A Case Study: Emergency Response and Time Critical Removal Action for the Stony Hill Road Trichloroethylene (TCE) Site in Wake Forest, NC

By

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Advisory Chair:

Linda Taylor

ABSTRACT

RHAME, KENNETH. Emergency Response, Removal Site Evaluation and Time Critical Removal Action for the Stony Hill Road TCE Site in Wake Forest, NC. A Case Study and Review of Actions Taken; under the Authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); commonly known as Superfund. (Under the direction of Linda Taylor).

TCE is a volatile organic compound (VOC) that is commonly used as an industrial solvent to remove grease from metal parts. It is also found in adhesives, paint removers, rug-cleaning fluids, spot removers, etc. (USEPA TEACH TCE). TCE is present in at least 852 of the 1,430 National Priority List sites identified by USEPA (ATSDR TCE ToxFAQs). The presence of TCE at the Stony Hill Road site is believed to be attributed to improper handling/disposal related to circuit board cleaning operations. The Stony Hill Road TCE site is not currently on the NPL. TCE is a designated hazardous substance as defined by 40 CFR 302.4 The United States Environmental Protection Agency (USEPA) classified TCE as a carcinogen to humans by all routes of exposure and determined it harmful to fetal development in 2011. It is these types of compounds that threaten public health and/or the environment that allow USEPA to initiate an action under CERCLA authority. CERCLA, also known as Superfund was enacted by Congress in 1980. Superfund created a tax on chemical and petroleum industries to establish a trust that could be used to address releases or threatened releases of hazardous substances that endanger public health or the environment. The appropriation for Superfund has expired and now most funding comes from either general tax revenues or by USEPA's cost recovery efforts against responsible parties. Therefore the funding that is available to address environmental threats from

year to year will vary and likely decline due primarily to the poor economic climate. It will become necessary to utilize critical thinking in decisions being made and to utilize outside resources effectively when response actions are initiated in the future. There are two types of response actions under CERCLA:

1. Removal Actions – short term actions taken that require a immediate or prompt response to address releases of hazardous substances
2. Remedial Actions – long term actions dealing with National Priority List (NPL) sites that significantly reduce the threats associated with releases of hazardous substances, but not immediately life threatening.

The National Contingency Plan (NCP) provides policy and guidance necessary in responding to releases or threatened releases of hazardous substances. The NCP is the federal government's doctrine for environmental emergency response actions. The NCP establishes three types of removal actions; emergency response, time-critical removals and non time-critical removals. The Stony Hill Road TCE site was addressed under CERCLA, consistent with the NCP and using both emergency response and time-critical removal action authority by the Federal On-Scene Coordinator (FOSC). In order for a site to meet the criteria to be addressed by the removal program, a concentration above a removal management level (RML) formerly known as the removal action level (RAL) must be documented. The RML for TCE was recently lowered from 128 parts per billion (ppb) to 8 ppb (USEPA, 1988 and USEPA RML Table 2012). The Stony Hill Road TCE site met the criteria as the TCE concentrations present in residential wells were documented as high as 340 ppb. A review of the decisions and actions taken at the Stony

Hill Road TCE site as well as issues encountered and future recommendations in responding to exposures or threats of exposures resulting from hazardous substances affecting residential drinking water wells using CERCLA authority will be presented.

BIOGRAPHY

Kenneth Rhame served in the United States Army, as a member of the 1st Infantry Division and was deployed to Iraq during the Gulf War prior to getting a Bachelor of Science Degree in Public Health with a concentration in Environmental Science from Indiana University in 1994. Mr. Rhame started his environmental career with the Indiana Department of Environmental Management as a State On-Scene Coordinator in 1995; this experience eventually opened the door to his current position as a Federal On-Scene Coordinator with the USEPA. Mr. Rhame has remained in a position that has been involved with pre-planning, coordinating and responding with local, state and federal agencies that are challenged with the task of mitigating threats to the environment and protecting public health. He has responded to some of the largest incidents in US history, including the Space Shuttle Columbia explosion, Hurricane Katrina and most recently the BP Oil Spill. Mr. Rhame currently serves as the EPA Out-Posted OSC in Raleigh, NC.

ACKNOWLEDGEMENTS

I would like to acknowledge and thank Ms. Linda Taylor for her support, guidance and motivation; for without whom this final paper would not have been written. I would also like to thank the faculty of the Environmental Technology program at NC State University, for they accepted me into “The Pack” and convinced me to continue my education.

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SITE BACKGROUND

Site Description –

The site is located in the Stony Hill area of unincorporated Wake Forest, Wake County, NC. The site consists of multiple single family residences located predominantly in a residential area. The site is not a fixed location as TCE plumes are in the area and contaminants may migrate with groundwater flow thus possibly expanding in size as more contaminated wells are discovered. There are two suspected sources, the property of a former circuit board manufacturing facility located at 7303 Stony Hill Road and a residence located at 7648 Bud Morris Road. The former circuit board manufacturer is believed to have operated at 7303 Stony Hill Road from 1987 to 1992. The contaminants of concern are trichloroethylene (TCE) and tetrachloroethylene (PCE). The highest concentration of TCE detected is 340 parts per billion (ppb) and the highest PCE concentration detected is 110 ppb. PCE had to be evaluated also but there were no wells that contained PCE that could not be addressed due to the presence of TCE.

