REMEDIATION SYSTEM EVALUATION

A-Z Automotive
West Milford, New Jersey

Report of the Remediation System Evaluation
Site Visit Conducted at A-Z Automotive
July 30, 2003

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NOTICE AND DISCLAIMER

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This report has undergone review by the state site manager and EPA headquarters staff. For more infomation about this project, contact: Joe Vescio (703-603-0003 or vescio.joseph@epa.gov) or Kathy Yager (617-918-8362 or yager.kathleen@epa.gov).

EXECUTIVE SUMMARY

A Remediation System Evaluation (RSE) involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- improvements in remedy effectiveness
- reductions in operation and maintenance costs
- technical improvements
- gaining site closeout

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all site stakeholders. This RSE report pertains to conditions that existed at the time of the RSE site visit, and any site activities that have occurred subsequent to the RSE site visit are not reflected in this RSE report (unless otherwise noted).

The A-Z Automotive site is a former gasoline retail outlet and automobile service station located on Union Valley Road between St. George Street and Lou Ann Boulevard in West Milford, Passaic County, New Jersey. Approximately 25 residences are located on St. George Street and Lou Ann Boulevard to the east of the A-Z site. Belcher Creek is about 1,000 feet further to the east of the subdivision. Petroleum impacts were discovered at the site in 1989 initially due to a diesel spill that occurred during the filling of a UST. Subsequent investigations found UST leaks, basement vapor issues, and potable well impacts. Shallow ground water occurs in a glacial deposit overburden that is reported to be about 80 feet bgs. The potable wells in the area are completed in the underlying bedrock (potable wells are reported to average about 150 feet bgs). Between 1989 and 1992, potable well sampling indicated exceedances of New Jersey Department of Environmental Protection (NJDEP) ground water standards at nine potable wells, and detectable contaminant concentrations in twelve additional wells. Gasoline odors were noted at that time in the basements of several residences. Approximately 19 point of entry treatment (POET) systems with GAC treatment were in place as of May 1995, and most of these are still in place.

Contaminants of concern include typical gasoline constituents such as benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE) and tertiary butyl alcohol (TBA). Benzene is present above NJDEP standards in the most widespread area. Analytical results for ground water samples taken in July 2003 show a marked decrease in the extent and magnitude of dissolved concentration from earlier results. Free product has been observed at the site, reaching as far downgradient as RW-13 (300 feet east of the abandoned gas station), where up to three feet of product has been observed during pumping conditions. During the site visit it was reported that free product was recently noted in MW-9, MW-15, and MW-16. There is concern that a large volume of product is trapped below the water table.

The current system P&T system consists of one main recovery well for hydraulic control (RW-13). Other wells are periodically pumped to lower the water table for soil vapor extraction (SVE) application. The recent (May to July 2003) system flow rate has been about 20 gpm. The current SVE system consists of several wells that can recover vapors to prevent contaminant migration to residences, and to remove mass. The vapors are extracted at a rate of approximately 70 to 100 cfm, and are currently treated by a catalytic oxidizer.

The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators but are offered as constructive suggestions in the best interest of the EPA, the public, and the facility. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations to improve effectiveness in protecting human health and the environment include the following:

- further delineation of ground water impacts beyond MW-37 and MW-38
- performing capture zone analysis (including the development of a target capture zone)
- formalizing a well sampling program
- conducting vapor monitoring at nearby residences

Recommendations to reduce costs include the following:

- clarifying the scope of the site contractor
- switching from the catalytic oxidizer to vapor phase carbon
- reducing the frequency of GAC changeouts

A recommendation for technical improvement is to begin more formal reporting regarding the status and progress of the system. A recommendation for site closeout is to start formulating a site-specific exit strategy that includes an estimated time frame for shutting down the system, and a specific monitoring program to indicate when the system can be shut off (including post-shut-down monitoring). All of these recommendations can be easily implemented, and a prioritization of the recommendations is provided.

A table showing estimated costs and/or savings associated with each recommendation is presented in Section 7.0 of this report.

PREFACE

This report was prepared as part of a pilot project conducted by the U.S. EPA Office of Underground Storage Tanks (OUST) and Office of Superfund Remediation and Technology Innovation (OSRTI). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump and treat systems managed by State UST programs. The following organizations are implementing this project.

Organization	Key Contact	Contact Information
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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000, 2001, and 2002 Remediation System Evaluations (RSEs) were conducted at 24 Fund-lead pump and treat (P&T) sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, EPA OSRTI and OUST are performing a pilot study of conducting RSEs at UST sites. During fiscal year 2003, RSEs visits at three State-managed UST sites were conducted in an effort to evaluate the effectiveness of this optimization tool for this class of sites. GeoTrans, Inc. is conducting these evaluations, and representatives from EPA may attend the RSEs as observers.

