbon source is facilitating contaminant degradation in the north; however, it does not appear that TPC has identified, characterized or delineated this hydrocarbon source.
- TPC originally installed only 2 permanent wells (MW-32S and MW-33S) in the northern source area. Both wells were installed at the water table but testing at NS-18 and NS-19 shows that the primary contaminants (TCE and 1,1,1-TCA; both with high specific gravities) are sinking below the water table to a depth below the screened intervals in these wells. When EPA requested a deeper permanent monitoring location, TPC offered to install MW-32D at NS-20. TPC's recommendation placed this monitoring location upgradient from the impacts and as a result, it does not intercept the heaviest impacts or characterize the source.
- High groundwater impacts were found at NS-2, NS-5, NS-6, NS-11 and NS-14, but the groundwater plume core remains undefined and unassessed because permanent wells are located upgradient or cross-gradient from impacts. There are no wells downgradient from sources, as shown on **Figure 1**.

Required Actions

- Define the nature (NAPL, sorbed and dissolved) and the horizontal and vertical extent of the contaminants in the northern source area(s) in three dimensions.
- Characterize and delineate shallow hot spots found in the soil at GP-14, GP-15, GP-25, NS-15 and NS-17 (TCE ranging from 8.3-100 ppm), and deeper impacts previously found in the soil at NS-14, NS-15, NS-16, NS-18, NS-20, MW-32 and MW-33.
- Collect and analyze soil samples over multiple vertical intervals above and below the water table in each of multiple soil borings within known and suspected source areas to determine: (1) maximum concentrations; (2) areas of Csat exceedances that require active remediation; (3) geometry of source impacts; (4) depth of maximum impacts; and, (5) appropriate placement of monitoring wells to intercept the heaviest impacts. Select samples of the most heavily-impacted soils for chemical analysis following quantitative field screening with either a FID calibrated for TCE, or MIP or equivalent technology.
- Analyze a sufficient number of samples from multiple zones of heaviest impact from each location to map the vertical and lateral profile of the full extent of contamination. Analyze samples for a combination of VOCs and/or total petroleum hydrocarbons (TPH), if applicable, to evaluate the degree of chemical-specific and overall Csat exceedances.
- Delineate the impacts with increasing depth and distance from the source areas following the apparent pathways of migration. Soil borings should be positioned to follow contaminant migration to depth in both the direction of the dip of the deep clay surface, and in the direction of groundwater flow after the depth of heaviest impacts has been determined (*see*, **Figure 2**).
- Install soil borings within and downgradient from identified northern source areas (including NS-5/NS-6/NS-18, NS-11/NS-19/NS-20, and around NS-17) SWMUs, and AOCs as needed to demonstrate that the magnitude and the lateral and vertical extent of the impacts have been accurately assessed for all SWMUs and identified impacts.
- Characterize and define the groundwater impacts at intermediate and deeper depths that appear to be migrating from source areas above the northwest-dipping deep clay surface between 35 and 47 feet at NS-19. Characterize and monitor the migration of contamination

by installing permanent groundwater wells at the depth of heaviest impacts in all source areas after determining source geometry in the soil.

Southern Source Area Characterization Deficiencies

- Data gaps exist because field screening was performed inconsistently. Many borings lacked field screening, were sampled on 5-foot centers, or were "blind drilled, preventing accurate analysis and leaving EPA with significant questions regarding the information TPC provided.
- Boring logs for SS-05 through SS-08 in the southern source area were omitted from the September 2012 Remedial Investigation and Groundwater Environmental Indicator Report and earlier reports because the borings were reportedly not logged, preventing interpretation of conditions and sample selection criteria.
- Impacts in the south have not been adequately assessed, characterized, or delineated. Only SWMU 5 (the solvent distillation recovery system) was targeted for soil sampling. TPC originally declined to perform passive soil gas sampling on the presumption that SWMU 5 was the known source. All remaining SWMUs were assessed with only cursory due diligence work. It is presumed that a due diligence assessment is not intended to characterize or define the extent of impacts. EPA requested further characterization, and TPC installed only two borings (SS-9 and SS-10) that did not adequately defined the depth, maximum concentration(s), or extent of impacts. Passive soil gas sampling in 2013 later found a large soil gas plume that remains unassessed because of TPC's focus on SWMU 5 as the source. The highest TCE impacts that appear to be present north of SS-2 [1] based on the survey have also not been assessed.
- The source of the solvent plume and the hydrocarbon plume near B-68 has not been identified, characterized, or delineated. EPA has repeatedly informed TPC of the need for sampling of this potential source area. Very high field screening measurements were found in the shallow soil at B-68 but no soil samples were analyzed. The area was omitted from the passive soil gas survey[1] despite EPA's request for testing. Page II-2 of a January 2007 Phase I ESA by ENVIRON identifies this as the location of exterior hazardous waste storage areas located "southeast of Building L" and near the "Current Cardboard Bailing Area" (ENVIRON's Figure III-1 is attached for reference for locations). The area reportedly contained stained soil and/or stressed vegetation encompassing several hundred square feet near the south property line, per page 6 of the October 2009 Phase I ESA by Atwell-Hicks. Potential source areas that remain inadequately assessed, characterized, or delineated include the former exterior hazardous waste storage area, oil and flammable chemical storage building (Building Q), vehicle maintenance area, and the wastewater treatment plant (Building R), SWMU 6 and SWMU 8. To date, only cursory due diligence assessment was performed in these areas. It is presumed that a due diligence assessment is not intended to characterize or define the extent of impacts.
- TPC installed one permanent shallow well (MW-34S) in an area presumed to be the southern source area near SWMU 5. EPA requested a deeper permanent monitoring location because the source geometry was not defined and TPC was not monitoring the tendency for contaminants with high specific gravities (> 1) to sink below the water table. TPC installed one deep well (MW-34D) in an existing boring. The one nested well pair installed in this

[1] The attached Passive Soil Gas Survey maps by Beacon Environmental were provided by TPC on August 30, 2013 as "working copies" but were not included in the October 15, 2013 Third Quarter 2013 Progress Report

source area of approximately 120,000 sq. ft. (based on the passive soil gas survey) is insufficient to characterize the vertical and horizontal extent of the impacts.

- High TCE impacts in grab groundwater samples were found throughout boring B-68 to a depth of 30 feet. When TPC did not install a permanent well, EPA requested a well at that location. When TPC originally installed that well (MW-35D), it was approximately 21 feet too deep to intercept the heaviest impacts, and EPA requested a second well (MW-35I) at a proper depth. Contaminant concentrations in MW-35I have been increasing since its installation, approaching levels that suggest the presence of nearby free-phase solvents that have not been further assessed.

Required Actions

- Define the nature (NAPL, sorbed and dissolved) and the horizontal and vertical extent of the contaminants on a grid over the entire southern source area(s) in three dimensions, conducting soil sampling and over multiple vertical intervals above and below the water table in each boring, using the methods previously discussed to determine the need for active cleanup, and evaluate the placement and screened intervals of existing/future monitoring wells.
- Delineate the impacts with increasing depth and distance from the source areas (including deep impacts in soil at MW-34) following the apparent pathways of migration.
- Install soil borings within and downgradient from identified southern source areas as needed to establish sufficient evidence that the magnitude and the lateral and vertical extent of the impacts have been accurately assessed for all SWMUs and identified impacts.
- Install permanent groundwater wells at the depth of heaviest impacts in source areas to characterize and monitor the groundwater impacts at the sources after determining source geometry in the soil.
- Complete passive soil gas sampling and/or accurately characterize the source area around B-68. Delineate the extent of soil and groundwater impacts in all directions, given the documented petroleum/solvent use/storage, high levels of contamination, lack of assessment, and potential exposure concerns.
- Resubmit the October 15, 2013 Third Quarter 2013 Progress Report with the final version of the passive soil gas survey[1] as an attachment.

Source Area Characterization Deficiencies in Other Potential Source Areas

- Passive soil gas surveys show 1,1,1-TCA at adjacent margins of both surveys that suggest the presence of an unidentified source area in the central building (*see*, **Figure 1**). The area was excluded from passive soil gas sampling. TPC installed only one boring in this 562,500 sq. ft. area, relying on due diligence testing to document site conditions. It is presumed that a due diligence assessment is not intended to characterize or define the extent of impacts. The one boring installed by TPC (NS-13) had high field screening readings throughout the entire soil column that were not analyzed, and heavy solvent impacts in the groundwater that were not defined or monitored. Very high TCE impacts (118,000 parts per billion volume-ppbv) were found in soil gas in this area at SV-11, and the source was not identified.
- Two RCRA drum storage areas (DSA) on the western portion of the site were previously closed through "removal-only." The southern-most DSA was previously a "low-lying

swamp area"[2]. The DSAs have not been assessed because the facility certified that "no spills had occurred." The passive soil gas results contradict the certification. The closest boring (MW-37S), requested by EPA because TPC had not assessed a former hazardous substance UST area, is a great distance from the DSAs.

- Earlier Phase I Environmental Site Assessments (ESAs) noted heavy staining in the building and other recognized environmental conditions (RECs) suggesting the potential for impacts, including the rail spurs on-site and at the western property margin. Impacts documented upgradient from SWMU 5 and at B-15 suggest releases, but the potential sources have not been identified or assessed.

Required Actions

- Perform passive soil gas sampling and laboratory analyses of soil and groundwater at interior and exterior locations over the 12 acres bounded by NS-17, MW-35, MW-36, and SS-3 for accurate characterization of all potential source areas, SWMUs and AOCs.
- Install soil borings on a grid, targeting heaviest impacts, and analyze samples from multiple intervals above and below the water table at each location based on FID/MIP screening results to characterize and define the extent of impacts and determine the geometry of source area impacts.
- Determine the need for active on-site soil/groundwater cleanup, and evaluate the proper placement of monitoring wells and well screen intervals in source areas after determining the magnitude and extent of impacts.
- Identify the locations of any additional RECs identified in the Phase I ESA's that require investigation. Complete investigation of all SWMUs and AOCs, including impacts identified in the aforementioned deficiency categories. Investigate all potential sources of solvent impacts, including those identified by TPC[3], including the "use of TCE during machining and degreasing processes and a former railroad spur where various chemicals, including TCE, were off-loaded from rail cars" as potential sources. Provide legible historical Sanborn Fire Insurance Maps to aid in EPA's further evaluation of RECs.

DEFICIENCY 2: 3-D CHARACTERIZATION OF MIGRATION PATHWAYS

Because the source areas were not sufficiently characterized, groundwater wells do not appear to have been positioned to intercept the heaviest impacts, and the migration pathways have not been accurately assessed. By monitoring only the margins of the groundwater plume, the full extent of groundwater impacts has not been determined. As a result, potential human exposures to contaminated soil gas and groundwater cannot be accurately evaluated, and the remediation needed to establish that exposures are under control cannot be determined.