Site History –

In August 2005 the property owner at 7305 Stony Hill Road contacted Wake County Health Department complaining of a petroleum odor in his well (tap) water. Wake County Environmental Services sampled the well. Results of that sample indicated that there was elevated concentrations of TCE present in the well water. The Wake County Health Department notified the North Carolina Department of Environment and Natural Resources and referred "the site" to the Division of Water Quality, Aquifer Protection Section (APS). The APS confirmed Wake County's sample result at 7305; APS sample results were 110 ppb TCE (NCDENR, Email). APS collected two additional samples at 7303 and 7312 Stony Hill Road. Both samples collected from 7303 and 7312 were non-detect for TCE. Based on these results, NCDENR assumed that the contamination was isolated and had not affected other wells in the area. The contaminated well located at 7305 Stony Hill Road was connected to a neighboring clean well at 7303 Stony Hill Road to provide an alternate drinking water supply. NCDENR shifted their focus on locating the source of the contamination and identifying a potentially responsible party. APS conducted an investigation and found a drainpipe coming from a cinder block building at 7303 Stony Hill Road, the former site of the circuit board manufacturing businesses. NCDENR issued a Notice of Corrective Action to the owner of the property, some additional sampling was conducted on site which revealed trace amounts of TCE in soil; TCE is not completely soluble in water (water solubility is 1,000 mg/L), it is more dense than water (specific gravity of TCE is 1.46, water is 0), thus tends to migrate down, through subsurface soils to groundwater rapidly (EPA Ground Water Issue). These transport and fate characteristics and the time span from when the circuit board business closed until the time that the site investigation took place, explain why the site investigation did not find high concentrations of TCE in soils on site.

In 2007 NCDENR underwent reorganization and the site was transferred to the Inactive Hazardous Sites Branch (IHSB). In June of 2012, IHSB sampled properties located at 7303, 7305, and 7333 Stony Hill Road. TCE was detected at the 7333 Stony Hill Road well at 22 ppb, prompting IHSB to refer the site to USEPA Region 4 Emergency Response and Removal Branch (ERRB).

RESPONSE AUTHORITY

The ERRB is in the Superfund Division and utilizes CERCLA authority to address threats to public health and the environment. There are two types of removal actions that Region 4 ERRB traditionally conducts; emergency response actions and time-critical removal actions. ERRB conducted an emergency response to address more immediate threatening exposures and followed up with a time-critical removal action to address longer term exposure threats at the Stony Hill Road TCE site. The emergency response action involved sampling, supplying bottled water to residents at or above the MCL, obtaining access agreements (signed statements giving USEPA permission to access property for the purpose of obtaining samples) and installing filters on homes where concentrations of TCE exceeded 80 ppb for general population or 8 ppb where sensitive populations (children or women of child bearing age) resided. In order to access funding thru the removal program and for removal authority to be utilized on a private potable well site; there has to be a hazardous substance that has impacted a potable well at or above the removal management level (RML). The RML for TCE is 8 ppb (USEPA RML Table 2012). Since the RML (8 ppb) was documented as being exceeded, the site met the criteria to be addressed by the removal program. ERRB initiated an emergency response within 24 hours of the referral from NCDENR, delivering bottled water to the affected home and going door to door obtaining access agreements from neighboring homes.

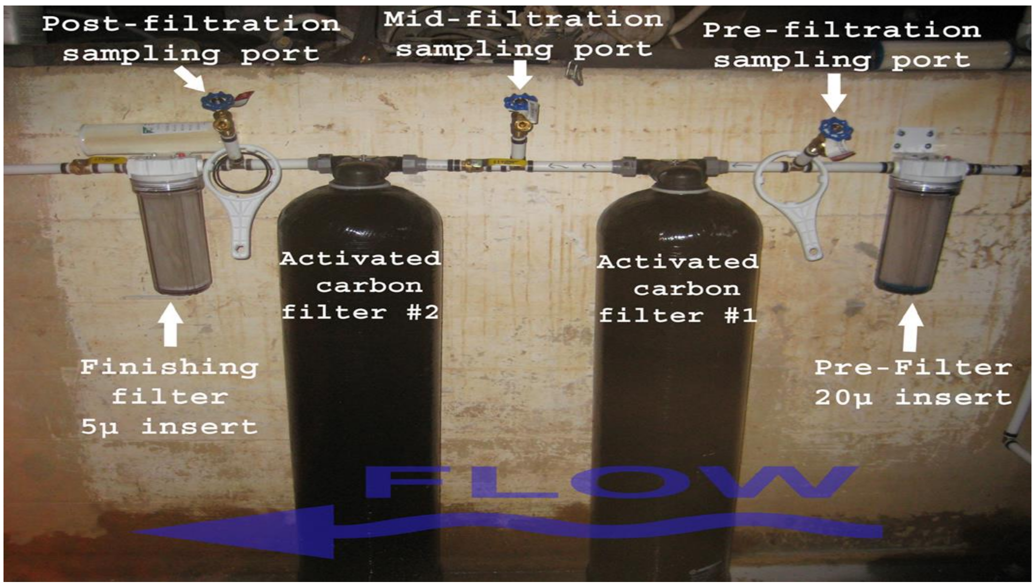
EMERGENCY RESPONSE ACTIONS

ERRB first notified and delivered bottled water to the resident located at 7333 Stony Hill Road (22 ppb TCE), ERRB then began getting access agreements signed by the residents in the area of the affected well and collected samples to confirm the state's results. ERRB collected potable well samples from seven homes located on both sides of Stony Hill Road. Sampling of potable residential wells followed the protocols identified in the Quality Assurance Project Plan (QAPP). Samples were submitted to a certified drinking water laboratory for volatile organic compound analysis using SW846-5030/8260B method. Three homes (all located on the west side of Stony Hill Road had TCE and PCE concentrations above MCLs.