The Remediation System Evaluation (RSE) process was developed by the US Army Corps of Engineers (USACE) and is documented on the following website:

http://www.environmental.usace.army.mil/library/guide/rsechk/rsechk.html

A RSE involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for 1-1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- improvements in remedy effectiveness
- reductions in operation and maintenance costs
- technical improvements
- gaining site closeout

The recommendations are intended to help the site team (the responsible party, if one exists, and the regulators) identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, might be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all site stakeholders. This RSE report pertains to conditions that existed at the time of the RSE site visit, and any site activities that have occurred subsequent to the RSE site visit are not reflected in this RSE report (unless otherwise noted).

The A-Z Automotive site was selected by EPA OUST, in coordination with NJDEP. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

EPA OUST is jointly conducting this RSE Pilot Study for UST sites with EPA OSRTI.

1.3 DOCUMENTS REVIEWED

Author	Date	Title
Peter R. Spinney, Inc.	October 19, 1990	Household Water Supplies Quarterly Report
Peter R. Spinney, Inc	October 29, 1990	Underground Storage Tank Decommissioning letter report (partial)
NJDEP	August 8, 1991	Case Transfer memorandum
NJDEP	May 1992	Groundwater Investigation Results fact sheet
NJDEP (Bureau of Wellfield Remediation)	June 16, 1992	Ground Water Impact Area memorandum
NJDEP	September 1, 1992	Decision Document
NJDEP	May 19, 1994	October-December 1993 Progress Report memo
NJDEP	October 21, 1994	Well Sampling memorandum
Converse Consultants East	November 3, 1994	Report on Contamination of Potable Well Supplies
NJDEP	March 15, 1995	October-December 1994 Progress Report memo
NJDEP	May 15, 1995	Alternatives Analysis Report
NJDEP	March 11, 1997	Potable Well Sampling memorandum
Handex	March 11, 1997	Soil Sample Results
Tri-Tech Engineering	February 11, 1999	Remedial Action Report (UST and Soil Removal)
NJDEP	May 28, 1999	Permit Authorization to Discharge Treated Groundwater
NJDEP	July 25, 2001	Contract to Engage Handex
NJDEP	July 2003	Well Sampling Data
Various	Various	Well Logs, Well Permits

1.4 PERSONS CONTACTED

The following individuals associated with the site were present for the visit:

- Ted Hayes, NJDEP
- Tom O'Neill, NJDEP

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The A-Z Automotive site is a former gasoline retail outlet and automobile service station. It is located on Union Valley Road between St. George Street and Lou Ann Boulevard in West Milford, Passaic County, New Jersey. The site location is shown on Figure 1-1. St. George Street and Lou Ann Boulevard extend southeast about 900 feet from Union Valley Road before they join and end. Approximately 25 residences are located on St. George Street and Lou Ann Boulevard to the east of the A-Z site. The topography of this area slopes from west to east, with an elevation difference of about 50 feet between the A-Z site and the eastern end of the subdivision. Belcher Creek is about 1,000 feet further to the east of the subdivision.

1.5.2 POTENTIAL SOURCES

Petroleum impacts were discovered at the site in 1989 initially due to a diesel spill that occurred during the filling of a UST. Subsequent investigations found UST leaks, basement vapor issues, and potable well impacts. The seven USTs containing diesel, gasoline, and kerosene were removed in 1990. Numerous holes were observed in five of the USTs. In addition, stained soils, petroleum odors, and a sheen on ground water were observed in the excavation. Approximately 1,022 tons of contaminated soil was removed with the USTs, but contamination was known to remain in place after the tank removal. An infiltration system was constructed in the former tank pit, which may have increased the potential for any contamination in that area to impact ground water and/or to spread contaminated ground water.

In 1998 the pump islands, piping, and additional soil were removed. In 1999 a waste oil UST and a heating oil UST (and associated contaminated soil) were removed, and post-excavation sampling indicated all soil levels below New Jersey soil criteria (residential, non-residential, and impact to ground water).

1.5.3 HYDROGEOLOGIC SETTING

The site is located in the Green Pond Mountain Region of the New Jersey Highlands Physiographic Province. Glacial deposits overlie bedrock at the site. Shallow ground water occurs in a glacial deposit overburden that is reported to be about 80 feet below ground surface (bgs). Depth to ground water at the site and in the downgradient impacted area ranges from about 5 to 35 feet bgs. In the deeper part of the overburden (from about 50 to 80 feet bgs) large cobbles and a fluid sand zone have been noted. The potable wells in the area are completed in the underlying bedrock (potable wells are reported to average about 150 feet bgs).