Incomplete Evaluation of Off-Site Contaminant Migration to the Northeast

- High impacts were found in grab groundwater samples at NS-6, NS-18, and NS-20 (among others). No monitoring wells were established downgradient from these locations (*see*, **Figure 1**). All downgradient wells were installed at great distances from the source(s).
- Heavily impacted wells NS-4S/I appear to be located cross-gradient from the plume path, and at shallower depths than impacts found at NS-18. EPA is concerned that groundwater contamination may be migrating off-site between MW-2S and MW-4S/I from NS-6 at deeper

[2] Maps included as attachment to TPC's February 1982 *Revised* Part A Hazardous Waste Permit Application.
[3] September 2009 Current Conditions Report

intervals and higher concentrations than those being monitored, and potentially at deeper intervals west of MW-2S (*see*, **Figures 1 & 2** for interpreted plume paths).

- All permanent groundwater wells installed before our October 2012 meeting targeted only the shallow water table and the deep clay surface (please refer to our draft cross-section in Figure 3). The wells were installed based on a generalized CSM because the source area soils were not sufficiently characterized to determine the depth of heaviest impacts emanating from source areas. Heaviest impacts appear to be located at intermediate depths that are not being monitored.
- The heaviest impacts in grab groundwater samples collected northeast of the site (B-23, B-26, B-31, and B-35) were found at 25-34 feet. TCE was found in the soil at 52,000 ppb at a similar depth at NS-18. Downgradient wells (MW-10D and MW-23) were installed at great distances from the source, and at shallower intervals that leave the heavier impacts at deeper intervals unmonitored. The vinyl chloride concentration at this shallow depth at MW-23 has increased from 3.2 ppb to 88 ppb, while the deeper original concentration of 450 ppb (B-35) has not been monitored. The increase at MW-23 indicates the plume is expanding, with only the shallow margin of the plume being monitored. Concentrations may be higher at the deeper interval now than when they were originally detected. EPA is concerned that these data suggest existing wells reflect a selection bias towards low concentrations.
- Further downgradient from B-35, MW-29S and MW-29D are located 600 feet cross-gradient from the apparent groundwater flow path. The wells were installed at the water table and the underlying deep clay, leaving the 41-feett of sand aquifer between the well screens unmonitored at the depth where the heaviest impacts were found upgradient.

Required Actions

- Add NS-18 (30-35 feet below grade) to the permanent quarterly monitoring network (requested by email on September 19, 2013) as an intermediate depth well.
- Complete Groundwater HRSC to justify the locations and screened intervals for well placement at intermediate depths where the heaviest impacts have been documented. Focus on areas near NS-6, NS-18, NS-19, MW-4S/I, B-35, and MW-23 and appropriate areas north of the site and downgradient along Patterson, Cummins, Kilbuck, and Maumee Streets.
- Establish a minimum of three permanent nested well locations at appropriate intermediate and shallow or deep intervals (depending on source characterization) between NS-20 and MW-23, downgradient from the apparent groundwater source areas at NS-6, NS-17, NS-18, NS-19, NS-20, GP-14, GP-15 and GP-25. Establish at least one nested well location at appropriate intermediate and shallow or deep intervals (depending on source characterization) downgradient from MW-23. Additional wells may be needed to accurately characterize the groundwater plume in 3-dimensions, and monitor groundwater contamination to evaluate human exposures and plume stability.
- Establish deeper wells to assess impacts at a depth of approximately 45 feet at NS-19, which appear to be migrating to the north above the northwesterly dipping deep clay surface towards SG-07.
- Collect Groundwater HRSC data to evaluate potential impacts at intermediate depths at MW-2S, and MW-7S, based on the orientation of the deep clay surface and presence of upgradient municipal pumping wells.
- Re-examine the depth and locations of current wells after completing adequate source area characterization to determine if additional wells are needed to monitor the expansion of the

plume (*see*, **Figures 2 & 3**). Install additional source area wells at intermediate depths as needed. Support decisions regarding the placement of additional permanent wells with site-wide 3-D visualization data, Groundwater HRSC data, and/or geophysical mapping. Define the groundwater impacts in three dimensions

- Provide information regarding the purpose of and data collected from borings B-55, B-56 and B-57 installed along the trend of the deep clay surface to the northeast, for which no data was provided to EPA.
- Implement efforts to stabilize the expanding groundwater plume through interim measures.

Incomplete Evaluation of Off-Site Contaminant Migration to the Southeast

- TPC reported high impacts in grab groundwater samples at GP-21 and GP-22[3] and SS-8[4]; however, no monitoring wells were established downgradient (*see*, **Figure 1**). All wells were positioned near the property line at great distances from the source(s) with the exception of MW-35I, installed after EPA's second request for a well at a proper depth downgradient from the source.
- Contaminant concentrations are increasing in MW-35I[5], at levels that suggest free-phase solvents that may be present in nearby groundwater that would require active recovery. EPA requested by email on June 25, 2013 that the southern passive soil gas survey be extended east of the building, but TPC declined this request. This one well does not characterize the groundwater impacts at or migrating from this source area(s).
- Downgradient from MW-35I, the closest well screened at the same interval (MW-21) is over 1,300 feet to the east, and over 1,900 feet from the area TPC considers the source. The concentration of TCE has increased by 50% at this location in August 2013[5].
- Data from the existing groundwater monitoring network may reflect a selection bias towards low concentrations. The highest impacts in groundwater at B-1, B-15, B-49 through B-51, and MW-35I were found at intermediate depths, but all permanent wells were installed only at the shallow water table or deep clay (*see*, **Figure 3**) based on a generalized CSM developed without accurate source area characterization. The TCE concentration in groundwater at B-50 was orders of magnitude higher at 13-15 feet (5,400 ppb) than it was just five feet deeper or five feet shallower. All of the wells near B-50 (MW-9S, MW-20S, PRB-01S, PRB-02S and PRB-07S) were installed at the water table, where lower levels of TCE were found. Following review of TPC's July 2013 Quarterly Report, EPA requested by email on July 29, 2013 that TPC revise the cross sections to highlight the impacts at intermediate depths at MW-35I as an update to the CSM, but TPC's consultant refused, noting on August 5, 2013 that the change would not affect the conceptual site model or the path forward.
- EPA previously requested wells to monitor contaminants entering and leaving the PRB to evaluate its effectiveness. TPC installed two wells (PRB-04D and PRB-08D) several hundred feet north and south of the path of the plume. Groundwater concentrations along the plume path upgradient and downgradient from the PRB are increasing at similar depths at MW-35I and MW-21 that are not being monitored at other locations. As a result, there is insufficient information to demonstrate that the groundwater plume is stable, that the PRB is operating effectively, or that TPC has achieved the 80% reduction in groundwater contamination that TPC has suggested.

[4] September 2012 Remedial Investigation and Groundwater Environmental Indicator Report
[5] October 2013 Third Quarter 2013 Progress Report

- Concentrations of TCE and 1,1,1-TCA in MW-20S are increasing[5], and concentrations of vinyl chloride in MW-20D are increasing[5]. The wells were installed at the shallow water table and deep clay surface without determining the source area geometry. The vertical placement of the wells omits groundwater monitoring within a 25-foot interval of sand aquifer between the screens. The interval omitted is the same as the interval with the highest contaminant concentrations in nearby borings B-1, B-15, and B-49 through B-51[4].
- Ethylbenzene, toluene, and xylenes were found in the groundwater near the property line at concentrations of 9,300 ppb, 61,000 ppb, and 59,000 ppb[4], respectively, along with 2-Butanone (methyl ethyl ketone or MEK) at 17,000 ppb and acetone at 13,000 ppb[6]. The source was not identified, but may be related to the RECs/SWMUs identified in the January 2007 Phase I ESA by ENVIRON. The impacts were not defined.
- Concentrations of TCE have been increasing at MW-25S[7], recently exceeding the MDEQ's residential drinking water criteria for the first time in June 2013. The well was installed at the water table without determining the source area geometry and without analyzing groundwater in the underlying 26 feet of sand aquifer below the well screen. The heaviest impacts appear to be located at this depth in nearby borings. EPA has previously requested that TPC define the impacts in this area.
- Contamination was previously found upgradient from MW-25S at B-15 and MW-19S/D. These borings also excluded groundwater testing within this apparent zone of heaviest impact between 30'-45 feet below grade.

Required Actions

- Re-examine the depth and locations of current wells in relation to the soil and groundwater plumes, the dip of the buried clay surface, and the direction of groundwater flow after the source areas have been characterized.
- Collect Groundwater HRSC data on-site near MW-35I and off-site along Maumee Street southeast of the site near B-50, MW-20S/D, and MW-21and downgradient from source areas to determine accurate locations and depths for the placement of permanent wells.
- Collect additional Groundwater HRSC data at intermediate depths at the southern boundary of the site near MW-25S, between PRB-11S and MW-1S, and between MW-1S and PRB-03S to evaluate the need for a permanent well at intermediate depths based on increasing concentrations at MW-35I, MW-20S/D, and MW-21 (and SG-01[8], discussed under Deficiency 3).
- Collect additional Groundwater HRSC data at intermediate depths at MW-5, to evaluate the effect of upgradient pumping wells on contaminant transport, and determine whether permanent wells at intermediate depths are needed.
- Install permanent nested wells to characterize and define groundwater impacts at intermediate and deeper intervals downgradient from groundwater source areas at GP-21, GP-22, and SS-8, near MW-35, near MW-21, and between NS-13 and MW-27 to determine the easterly and southerly component of contaminant migration. Support decisions regarding the placement of additional permanent wells with site-wide 3-D visualization data,

[6] September 2012 Performance Monitoring Report, Permeable Reactive Barrier Downgradient of the Southern Source Area

[7] July 2013 Second Quarter 2013 Progress Report

[8] September 2013 Supplement to the Current Human Exposures Environmental Indicator Report

Groundwater HRSC data, and/or geophysical mapping. Define the groundwater impacts in three dimensions.

- Monitor the heaviest impacts moving through the PRB by installing permanent wells at intermediate depths upgradient and downgradient from B-50 and hotspots found through groundwater HRSC to confirm this interim measure is operating properly, and ensure the protection of human health.
- Characterize the magnitude and extent of BTEX, MEK, and acetone (and the hydrocarbon source) in groundwater to evaluate air sampling results.
- Continue to monitor locations MW-40S/D on a quarterly basis, as requested by email on September 19, 2013, while defining the extent of impacts in this expanding plume.

DEFICIENCY 3: INCOMPLETE EVALUATION OF POTENTIAL HUMAN HEALTH EXPOSURES

Due to the deficiencies in source area characterization and groundwater assessment, groundwater impacts have not been characterized or delineated in aerial extent. As a result, the evaluation of exposure pathways is incomplete. There is insufficient information confirming that the expanding groundwater plume is adequately addressed with the groundwater ordinance, and there is insufficient information to confirm that soil gas emanating from the groundwater plume has been adequately evaluated. As a result, there is insufficient information to demonstrate that human exposures are under control.