Address	TCE	PCE
7317 Stony Hill Rd	67	41
7327 Stony Hill Rd	47	110
7333 Stony Hill Rd	19	13

Initial Response Sample Results Table

Since there was an exceedence of the RML (8 ppb for TCE) as well; ERRB had the authority to conduct a emergency response and removal action. Federal On-Scene Coordinators (OSC) have the authority to commit up to $250,000 for emergency response actions based on their determination of threat (Stony Hill Road TCE Action Memorandum). The OSC conducting the emergency response utilized this authority to provide bottled water to affected residents at or above the MCL (5 ppb TCE and 5 ppb PCE). Potable well samples were collected in the direction where affected wells were identified, a 24 hour turn-around time was requested from the laboratory so that residents would be aware of their sample results and bottled water could be provided the following day. The strategy was to get multiple clean well samples in all directions surrounding the affected area to obtain a high level of confidence that all the residents being exposed were identified so that exposure pathways could be mitigated. While the bottled water mitigated the ingestion exposure pathway, it did not address the inhalation and direct contact exposure pathway from showering and bathing. All residents that had TCE or PCE present in their well water were given recommendations to reduce their exposure by reducing their shower times, opening bathroom windows and doors while showering, turning on exhaust fans, drying off and dressing in a different room than the room where they showered. To address the inhalation threat posed by showering, the OSC installed point of entry (POE) whole house granular activated carbon filtration systems on homes that had TCE at or above 80 ppb for general population and for homes that had TCE at or above 8 ppb that had a sensitive population (children or women of child bearing age). This criteria and concentrations were established by the USEPA Region 4 Technical Services Section toxicologists. A POE carbon filtration system removes TCE and PCE by adsorption (binds the TCE and PCE to the carbon). When the activated carbon becomes saturated, contaminant breakthrough begins to occur. The POE system installed at the Stony Hill Road site consists of a double granular activated carbon chamber to address the TCE/PCE, three sampling ports (pre-filter, mid-filter and post filter) so that samples could be collected at various stages of the system to determine effectiveness and contaminant breakthrough time; a ultra violet (uv) light was installed post filter to address any bacteria that may grow in the carbon chambers. The point of entry activated carbon filtration system installed can cost anywhere from $3,500 to $4,500 per home. The cost varies depending on how the home is set up; crawl space or basement, whether a “freeze hut” is needed to install the system outside the home and whether an electrician is needed to install an electrical outlet (needs electrical outlet for uv light).



Point of Entry Activated Carbon Filtration System

The NCP lists six options for providing alternative water supplies; individual treatment units, water distribution systems, new well in new location or deeper depth, cisterns, bottled water and upgraded treatment for existing distribution systems. Ground water responses vary, sometimes POEs are considered permanent solutions; when there are no other reasonable water supply options available and when concentrations are such that POEs are easily managed. The Stony Hill Road TCE site had concentrations of TCE (up to 340 ppb); this would make it more difficult to manage the carbon filtration systems due to frequency of necessary carbon changes. Carbon changes are necessary to prevent contaminant breakthrough; breakthrough is based on water usage and concentration; thus the frequency of carbon changes is dependent on water usage. For the Stony Hill Road TCE site it was decided by the OSC that extending an existing community water line was appropriate due to the number of residences affected, concentrations of TCE, and the proximity to the existing community water line. The water line extension portion of the action could not be done as part of the emergency response; emergency responses are quick responses to eliminate immediate dangers to the environment or public health. The emergency response consisted of sampling, providing bottled water and installing POE filtration systems. More than 100 potable residential and 11 community wells were sampled, 7 whole house POE filters installed, 15 homes provided with bottled water as part of the emergency response. The permanent solution; the water line extension, would have to be done as a time-critical removal action since it is not a quick response; it requires engineering and design, approval from both NC DENR Public Water Supply Section and the Department of Transportation that would take several months to complete.

TIME CRITICAL REMOVAL ACTION

The time critical removal action consists of extending community water lines to provide a permanent clean water supply to the affected area that will allow homes with TCE to be connected to the line by USEPA and that will be available for other homes to hook up that may become impacted with TCE/PCE contaminants in the future. The water line extension would be constructed in two phases, the residents with the highest concentrations along Stony Hill Road and Budd Morris Road nearest the two sources (within ¼ mile of the existing community waterline) was constructed first (Phase 1). Phase 1 was completed on October 23 providing community water to 9 homes. Phase 2 will consist of constructing 17,000 linear feet of water main, connecting 3 separate community well systems together that will provide community water to more than 40 additional homes; 12 of which will be connected by USEPA. Phase 2 began on January 2, 2012 and is estimated to be completed in early March 2012. To date, approximately 3,000 linear feet of the Phase 2 project has been installed.