The NJDEP (June 16, 1992 memorandum) provides estimates of hydraulic conductivity of 38.1 feet per day (based on West Milford MUA Birch Hill Well 1A) for the overburden and 6.4 feet per day for the bedrock. The reported gradient in the overburden (in the 1992 memo) was 0.022 feet per foot to the southeast to east. This is consistent with water level data collected in June 1999. The bedrock gradient was estimated at 0.03 feet/feet (in the 1992 memo, based on review of water levels in the same rock units at the nearby Leroy's Mobil site), and was assumed at the time to be to the northeast due to the influence of the Greenbrook Water Company supply wells located 3,000 feet northeast of the site. The RSE team was not able to locate water level data that could confirm these assumptions.

1.5.4 RECEPTORS

As discussed earlier, potable wells in the area are screened in the bedrock aquifer. The glacial deposits are presumably a source of recharge to the bedrock aquifer. The shallowest potable well was completed to 90 feet bgs at a residence on Lou Ann Boulevard. That well was replaced with a deeper well, and the former potable well was converted to a remedial system recovery well.

Between 1989 and 1992, potable well sampling indicated exceedances of NJDEP ground water standards at nine potable wells, and detectable contaminant concentrations in twelve additional wells. Gasoline odors were noted at that time in the basements of several residences.

Approximately 19 point of entry treatment (POET) systems with Granular Active Carbon (GAC) treatment were in place as of May 1995, and most of these are still in place. Ground water quality is monitored at the locations with POETs and 16 additional residences. Soil vapor extraction wells are operated in the area and at three specific residences that have historically had vapor intrusion issues. During the site visit, NJDEP stated that the POET systems were successful in providing potable water to the residences and that the SVE system has been successful in preventing further vapor issues.

The 1995 NJDEP Alternatives Analysis Report estimates potential contaminant migration rates in the overburden and bedrock. For benzene, the rates are 1.8 feet per day and 0.6 feet per day, respectively. For MTBE, the rates are 3.8 feet per day and 1.5 feet per day, respectively. These estimated contaminant migration rates indicate that contaminants may migrate through the overburden aquifer to Belcher Creek within three years from 1995. The bedrock migration rates indicate that MTBE could migrate to the Greenbrook Water Company wells within six years and benzene could migrate to the wells within 14 years of 1995.

1.5.5 DESCRIPTION OF GROUND WATER PLUME

Contaminants of concern include typical gasoline constituents such as benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE) and tertiary butyl alcohol (TBA). Benzene is present above NJDEP standards in the most widespread area. Figure 1-3 depicts the extent of VOCs in the overburden in May 2001, and Figure 1-4 depicts the extent of VOCs in the overburden in July 2003. Analytical results for ground water samples taken in July 2003 show a marked decrease in the extent and magnitude of dissolved concentration from earlier results. However, some of the wells sampled in 2001 were not resampled in 2003. For example, MW-37, the easternmost well, had elevated benzene and MTBE concentrations in 2001 but was not resampled in 2003. The RSE team does not know the reason why some of the wells were not resampled in 2003.

Free product has been observed at the site, reaching as far downgradient as RW-13 (300 feet east of the abandoned gas station), where up to three feet of product has been observed during pumping conditions.

During the site visit, it was reported that free product was recently noted in MW-9, MW-15, and MW-16. There is concern that a large volume of product is trapped below the water table.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

A P&T system was installed by the responsible party in 1990. The NJDEP took over operations at the site in 1991. As of 1992, the remediation system included ten ground water recovery wells along St. George Street and eleven vapor recovery points. Ground water was pumped from the wells to an oil/water separator and then to an air stripper with GAC polishing. Twenty percent of treated water was reported to be reinjected into the former tank field area while the remainder was discharged to the storm sewer. The percentage of reinjected water was apparently increased between 1993 and 1999. Air emissions from the air stripper were treated through vapor-phase GAC. Emissions from the vapor recovery points were treated through a catalytic oxidizer. As of September 1992, NJDEP estimated that 4,500 gallons of petroleum product had been removed from the subsurface.

The system was upgraded in late 1993 and early 1994. Five new recovery wells with pneumatic total fluid pumps replaced the previous extraction system. The extraction rate during this time was about 22 gpm. In late 1994, the air stripper was removed from the treatment system and GAC was used exclusively for dissolved contaminant removal.

The system was altered in 1999 using RW-13 as the sole recovery well due to its relatively high yield and high constituent concentrations relative to other wells. An electrical submersible pump was installed in RW-13, and piping upgrades were made that allowed pumping of RW-13 up to about 20 gpm. The on-site infiltration system was not capable of handling the discharge rate, so all treated water was discharged to surface water. Free product was also collected from RW-13, and high vapor concentrations led to reactivation of the SVE system.