Incomplete Evaluation of Vapor Intrusion Pathway to the Northeast

- TPC has not collected sufficient data to evaluate the potential for vapor intrusion northeast of the site because the source(s) and groundwater impacts have not been characterized. Per MDEQ Guidance[9], "the reliability of the VI [vapor intrusion] evaluation is based on the extent that the conditions and location of the sources of vapors are appropriately characterized and identified." TPC has not defined the contaminant extent or established that the exposure pathway is incomplete and should not use the least protective of MDEQ's screening criteria at this stage of assessment.
- A soil vapor extraction (SVE) system was installed at the north property line on TPC's assumption it would capture soil vapors migrating laterally from source soils. However, the concentration of TCE in soil gas increased in August 2013 to the highest level measured at SG-07 to date[8]. This increase indicates that the SVE system is not reducing soil gas concentrations in this area. EPA believes the system's limited effectiveness may be attributable to the uncharacterized groundwater plume. The migration of the groundwater plume, as evidenced by increasing groundwater concentrations downgradient at MW-23, will contribute to an expanding soil gas plume as contaminants continue to migrate from the groundwater to the soil gas. The TCE concentration in soil gas downgradient from SG-07 at SG-10 exceeds MDEQ's shallow screening criteria (12 ppbv) for shallow samples. The location is adjacent to a residential area. The TCE concentrations at SG-10 are similar to levels at SG-09, where a vapor mitigation system was needed to reduce the potential for exposure.
- Vinyl chloride in groundwater at the distal monitoring location MW-23 (88 ppb) already exceeds the MDEQ Vapor Intrusion Groundwater Screening Level (2.8 ppb). The well is

[9] May 2013 Guidance Document for the Vapor Intrusion Pathway by MDEQ (http://www.michigan.gov/documents/deq/deq-rrd-VIGuidanceDoc-May2013_422550_7.pdf)

located at the plume margin, at shallower depths than the plume core, and concentrations are increasing. Should the plume continue to expand, the area where the screening criteria are exceeded will increase, extending further to the northeast beyond MW-23. To date, the plume core remains uncharacterized. TPC has attempted to use nearby soil gas data and physical site conditions to dismiss the screening level exceedances without first determining the location and extent of impacted groundwater.

- TPC has proposed that a native clay layer is an effective barrier to vapor intrusion northeast of the site, but has not provided sufficient information to ensure the exposure pathway is eliminated by: (1) defining the areal extent of the clay through confirmation soil sampling; (2) identifying locations where the unit may have been penetrated by foundations or utilities that would render the barrier ineffective; (3) collecting soil gas samples beyond the area where the clay is in contact with shallow contaminated groundwater; and, (4) conducting soil gas sampling at the perimeter of the clay unit to evaluate the potential for the lateral migration of contamination beneath the clay and the exposure from volatilization at the margins of the suggested barrier (after defining the extent of groundwater impacts).
- Near the intersection of Cummins and Maumee Streets, saturated soil conditions prevented the consistent collection of soil gas samples at SG-12/R, SG-14/R and SG-15/R, and upgradient soil gas locations SG-05, SG-06, SG-07 and SG-10 have exceeded both MDEQ's and EPA's most stringent screening criteria. The geologic profile in this area appears similar to the profile near SG-02, where the accumulation of soil vapors is limited because of groundwater in contact with the shallow clay. However, downgradient near SG-09, soil gas concentrations increase due to lower groundwater elevations and an increased thickness of the vadose zone above impacted groundwater. EPA is concerned that conditions downgradient from SG-12R, SG-14R and SG-15R to the east may be similar to those near SG-09, where remediation was needed. No soil gas samples have been collected east of SG-12R, SG-14R and SG-15R, and TPC has not yet evaluated this potential.
- By email on August 1, 2013, Joseph Kelly of EPA notified Graham Crockford (TRC) on behalf of TPC to begin using MDEQ screening criteria[9] for comparison with soil gas data. EPA recommended the use of MDEQ's criteria for use and eventual approval by MDEQ's Remediation Advisory Team, but did not agree that all remaining site-specific screening criteria developed for the project should be removed from the tables. MDEQ's criteria are much less conservative than EPA's screening criteria, and TPC consistently uses the least stringent deep soil gas screening criteria (120 ppbv for TCE or residential properties) without explanation. The MDEQ guidance[9] indicates that the "more restrictive $SG_{VI\text{-}SS}$ values are used in the initial assessment," and that a site-specific evaluation is needed when groundwater is found within 3 meters from the ground surface.

Required Actions

- Determine the extent of groundwater impacts exceeding the Vapor Intrusion Groundwater Screening Levels and characterize the associated soil gas contamination accordingly to evaluate the threats related to vapor intrusion.
- Further assess the expanding soil gas plumes to evaluate the threat of exposure concerns to residents and off-site workers.
- Continue to collect soil gas samples from all sampling locations, supplemented by additional soil gas locations established after characterizing the groundwater impacts and determining the extent.

- Begin sub-slab and indoor air sampling at residences to the northeast based on increases in soil gas and groundwater concentrations in that area, beginning at residences bounded by Cummins, Ottawa, Kilbuck, and Maumee Streets. Based on those results, determine if sampling downgradient at properties bounded by Cummins, Maumee, Wyandotte and Pottawatamie Streets is needed.
- Establish a community involvement plan if conditions warrant indoor air investigation in off-site areas surrounding the facility.
- Further evaluate the effectiveness of the clay layer as a barrier to vapor intrusion after defining the extent of groundwater impacts by addressing the noted deficiencies to ensure that human exposures are prevented.
- Perform soil gas sampling near homes located along Division Street between Chicago and Pottawatamie Streets after delineating groundwater contamination, to determine if a sufficient vadose zone allows for the accumulation of soil vapors, and creates a potential for vapor intrusion similar to the situation near SG-09.
- Revise the October 2013 Quarterly Progress Report and all future report tables to include all of the soil gas screening criteria developed for the project. Include all of screening criteria for comparison, and use the most stringent (12 ppbv for MDEQ, and 4 ppb for EPA for TCE) as the appropriate criteria for assessment of samples collected from shallow intervals near residential areas.

Incomplete Evaluation of Vapor Intrusion Pathway to the Southeast

- TPC has not collected sufficient data to evaluate the potential for vapor intrusion southeast of the site because the contaminant source(s) and groundwater impacts have not been characterized. Per MDEQ[9] Guidance, "the reliability of the VI [vapor intrusion] evaluation is based on the extent that the conditions and location of the sources of vapors are appropriately characterized and identified." TPC has not defined the extent of the contamination or established that the pathway is incomplete and should not use the least protective of MDEQ's screening criteria at this stage of assessment.
- Increasing TCE concentrations at MW-20S, MW-21, MW-25S and MW-35I indicate the groundwater plume is expanding. As the TCE groundwater plume expands/migrates, the TCE soil gas plume should also migrate. The concentration of TCE at MW-21 increased from levels approximately 1,000 ppb to 1,500 ppb in the groundwater in August 2013[5]. The TCE concentration in the exhaust sample collected from the 704 Mohawk residence in November 2012 increased[8] before the groundwater increase at MW-21. Only 1 of 5 residences in this area currently has a vapor mitigation system installed to address contamination that appears to be increasing.
- The TCE soil gas plume appears to be expanding as the groundwater plume expands/migrates. An increasing trend in the TCE concentration at MW-35I accompanied a sudden and significant increase in TCE at SG-01.[8] A significant increase in the TCE concentration at SG-02 was also observed downgradient from the PRB in August 2013.[8] To address the potential for human exposure, TPC proposed the installation of a SVE system along the north and west boundaries of the southeast-adjacent property[10]. By email on November 26, 2013, Joseph Kelly of EPA notified Graham Crockford (TRC) on behalf of TPC that EPA does not believe the SVE system will be effective in controlling the migration

[10] November 2013Workplan to Install a Perimeter Soil Vapor Extraction System, Southeast Site Perimeter

of the soil gas plume onto the adjacent site because the soil gas impacts are more-likely related to the migrating groundwater plume that TPC has not characterized.

- TPC found MEK, acetone, ethylbenzene, toluene and xylenes in air samples from residences east of the site. These contaminants were considered to be background by TPC, but MEK was previously found in groundwater at 17,000 ppb in PRB-09s, and acetone, ethylbenzene, toluene and xylenes were found at high levels in PRB wells and soil borings B-58 through B-67. A lack of permanent monitoring wells in this area prevents EPA from accurately evaluating the migration of these secondary contaminants from groundwater to soil gas or indoor air, and/or whether they should be regarded as background.

Required Actions

- Initiate a vapor intrusion investigation at the Martens Home Center, where adjacent soil gas samples at nearby SG-01 have shown a marked increase, to evaluate the potential for human exposure to soil vapors exceeding screening criteria. Determine whether Human Exposures are under control.
- Continue to collect soil gas samples from all sampling locations and determine the need for additional locations.
- Continue to collect indoor air/crawlspace air samples as appropriate on at least a semi-annual basis from the homes in the southeast until the effectiveness of the PRB can be confirmed and groundwater concentrations are stable, or assume that an unacceptable risk exists and implement presumptive remedies to mitigate the potential exposure pathway at these residences as an alternative. Collect ambient air samples along with indoor air/crawl space samples.
- Continue to conduct air sampling to confirm that the mitigation system installed at the 704 Mohawk residence continues to address the contamination at that residence.
- Continue to list MDEQ screening criteria[9] for MEK, acetone, ethylbenzene, toluene and xylenes on the tables while the groundwater contamination in this area is assessed.

Incomplete Evaluation of Groundwater Ingestion Pathway

- The wells established by TPC appear to display a selection bias towards low concentrations due to the installation depths (*see*, **Figure 3**), and because the wells were positioned at great distances from the source areas (*see*, **Figure 1**).
- Permanent wells established at the water table or clay surface have shown increasing concentrations, while higher levels of contamination originally found in grab groundwater samples at different depths have not been monitored. As concentrations at permanent monitoring locations already suggest the potential presence of free product at great distances from the source(s), and higher levels of impact may be present in groundwater not being monitored within the expanding groundwater plumes, further study of the groundwater is needed.
- The information provided by TPC has not established that impacted groundwater does not extend beyond the area of the groundwater ordinance. By email on April 11, 2001, TPC's attorney notified the Village of Tecumseh's attorney that the area of the ordinance was based on an "estimation...of where groundwater contamination exists above criteria [and] expanded to include all other areas where future migration above criteria might occur, based on the most conservative assumptions applied to existing data." EPA finds that the maximum source area concentrations have not been established and the extent of impacts has

not been defined. With groundwater impacts undefined, and the plumes expanding even though the heaviest impacts are not being monitored, it is no longer clear that these assumptions are still representative of the most conservative scenarios. Without identifying the maximum concentrations or defining the extent of impacts, TPC cannot establish or predict the distance at which the applicable screening criteria are met. Without establishing where the screening criteria are met and demonstrating that the plume is stable, TPC should not assume that the ordinance prevents the ingestion of contaminated groundwater over the full area of impacts, or that presumptions regarding contaminant migration are appropriate when there is a potential for DNAPL or free product to be present. It is necessary to determined the magnitude and extent of impacts and demonstrate that the plume is stable before presuming that the groundwater ordinance can be used to prevent exposure.