Actions occurring concurrent to the time-critical removal action are a site investigation being conducted by NCDENR to score the site for potential listing on the NPL. Being placed on the NPL would allow for long term monitoring and resources to address remediation. Emergency response and time-critical removal actions do not address groundwater remediation. This would also provide a mechanism to mitigate threats of exposure in the future if the plume continues to migrate, contaminating more residential wells. A vapor intrusion assessment was also conducted simultaneous to the time-critical removal action. NCDENR conducted two rounds of vapor testing in the area. The first round of testing found one residential property to have levels above levels of concern for sub-surface soil vapor. Air samples were collected in this homes crawl space and were found to be non-detect. Another vacant residential property had elevated sub-surface soil vapor contaminant levels. During the second round of vapor testing, eighteen crawl spaces and four sub-slabs were tested. NCDENR found no detection of TCE in any of the samples; and found one, low-level detection of PCE. This result was below the health risk threshold of both NCDENR and USEPA.

SITE CONSIDERATIONS AND LESSONS LEARNED

During the emergency response and the removal action all potable well sampling was conducted by USEPA in accordance with the site QAPP and USEPA Region 4 Science Ecosystem Support Division's (SESD) the sampling was Potable Water Supply Sampling operating procedures. This required purging the well for a minimum of 15 minutes while monitoring pH, turbidity, conductivity and temperature every three to five minutes. This procedure is necessary to determine that the well has stabilized. Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Unit (SU), conductivity is within 10% variance and temperature is constant (Stony Hill Road TCE QAPP). This detailed sampling procedure was not followed by other agencies, individuals or consultants involved with the site; therefore, USEPA had to confirm elevated concentration results that were collected by other entities. It is important to establish these protocols early in the response to avoid repetitive sampling and to insure confidence in the data collected.

The samples were submitted for laboratory analysis with a 24 hour turn-around request and Level IV Data Package. Due to the on-going exposures and demand for results, decisions were made prior to a complete Quality Assurance/Quality Control (QA/QC) review of the Data Package. This could have resulted in disseminating bad data; however, decisions were made with a conservative bias, thus providing bottled water to those that were close to the MCL and filters to those that were close to the filter criteria; 8 ppb for sensitive population or 80 ppb for general population.

The media coverage seemed to drive the response in the beginning, instilling fear in residents and communities miles away from the affected area. This diverted resources to areas outside the area of concern; but also lead to the discovery of a new site, Mangum Estates approximately 2 miles away from the Stony Hill Road TCE site. Mangum Estates was discovered by a home buyer; after seeing news coverage regarding the Stony Hill Road TCE site; the home buyer required their builder to sample for VOCs prior to closing on the purchase of the home. TCE was found in the well at 12 ppb. It was difficult calming public fears without having established site boundaries. Site boundaries were not established in the beginning since the plume had not been delineated and sampling was still occurring. This situation could have been improved by requesting a Public Information Assist Team (PIAT). The PIAT could have established a Joint Information Center, disseminated public information, coordinated media relation activities and community relations. This would have also freed up the OSC to focus more on response efforts.

Prior to the decision being made to extend community water lines; USEPA worked with the community water line owner and operator, Aqua North Carolina. A determination had to be made that the community water system had capacity to service the affected homes. In this case, there was no one water system that had capacity to service all the homes in need; therefore several water system lines were extended by USEPA and then turned back over to Aqua's ownership for operation and maintenance.

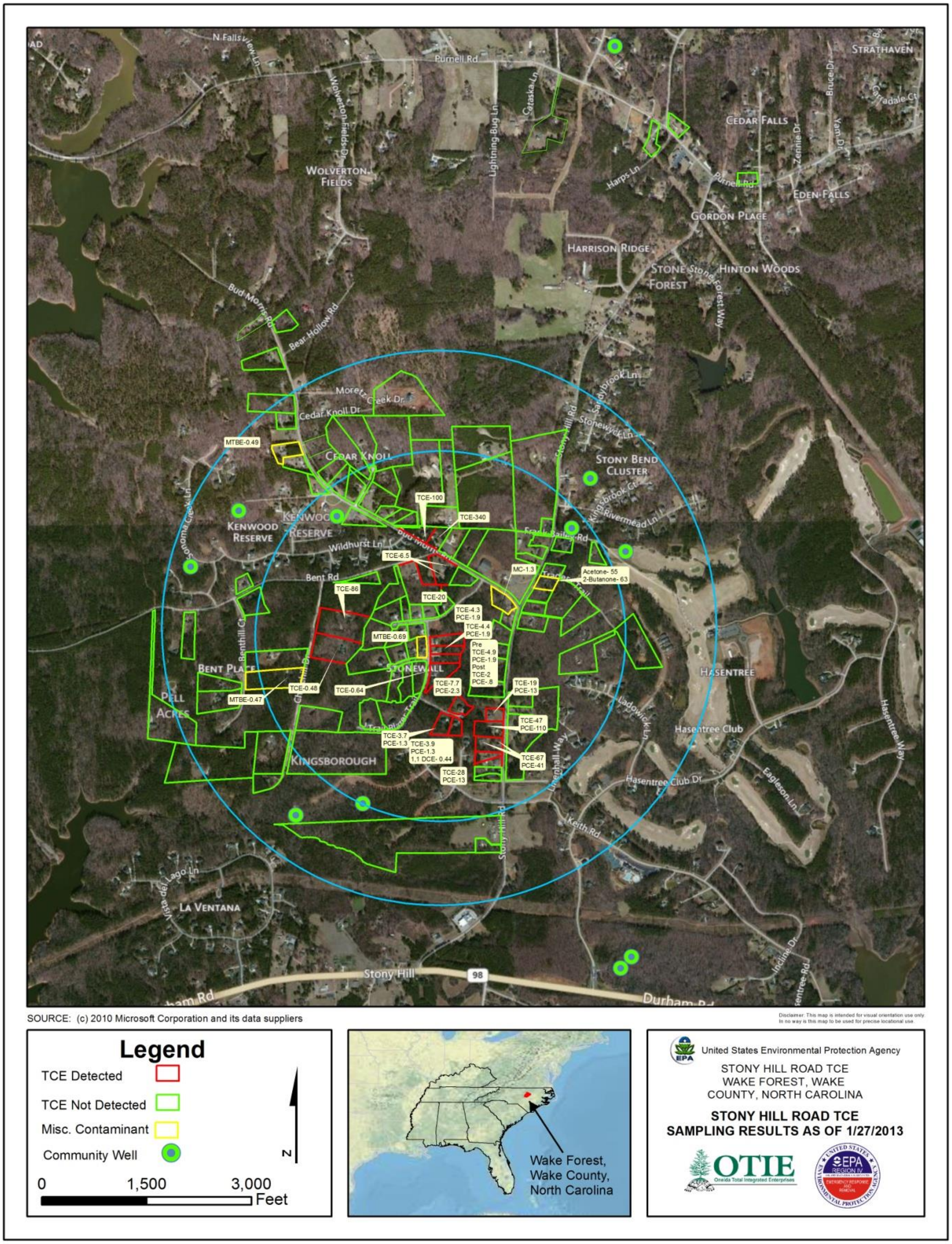
The water line extension in the vicinity of the TCE/PCE sources required chemical resistant gaskets and wrapping. This was necessary to prevent contaminant infiltration. USEPA also collected soil samples for VOC analysis in the trenches that were being used to locate the water line to insure that TCE/PCE was not present and would not potentially use the trench as a pathway to migrate off-site and impact other residential properties or neighborhoods.

As a result of the vapor intrusion investigation; there was one residential property that had elevated levels of isopropyl alcohol in a sub-surface soil gas sample. It is thought that this is a result of decontaminating the heavy equipment used to construct the boring with a alcohol solution. It is important to consider on-site decontamination procedures prior to sampling and when interpreting data collected.

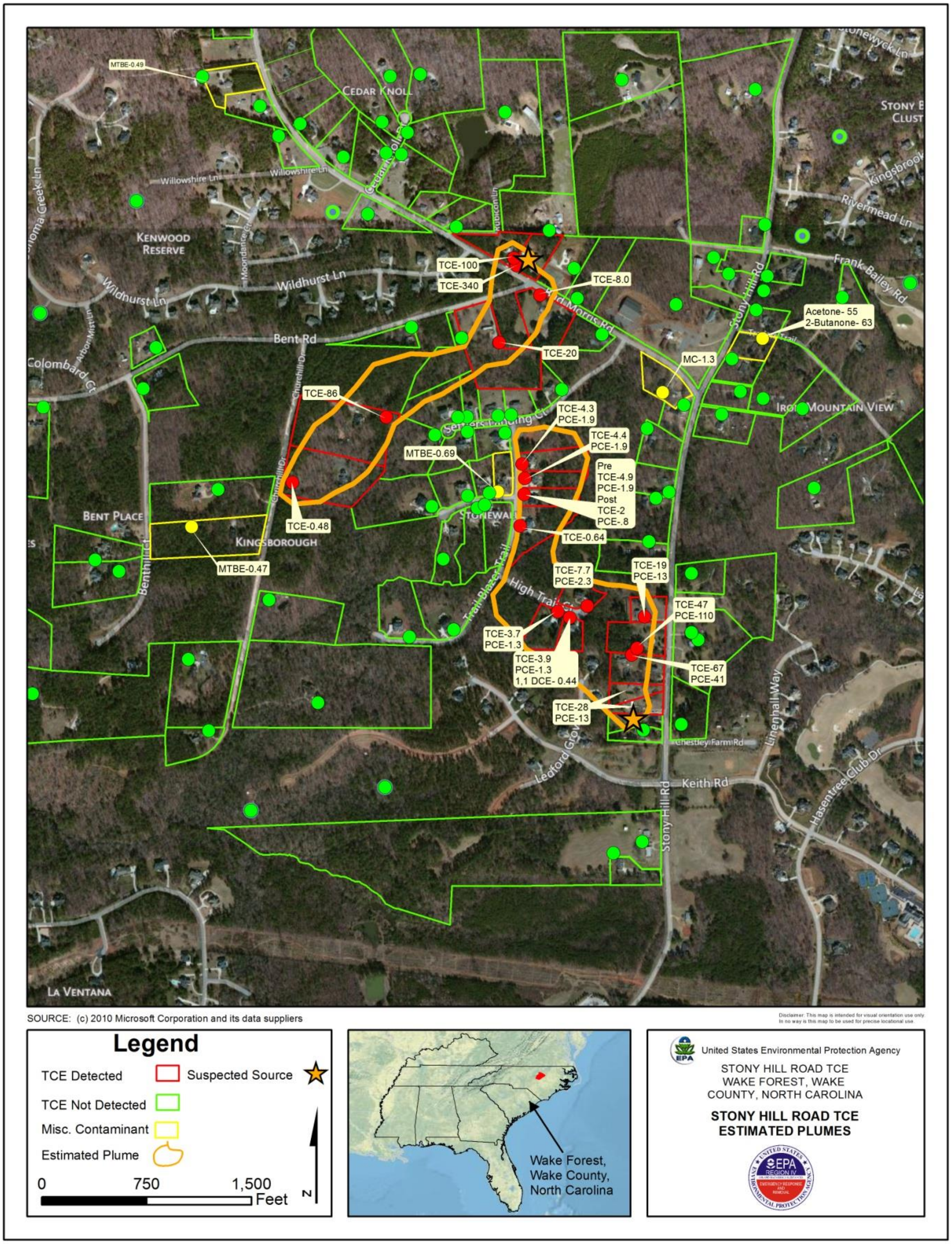
During the vapor intrusion investigation a background (upwind) sample of ambient air was collected to determine if there were any off-site influences to the vapor samples being collected in the Stony Hill Road TCE site area. The sample results for this sample detected trace amounts of acetone. It is believed that this acetone may be a result of natural processes. Acetone is a chemical that can be found naturally in the environment (air and soil) and can occur in plants, trees, volcanic gases, and forest fires (ATSDR, Public Health Statement, Acetone). The location of this sample was in a field near a heavily treed wood line.