- TPC uses the river to define the eastern edge of the boundary for the groundwater ordinance based on a groundwater / surface water interface (GSI) evaluation submitted to MDEQ for evaluation. On several occasions, EPA requested additional information about the area east of MW-31 to confirm contaminant concentrations and geologic conditions. On December 10, Peter Quackenbush of MDEQ notified TPC by email that their GSI assessment is insufficient because of an insufficient determination of; the flow path and fate of the impacted groundwater, the volume of impacted groundwater discharging to the wetland, and the volume of impacted groundwater discharging to the River Raisin. EPA agrees with MDEQ's assessment that further assessment is needed.
- EPA is concerned that groundwater impacts have not been defined, and the sand unit in which contaminants are migrating extends to deeper elevations (below the river) near MW-40 and MW-29 (*see*, TPC's cross sections G-G' and I-I'[7]). The sand extends almost 20 feet below the river in the northeast where the groundwater plume remains uncharacterized, undefined, and appears to be expanding, and residential wells are present at the intersection of Monroe and St. Andrews Streets at similar depths as the impacts west of the river. The extent of impacts is also not defined in the southeast.
- Based on EPA's concerns that the groundwater data indicates a selection bias towards low concentrations, the maximum concentrations used in the GSI evaluation may be lower than actual conditions.
- Since the extent of impacts has not been defined, the "area" of the interface may be much greater than the area used on the GSI calculations.
- At the time of implementation of the groundwater ordinance, the hospital was not notified of potential contamination under the MDEQ Part 201 regulations due to the low vinyl chloride concentrations in MW-23. By email on April 19, 2011, Sue Perdomo of EPA notified TPC's attorney that EPA had not concluded that the extent of groundwater contamination had been defined at that time. The extent of impacts still remains unresolved, as the vinyl chloride concentration is increasing at MW-23 and the deeper impacts remain unmonitored.

Required Action:

- Characterize the groundwater plumes by performing Groundwater HRSC and installing appropriately placed permanent wells defining the magnitude and extent of groundwater impacts.
- Provide sampling data showing that contaminant migration beyond the river is not occurring. Conduct vertical aquifer sampling near the river following the primary groundwater flow

paths, should TPC be unable to define the extent of impacts in both the northeast and southeast.

- Install drive point piezometers along the wetland/river area east of MW-31 to evaluate groundwater discharge to the river and/or wetland. Determine the zones of strongest groundwater discharge and contaminant flux, and evaluate the extent of contaminant migration to those areas to support the GSI evaluation and the ecological assessment. Continue to monitor MW-31 or propose an alternate permanent well location.
- Determine whether the area covered by the groundwater ordinance is applicable after determining the extent of impacts in groundwater.
- Determine whether the hospital should be notified of potential impacts and determine if additional notifications are required to areas beyond the area covered by the groundwater ordinance after defining the extent.

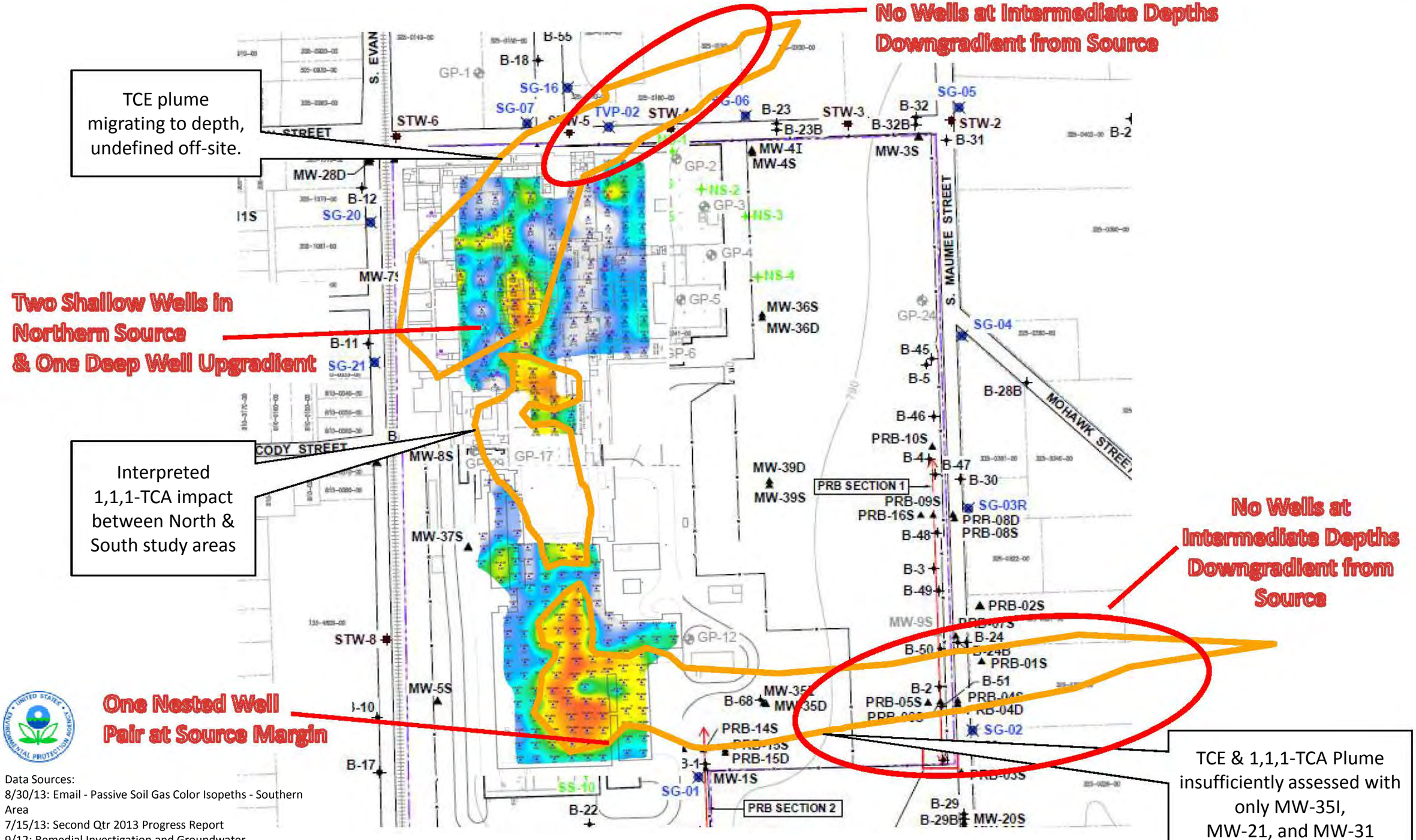
Incomplete Evaluation of Inhalation Pathway

- In the September 30, 2013, Supplement to the Current Human Exposures Environmental Indicator Report, TPC identified an exhaust sample collected from the 704 Mohawk residence in November 2012 with a TCE concentration of 1,100 ppbv (approximately 5,500 $\mu g/m^3$). The ambient air screening criterion for TCE is 2 $\mu g/m^3$.
- The indoor air samples collected between November 2011 and November 2012[8] at this residence are approaching MDEQ's Residential Indoor Air Screening Level[9].
- The concentration of TCE increased in soil gas downgradient from the PRB at SG-02 from 1,900 ppbv in May 2013 to 9,100 ppbv in August 2013.[8]

Required Action:

- Conduct monitoring of ambient air at the 704 Mohawk residence as needed to establish the protection of human health.
- Review air sample and soil gas data for the neighboring area due to the sudden elevation of TCE in the soil gas under the aforementioned residence, and the recent increase in TCE in groundwater at MW-21, and increases in soil gas concentrations at SG-01 and SG-02.
- Continue to collect soil gas samples from all sampling locations and continue to collect indoor air/crawlspace air samples as appropriate on at least a semi-annual basis from the homes in the southeast, or assume that an unacceptable risk exists and implement presumptive remedies to mitigate the potential exposure pathway at these residences as an alternative.

Figure 1: Interpretation of Potential Plumes



Data Sources:
8/30/13: Email - Passive Soil Gas Color Isopeths - Southern Area
7/15/13: Second Qtr 2013 Progress Report
9/12: Remedial Investigation and Groundwater Environmental Indicator Report

Figure 2: Interpretation of Northern Plume Migration from Assessment Data

NS-11
Ran 0-4’ TCE = 0.77 ppm
Highest PID @ 12’; no sample
Ran 22-23’ TCE = 4.1 ppm

NS-12
Ran 0-2’ PID 47
PID = 2700 2-5’; no sample
Moderate PIDs through 22’
Ran 22-24’ TCE = 2 ppm

NS-19
High PIDs 0-23’; no samples
PID @25-30’ =0; TCE = 2.6ppm
PID @ 35-38’ =12 ; TCE= 45 ppm
Ran 45-47’; TCE = 11ppm

MW-32S
Ran 0-1.5’; TCE = 1.2 ppm
High PIDs throughout; no samples
Ran 22-24’; TCE = 26 ppm

NS-20/MW-32D
High PIDs 16-23’; no samples
Ran 23-28’; TCE = 26 ppm
Highest PID @ 28-29’
Ran 29-30’; TCE = .43* ppm
Ran 35-40’ ; TCE= 8.7 ppm

NS-14
High PIDs 11-20, no samples
Ran 0-3
Ran 22-23; TCE=18 ppm

NS-7
No Screening
Ran 10-11’ TCE= 1.5ppm

NS-6
No Screening
Ran 2-3’ TCE = 5.2ppm
Ran 23-24’ TCE = 0.52ppm

NS-18
High PIDs 0-2 ,17’; no samples
Ran 20-25’ TCE = 30 ppm
High PID @34’ Ran 30-35’ TCE = 53 ppm
Ran 40-43’; TCE = 11 ppm

NS-5
No Screening
Ran 12-14’ TCE = 4.5ppm

NS-8
No Screening
Ran 12-14’ TCE = 4.3

NS-15
PID = 290 @ 0-2’; no samples
Ran 2-4’; PID=23; TCE = 72 ppm
PIDs high 8’-terminus; no samples
Ran 19-20’; PID = 10; TCE = 18 ppm

NS-16
Ran 2-4’; TCE = 1.7ppm
PIDs high 7’-terminus; no samples
Ran 19-20’; TCE = 3 ppm