The most apparent lesson learned should be properly assessing a site upon discovery. It is obvious that NC DENR's Aquifer Protection Section should have collected more potable well samples in all directions of the affected well when the site was first discovered by Wake County Health Department in 2005. A more aggressive pursuit of access agreements and sampling in the Stony Hill Road TCE site area in 2005 could have prevented many exposures from occurring since many of the homes affected were built after 2005.

Recent legislation could also prevent future exposures form occurring. G.S. 87-97 will require new wells to be sampled and analyzed for TCE and PCE. This legislation implements a private drinking water well permitting, inspection, and testing program to be employed by local health departments. Local Health Departments would be required to analyze water from new wells for arsenic, barium cadmium, chromium, copper, fluoride, lead, iron, magnesium, manganese, mercury, nitrates, nitrites, selenium, silver, sodium, zinc, pH, bacteria, methyl tert-butyl ether, ethylene dibromide, 1,2-dichloroethane, 1,2-dichloropropane, isopropyl ether, benzene, toluene, ethylbenzene, xylenes, trichloroethylene, and tetrachloroethylene. This legislation does not go in effect until drinking water testing rules are developed and adopted by the Commission for Public Health.



Purnell Rd
Bud Morris Rd
Bear Hollow Rd
Cedar Knoll Dr
Wildhurst Ln
Bent Rd
Stony Hill Rd
Frank Bailey Rd
Hasentree Club Dr
Keith Rd
Durham Rd
Stony Hill
98
Wolverton Fields
Cedar Falls
Eden Falls
Gordon Place
Harrison Ridge
Stone Forest
Hinton Woods
Strathaven
Stony Bend Cluster
Cedar Knoll
Kenwood Reserve
Bent Place
Pell Acres
Stonewall
Kingsborough
Hasentree
Hasentree Club
La Ventana
MTBE-0.49
TCE-100
TCE-340
TCE-6.5
MC-1.3
Acetone- 55
2-Butanone- 63
TCE-86
TCE-20
TCE-4.3
PCE-1.9
TCE-4.4
PCE-1.9
MTBE-0.69
Pre
TCE-4.9
PCE-1.9
Post
TCE-2
PCE-.8
TCE-0.48
MTBE-0.47
TCE-0.64
TCE-7.7
PCE-2.3
TCE-19
PCE-13
TCE-47
PCE-110
TCE-3.7
PCE-1.3
TCE-3.9
PCE-1.3
1,1 DCE- 0.44
TCE-67
PCE-41
TCE-28
PCE-13
SOURCE: (c) 2010 Microsoft Corporation and its data suppliers
Legend
TCE Detected
TCE Not Detected
Misc. Contaminant
Community Well
N
0
1,500
3,000
Feet
Wake Forest,
Wake County,
North Carolina
United States Environmental Protection Agency
STONY HILL ROAD TCE
WAKE FOREST, WAKE
COUNTY, NORTH CAROLINA
STONY HILL ROAD TCE
SAMPLING RESULTS AS OF 1/27/2013
OTIE