MW-33S
PID @ 1’-3’ = 84; TCE = 5.7 pm
High PIDs 8-19’; no samples
PID @ 19’-22’ =13.2 ; TCE= 19ppm
No field screening 22’-28’

MW-2S
MW-4I/MW-4S
MW-8S/
MW-8D
MW-32S
MW-32D
/NS-20
MW-33S
NS-11
NS-7
NS-8
NS-18
NS-6
NS-5
NS-15
NS-16
NS-12
NS-19
NS-17
NS-14
NS-10
NS-9
NS-13
GP-14
GP-25
GP-27
GP-15
GP-30
GP-16
GP-28
GP-7
GP-6
SV-05
SV-01
SV-04
SV-03
SV-10
PLUME
FLOW
WATER FLOW
CLAY DIP

Soil Borings
- Due Diligence
- Initial TPC
- Post Soil Gas
- Final TPC
- Wells

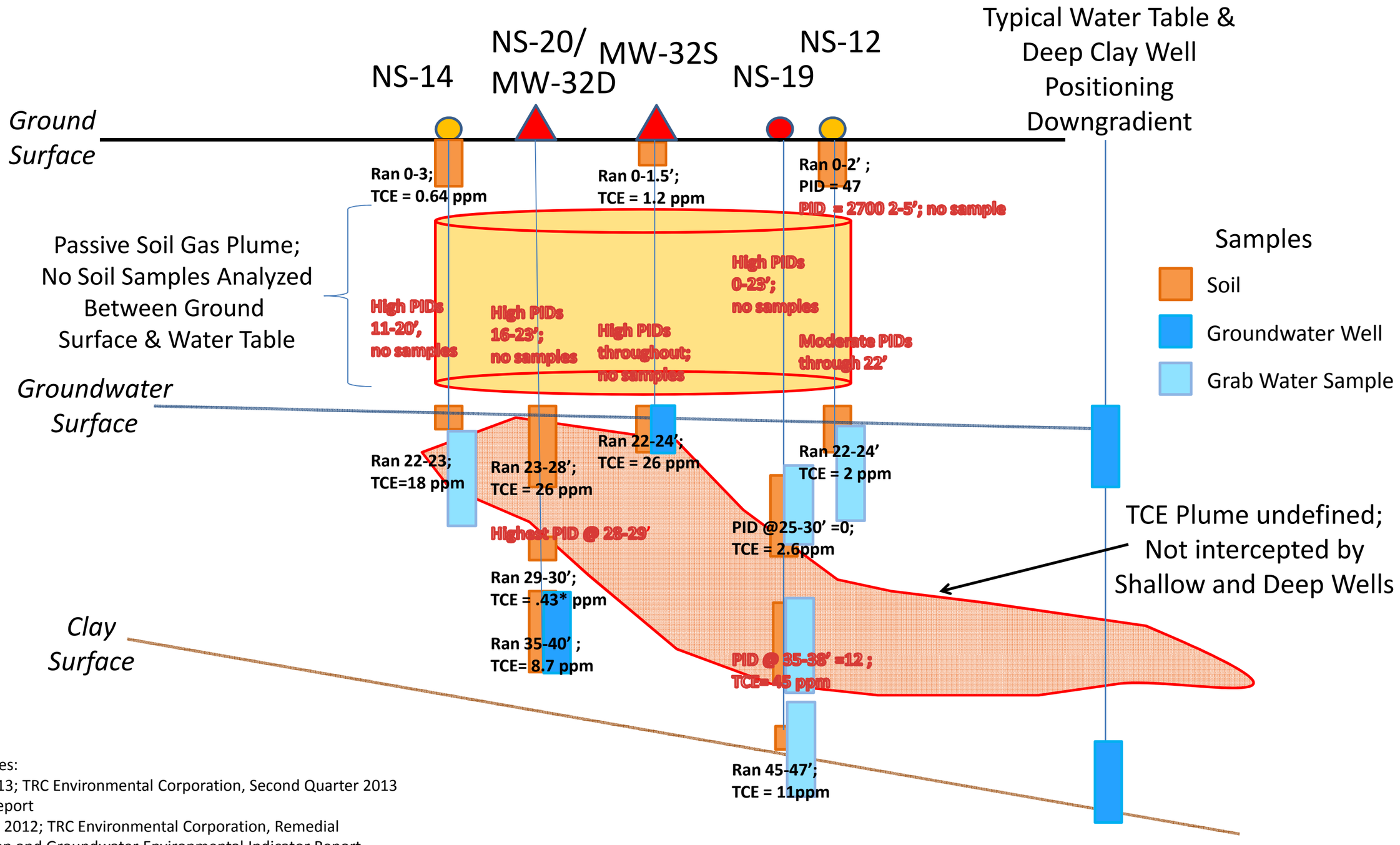
450
400
350
300
250
200
150
100
50
0
Micrograms of TCE
and Degradation Products

N

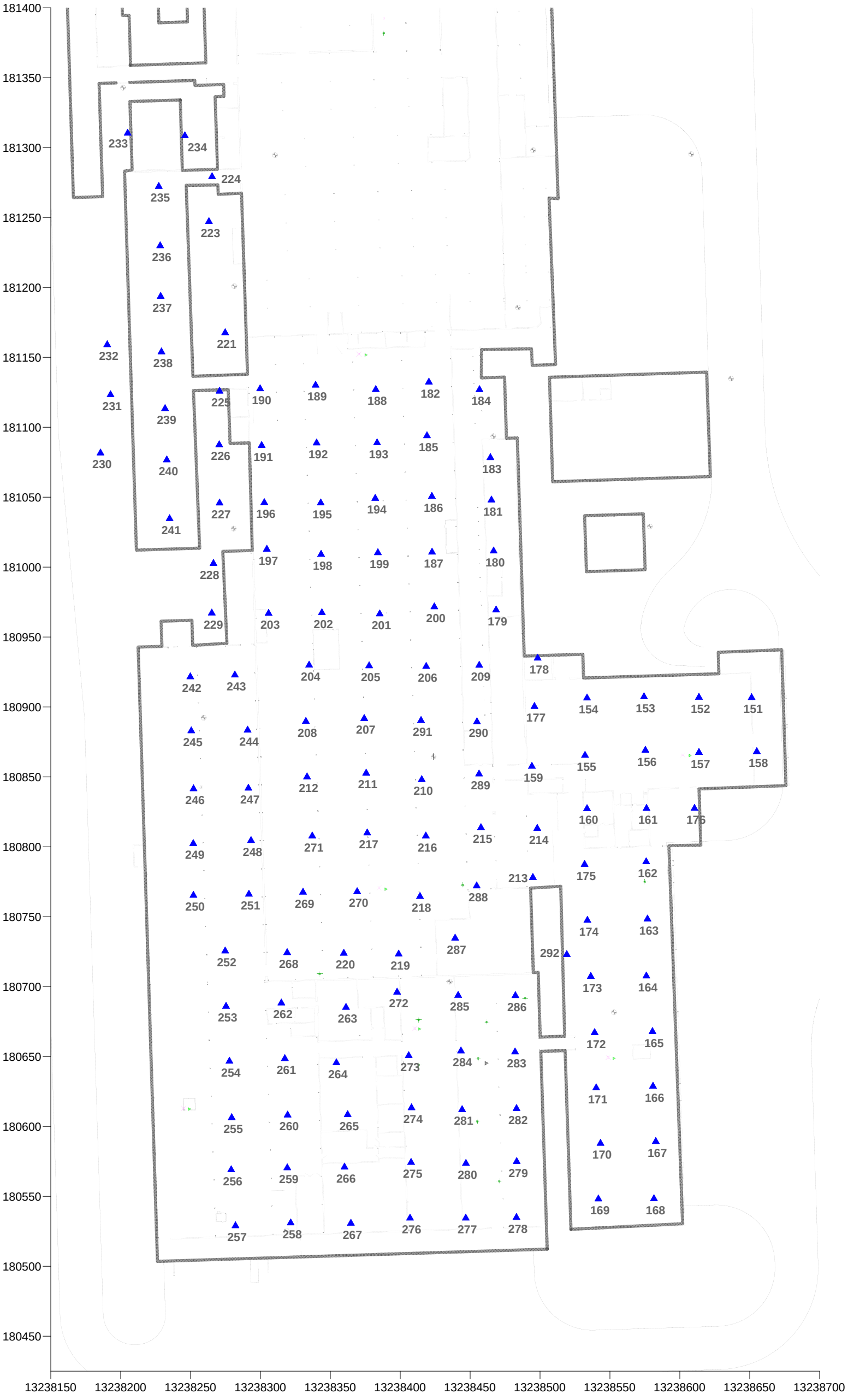
0 50 100 200
Feet

Data Sources:
7/15/13: Second Qtr 2013 Progress Report
9/12: Remedial Investigation and
Groundwater Environmental Indicator
Report

Figure 3: Interpreted Cross-Section and Sampling Profile



Data Sources:
July 15, 2013; TRC Environmental Corporation, Second Quarter 2013 Progress Report
September 2012; TRC Environmental Corporation, Remedial Investigation and Groundwater Environmental Indicator Report



LEGEND

273 PASSIVE SOIL-GAS SAMPLE LOCATION

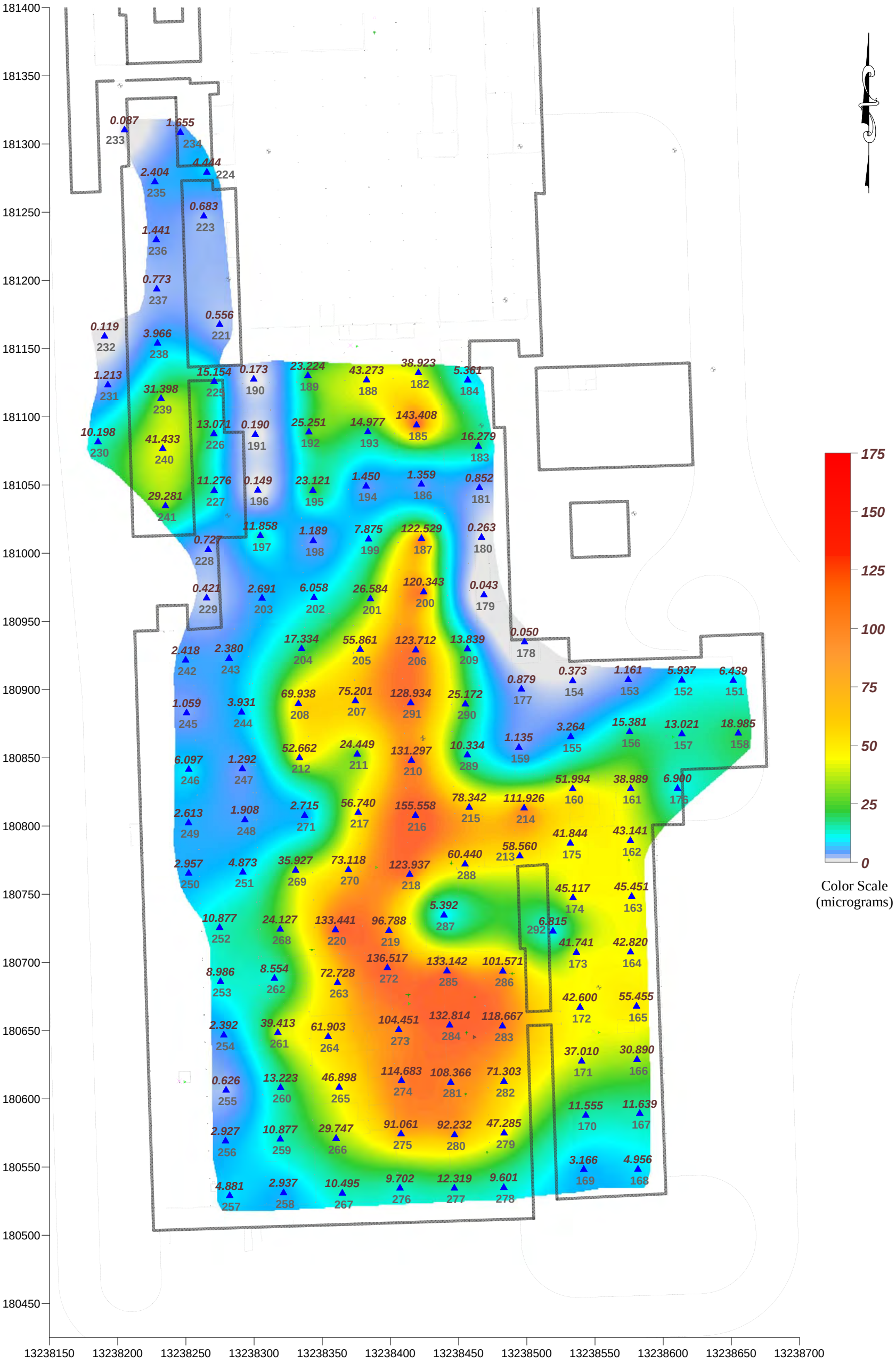
Scale in Feet

0 75 150

BEACON ENVIRONMENTAL SERVICES, INC.
2203A Commerce Road, Suite 1, Forest Hill, MD 21050 USA
www.Beacon-USA.com 1-410-838-8780
Beacon Project No. 2704, July 2013

Figure 1
Passive Soil-Gas Survey
Sample Locations

Former Tecumseh Products
Tecumseh, MI



LEGEND

1,000 MICROGRAMS/SAMPLER

273 PASSIVE SOIL-GAS SAMPLE LOCATION

Scale in Feet

0 75 150

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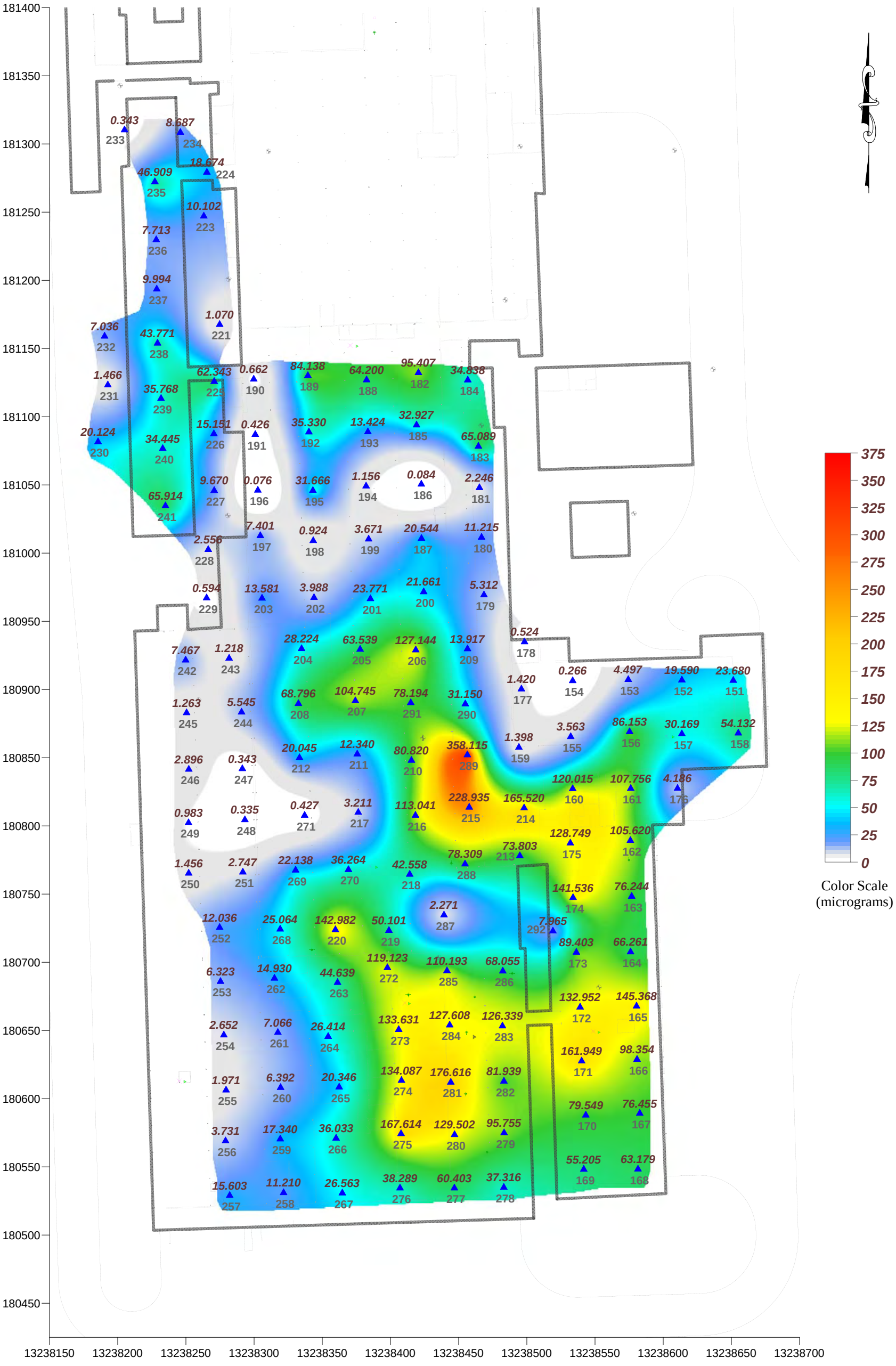
Beacon Project No. 2704, July 2013

Figure 2
Passive Soil-Gas Survey
1,1,1-Trichloroethane

Former Tecumseh Products
Tecumseh, MI



LEGEND

1,000 MICROGRAMS/SAMPLER

▲ 273 PASSIVE SOIL-GAS SAMPLE LOCATION

Scale in Feet

0 75 150

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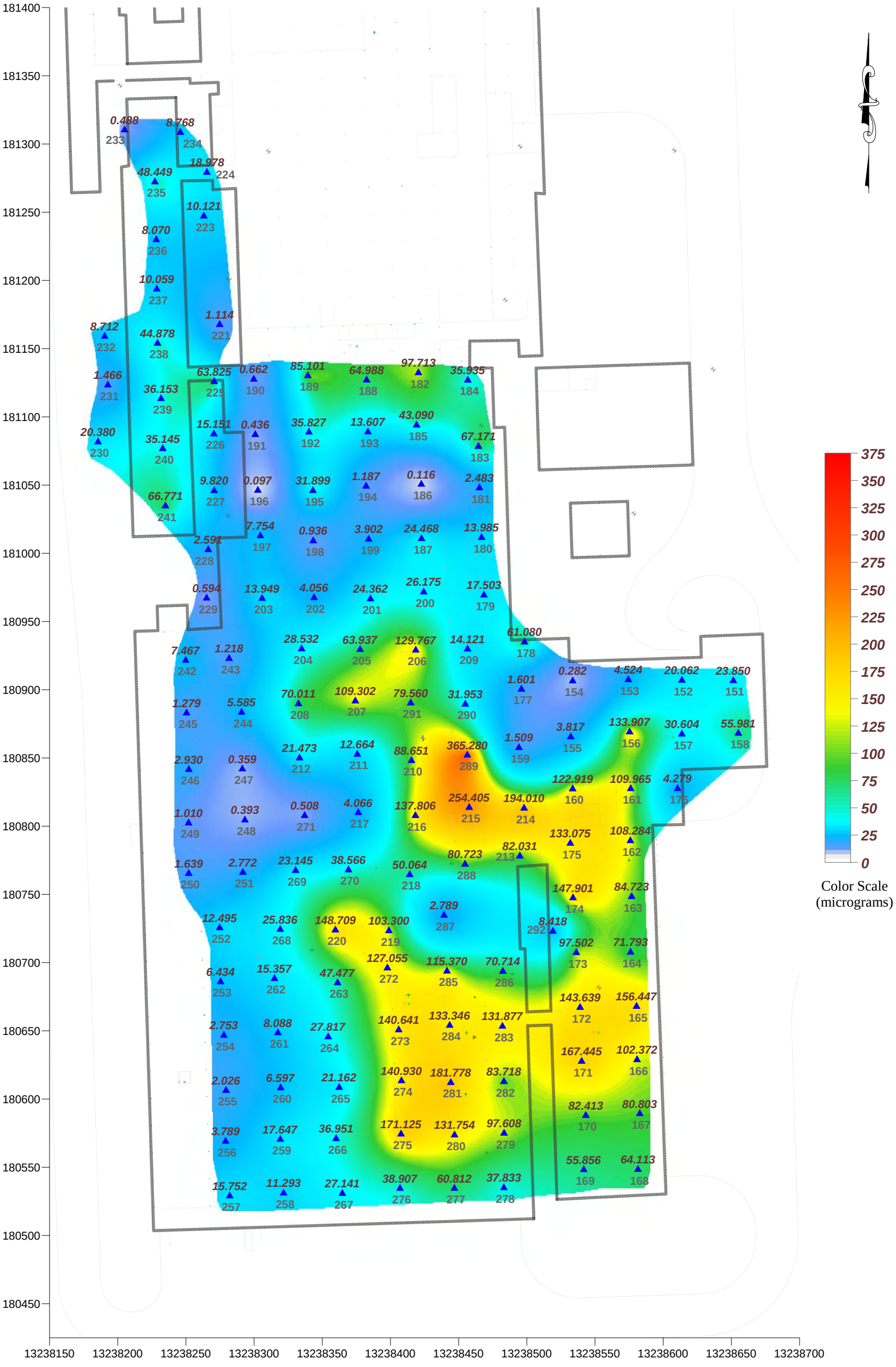
Beacon Project No. 2704, July 2013