MTBE-0.49
CEDAR KNOLL
KENWOOD RESERVE
Willowshire Ln
Wildhurst Ln
Bent Rd
Colombard Ct
TCE-100
TCE-340
TCE-8.0
TCE-20
TCE-86
TCE-0.48
MTBE-0.69
MTBE-0.47
BENT PLACE
KINGSBOROUGH
TCE-4.3
PCE-1.9
TCE-4.4
PCE-1.9
Pre
TCE-4.9
PCE-1.9
Post
TCE-2
PCE-.8
TCE-0.64
TCE-7.7
PCE-2.3
TCE-19
PCE-13
TCE-47
PCE-110
TCE-3.7
PCE-1.3
TCE-3.9
PCE-1.3
1,1 DCE- 0.44
TCE-67
PCE-41
TCE-28
PCE-13
Acetone- 55
2-Butanone- 63
MC-1.3
IRON MOUNTAIN VIEW
Stony Hill Rd
Frank Bailey Rd
Rivermead Ln
Keith Rd
Chestley Farm Rd
Hasentree Club Dr
LA VENTANA
SOURCE: (c) 2010 Microsoft Corporation and its data suppliers
Legend
TCE Detected
Suspected Source
TCE Not Detected
Misc. Contaminant
Estimated Plume
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1,500
Feet
N
Wake Forest,
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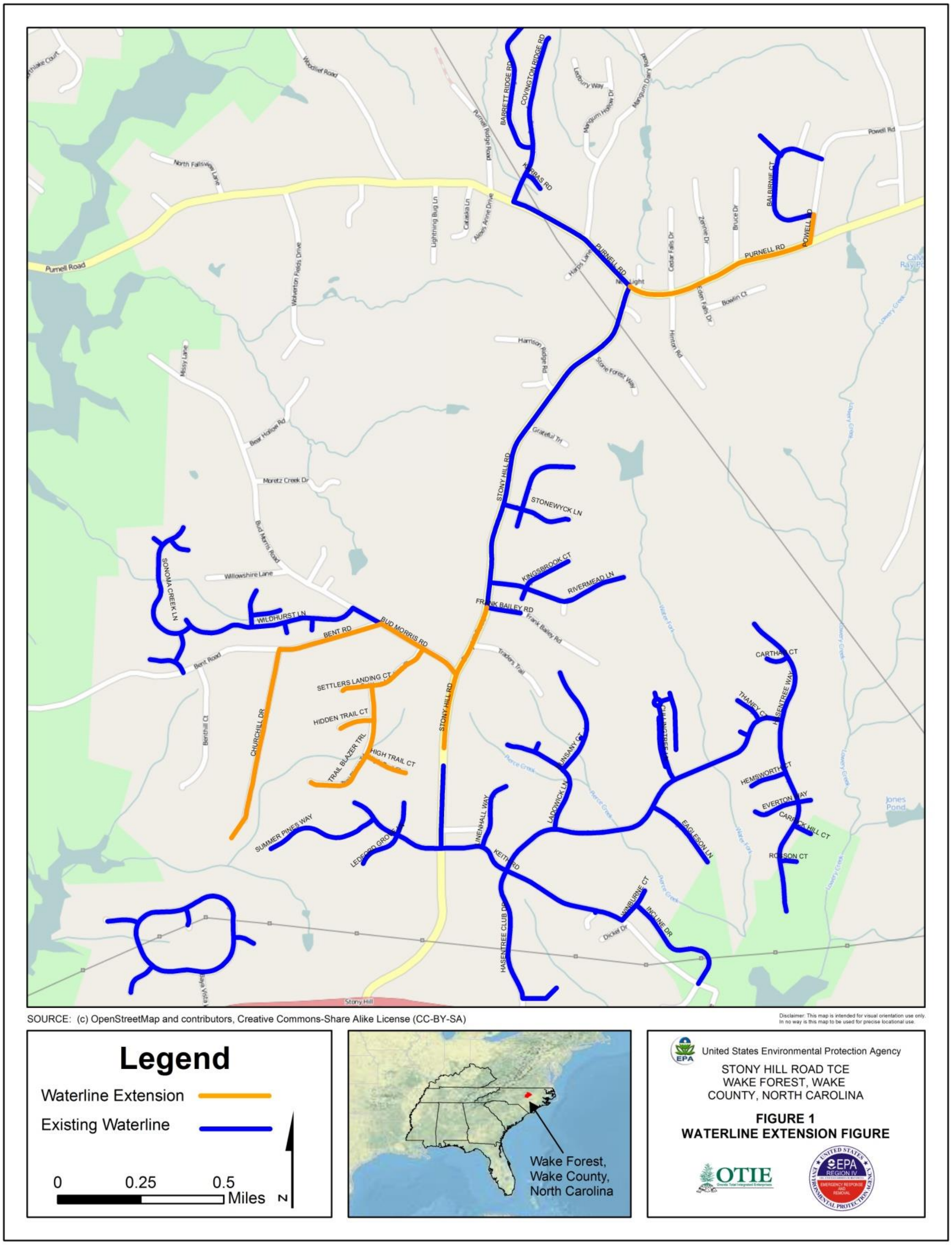
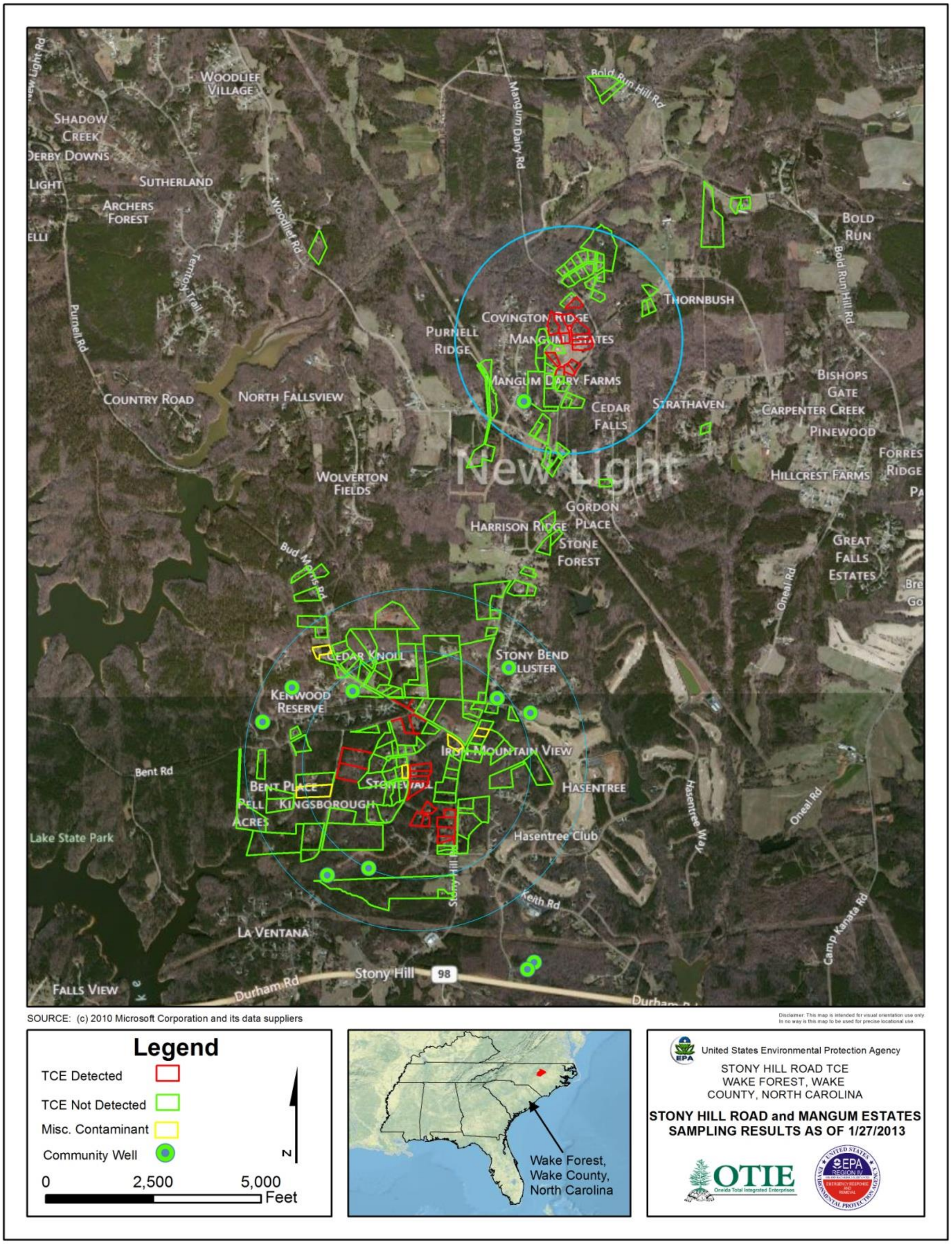
North Carolina
United States Environmental Protection Agency
STONY HILL ROAD TCE
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
STONY HILL ROAD TCE ESTIMATED PLUMES