Figure 3
Passive Soil-Gas Survey
Trichloroethene

Former Tecumseh Products
Tecumseh, MI



LEGEND

1,000 MICROGRAMS/SAMPLER

273 PASSIVE SOIL-GAS SAMPLE LOCATION

Scale in Feet

0 75 150

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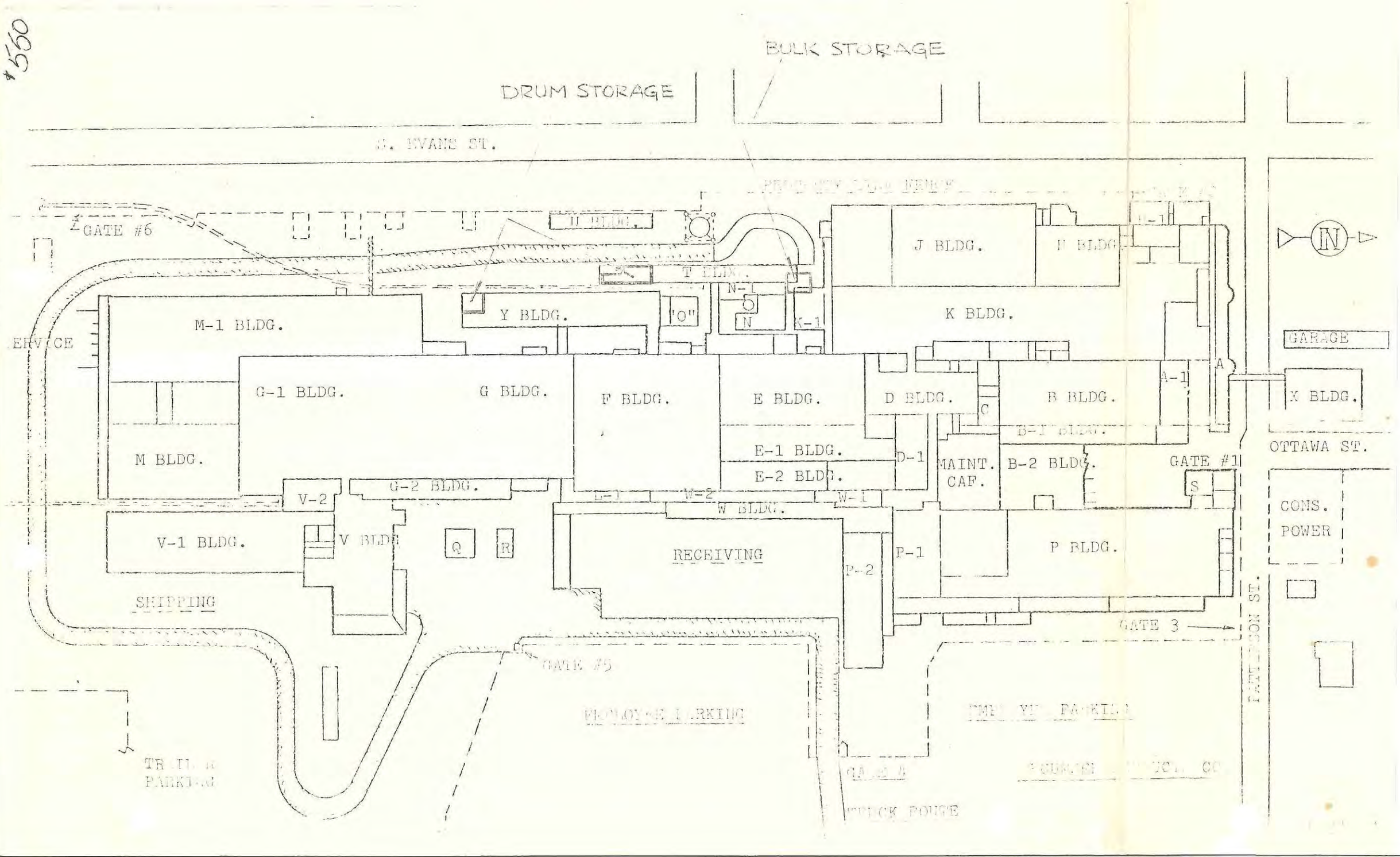
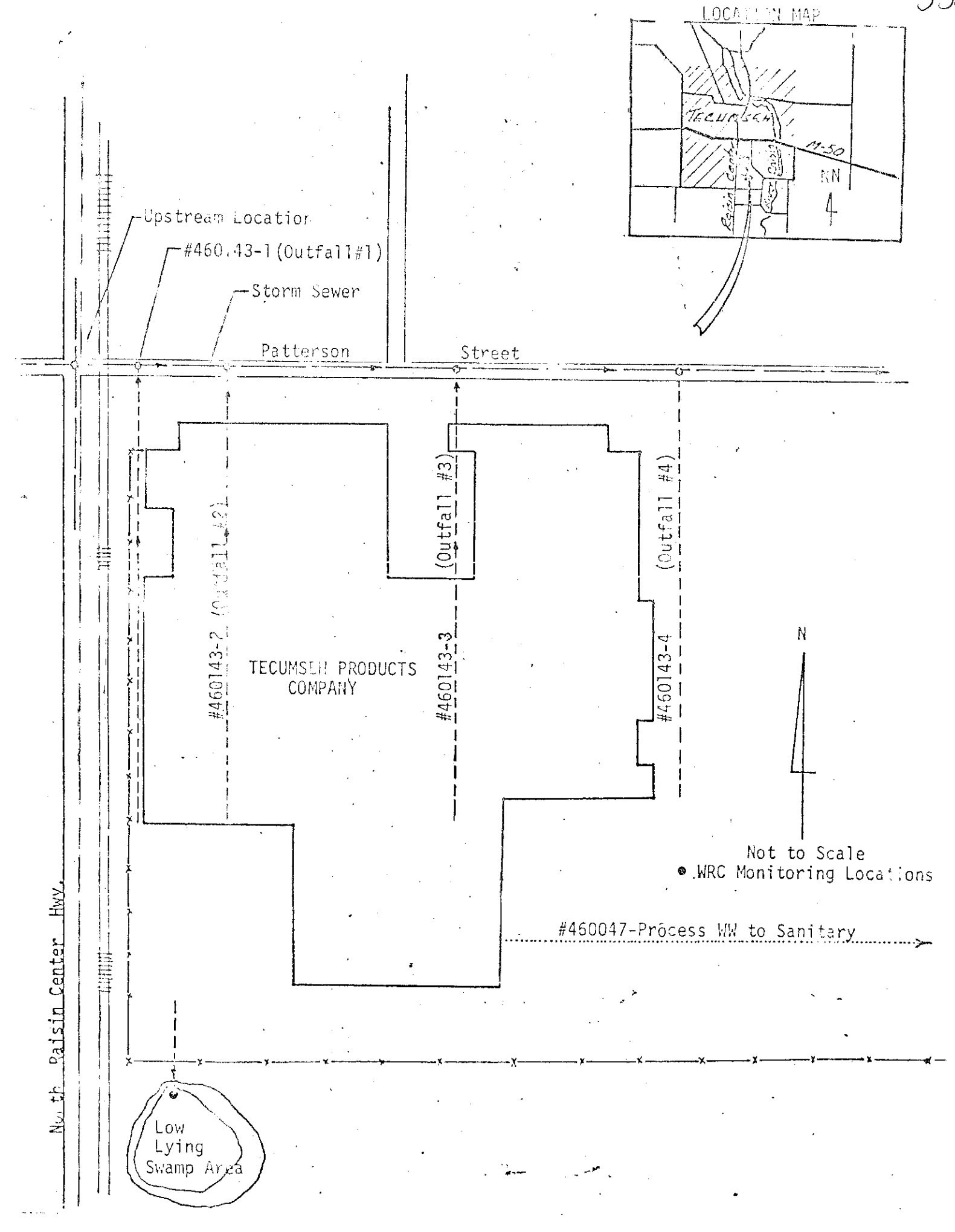
Beacon Project No. 2704, July 2013