Purnell Road
PURNELL RD
STONY HILL RD
BUD MORRIS RD
BENT RD
CHURCHILL DR
SETTLERS LANDING CT
HIDDEN TRAIL CT
TRAIL BLAZER TRL
HIGH TRAIL CT
FRANK BAILEY RD
STONEWYCK LN
KINGSBROOK CT
RIVERMEAD LN
WILDHURST LN
SONOMA CREEK LN
SUMMER PINES WAY
KEITH RD
HASENTREE CLUB DR
INCLINE DR
EAGLESON LN
LADOWICK LN
CARTHAY CT
HEMSWORTH CT
EVERTON WAY
BALBIRNIE CT
POWELL RD
BARRETT RIDGE RD
COVINGTON RIDGE RD
SOURCE: (c) OpenStreetMap and contributors, Creative Commons-Share Alike License (CC-BY-SA)
Disclaimer: This map is intended for visual orientation use only. In no way is this map to be used for precise locational use.
Legend
Waterline Extension
Existing Waterline
0
0.25
0.5
Miles
N
Wake Forest, Wake County, North Carolina
United States Environmental Protection Agency
STONY HILL ROAD TCE
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
FIGURE 1
WATERLINE EXTENSION FIGURE
OTIE
EPA REGION IV


Woodlief Village
Shadow Creek
Derby Downs
Sutherland
Archers Forest
Country Road
North Fallsview
Purnell Rd
Territory Trail
Woodlief Rd
Mangum Dairy Rd
Bold Run Hill Rd
Bold Run
Thornbush
Covington Ridge
Mangum Estates
Purnell Ridge
Mangum Dairy Farms
Cedar Falls
Strathaven
Bishops Gate
Carpenter Creek
Pinewood
Hillcrest Farms
New Light
Wolverton Fields
Gordon Place
Harrison Ridge
Stone Forest
Great Falls Estates
Oneal Rd
Bud Morris Rd
Cedar Knoll
Stony Bend Cluster
Kenwood Reserve
Iron Mountain View
Bent Rd
Bent Place
Stonewall
Hasentree
Pell Acres
Kingsborough
Lake State Park
Hasentree Club
Hasentree Way
Keith Rd
Stony Hill Rd
La Ventana
Camp Kanata Rd
Stony Hill
98
Durham Rd
Falls View
SOURCE: (c) 2010 Microsoft Corporation and its data suppliers
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TCE Detected
TCE Not Detected
Misc. Contaminant
Community Well
N
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WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
STONY HILL ROAD and MANGUM ESTATES SAMPLING RESULTS AS OF 1/27/2013
OTIE
Oneida Total Integrated Enterprises
EPA REGION IV

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