Figure 4
Passive Soil-Gas Survey
TCE and Breakdown Products

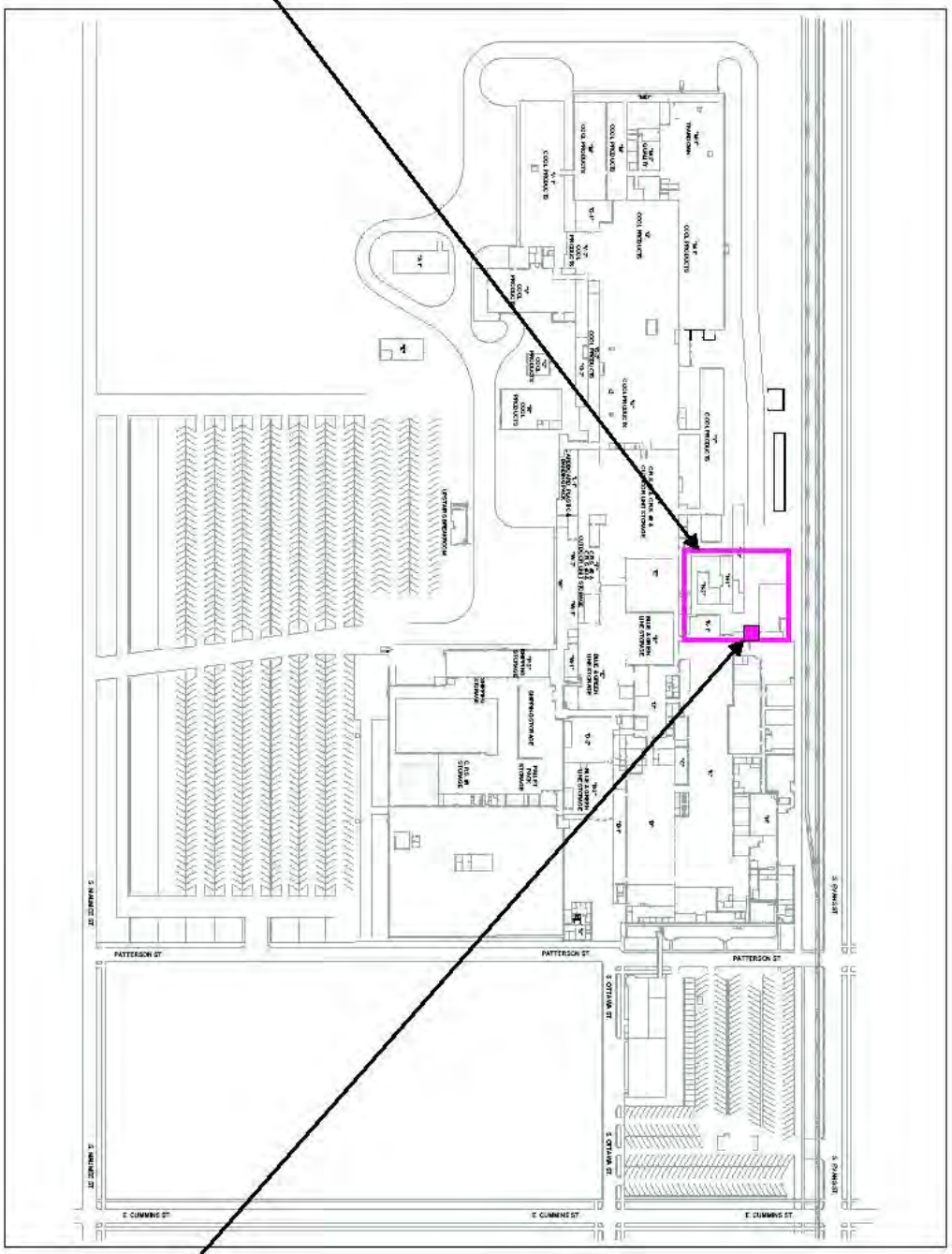
Former Tecumseh Products
Tecumseh, MI


#550
BULK STORAGE
DRUM STORAGE
S. EVANS ST.
GATE #6
H BLDG.
T BLDG.
J BLDG.
H BLDG.
H-1
IN
N-1
Y BLDG.
"O"
N
K-1
K BLDG.
M-1 BLDG.
SERVICE
GARAGE
G-1 BLDG.
G BLDG.
F BLDG.
E BLDG.
D BLDG.
C
B BLDG.
A-1
A
X BLDG.
M BLDG.
E-1 BLDG.
D-1
MAINT. CAF.
B-2 BLDG.
GATE #1
OTTAWA ST.
E-2 BLDG.
S
G-2 BLDG.
V-2
L-1
W-2
W-1
W BLDG.
CONS. POWER
V-1 BLDG.
V BLDG.
Q
R
RECEIVING
P-2
P-1
P BLDG.
SHIPPING
GATE 3
PATTERSON ST.
GATE #5
EMPLOYEE PARKING
TRUCK PARKING
TRUCK ROUGE

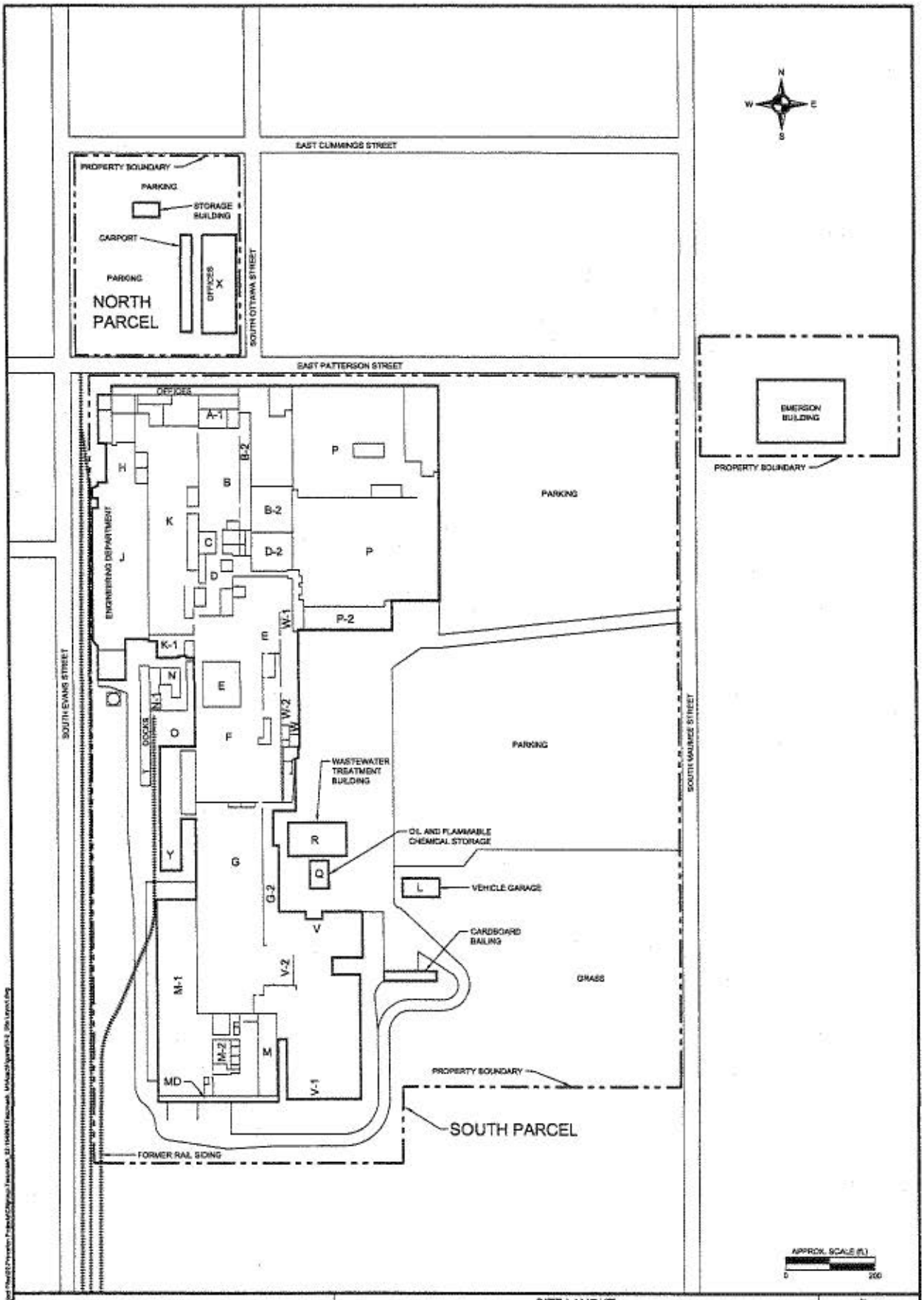
#550


LOCATION MAP
TECUMSEH
M-50
Raisin Center
NN
4
Upstream Location
#460143-1 (Outfall #1)
Storm Sewer
Patterson
Street
#460143-2 (Outfall #2)
(Outfall #3)
#460143-3
(Outfall #4)
#460143-4
TECUMSEH PRODUCTS COMPANY
N
Not to Scale
WRC Monitoring Locations
#460047-Process WW to Sanitary
North Raisin Center Hwy.
Low Lying Swamp Area

Approximate location of radar scan on exterior of buildings



Possible U.S.T.

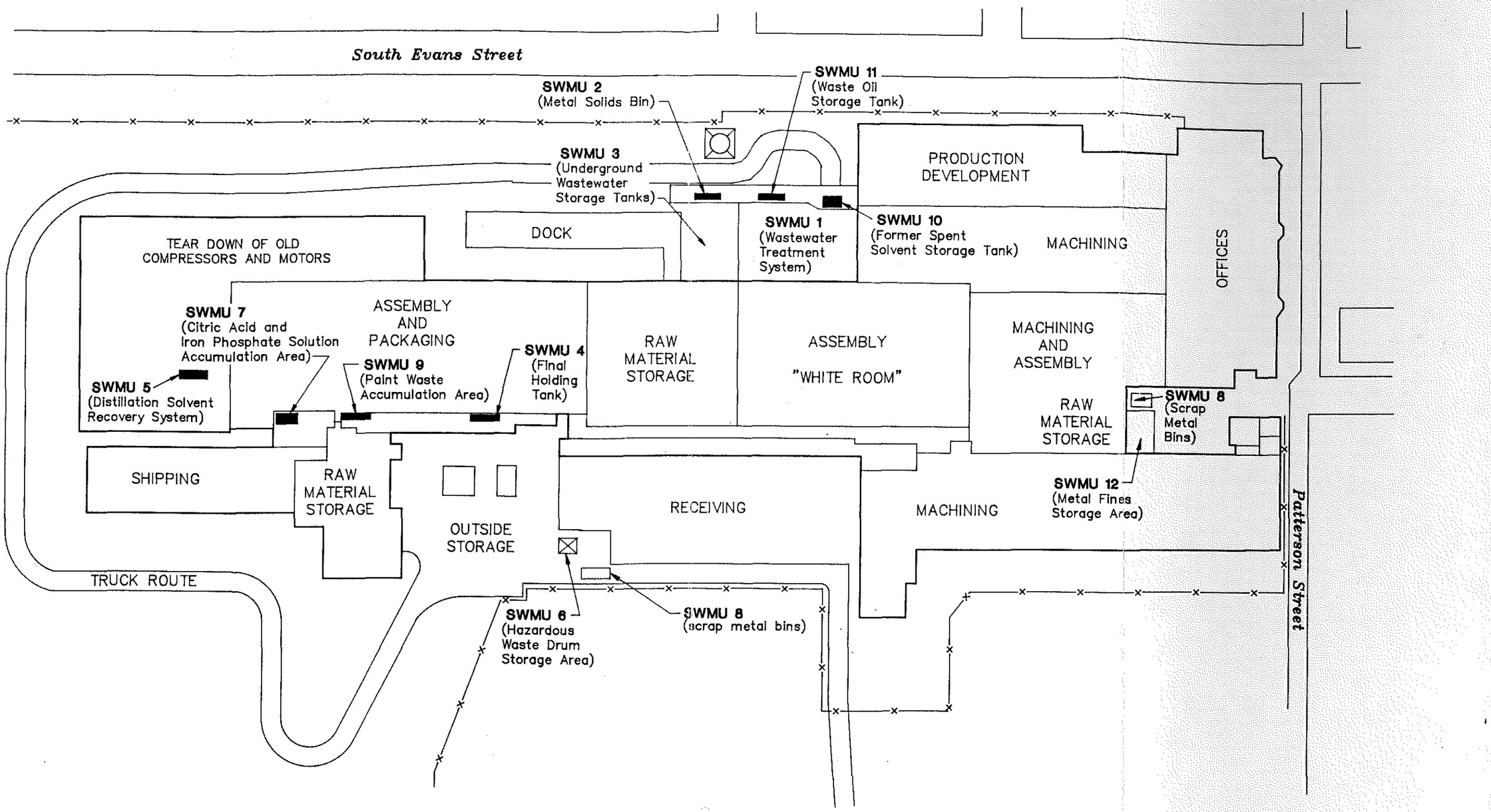


ENVIRON

SITE LAYOUT
TECUMSEH PRODUCTS
100 EAST PATTERSON STREET
TECUMSEH, MICHIGAN

Figure
III-2

Drafter: APR/ELS | Date: 12/10/05 | Contract Number: 02-15499A | APPROVED: | REVISED:



"NOT TO SCALE"

SOURCE: TECUMSEH PRODUCTS COMPANY, 1992

TECUMSEH PRODUCTS, INCORPORATED
TECUMSEH, MICHIGAN

FIGURE 2
FACILITY LAYOUT

PRC ENVIRONMENTAL MANAGEMENT, INC.