The current P&T system consists of one main recovery well for hydraulic control (RW-13) with an electrical submersible pump. Other wells are periodically pumped to lower the water table for SVE application (MW-15 was being pumped at the time of the site visit). The discharge from the wells is pumped to an equalization sump. The water from the sump is pumped on a batch basis at about 45 gpm through two bag filters in series, followed by two 1,500-pound GAC units in series. The water flow is measured with a totalizing flow meter before it is discharged to the storm sewer. The recent (May to July 2003) system flow rate has been about 20 gpm. One GAC unit is changed out about once per month. The RSE team was not provided with any data indicating whether or not NPDES discharge limits are met.

The current SVE system consists of several wells that can recover vapors from near residences. Recovery wells are operated as needed to prevent contaminant migration to residences, and to remove mass. The vapors are extracted a rate of approximately 70 to 100 cfm, and are currently treated by a catalytic oxidizer. NJDEP reports that the catalytic oxidizer operates with an influent concentration of approximately 10 ppm and uses approximately $680 per month in electricity. RW-13, MW-15 (on the former station property), MW-8, MW-13, MW-16, MW-20 and MW-9 and other wells along St. George Street have been used as vapor recovery points. On multiple occasions since October 2001, an internal combustion engine has been used for enhanced extraction at select monitoring wells (MW-1, MW-2, MW-3, MW-4, MW-7, MW-9, MW-12, MW-15, and MW-16).

Within the source/high concentration area a significant volume of petroleum has been removed over time by a combination of fluid extraction, vapor recovery, and hand bailing. An NJDEP status memo indicated that 4,500 gallons of gasoline were recovered over a 12-month period beginning in the summer of 2001. In addition to continuing P&T and SVE, NJDEP is beginning to conduct air sparging tests in St. George Street area wells to determine if significant petroleum mass remains in the area. If petroleum mass is found, ground water pumping to expose soil to SVE or possibly an air sparging system will be used.

2.2 MONITORING PROGRAM

The monitoring program has included sampling of monitoring wells on decreasing frequency since 1990. Wells were sampled quarterly in 1990, semiannually in 1992 through 1997, annually from 1998 to 2001 and again in 2003. It is unclear what future sampling frequency is proposed. The 2001 contract with Handex specifies quarterly monitoring which has not been accomplished. Forty-one monitoring and five recovery wells have been sampled either in 2001 or 2003, including ten wells that were installed in 2001. Approximately eight of the monitoring wells are completed in bedrock while the remainder are overburden wells. Ground water level data, except those associated with a pumping test in 1999, were not provided to the RSE team. In addition, the RSE team was not provided with information that identifies the specific wells completed in the bedrock.

Water quality is monitored at about 35 area potable wells on a regular basis including influent, first-GAC effluent, and final effluent samples at POET systems. These monitoring schedules have been arranged with and agreed to by homeowners.

Monitoring at the site remediation system includes weekly analysis of first-GAC effluent, monthly influent, and final effluent. Vapor emissions are monitored by organic vapor analyzer (OVA) screening.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The main goal of the remediation at the site has been the protection of the residents' health by maintenance of the POET systems and the vapor recovery systems. The ground water extraction and treatment system has been historically used to prevent further migration of impacted ground water to residences and remove contaminant mass. It appears that the current goal of the ground water extraction is to capture ground water from the area near and upgradient of the lone recovery well (RW-13), which is located approximately 300 feet downgradient of the site boundary. Other activities in the area upgradient of RW-13 are intended to remove additional mass and hasten progress toward NJDEP standards. These activities include SVE, sporadic ground water extraction at wells other than RW-13 (to expose screen area to SVE), and air sparging (testing is ongoing). The area downgradient of RW-13 is apparently being allowed to naturally attenuate, although there is no documented plan regarding this effort.

The following table outlines the most stringent NJDEP ground water standards for BTEX compounds, MTBE and TBA.

Contaminant	NJDEP Standard
Benzene	1 ug/L
Ethylbenzene	700 ug/L
Toluene	1000 ug/L
Xylenes	1000 ug/L
MTBE	70 ug/L
TBA	100 ug/L

The number of wells impacted above these levels has decreased considerably since the mid-1990s, as have the ground water concentrations. However, ground water concentrations continue to exceed standards in wells near the source area and up to 900 feet downgradient of the site. Due to the long-term impacts to potable water in this neighborhood and the potential migration of contaminants to public water supply wells, any variance to the NJDEP standards is not likely.

3.2 TREATMENT PLANT OPERATION STANDARDS

The system NPDES permit requires effluent reporting for the following parameters:

Parameter	Daily Maximum
Flow	No limit
Total Suspended Solid (TSS)	25 mg/L
Total Organic Carbon (TOC)	20 mg/L
Benzene	7 ug/L
Naphthalene	59 ug/L
MTBE	No limit
TBA	No limit
Total Petroleum Hydrocarbons (TPH)	15 mg/L
pH	6 to 9
Lead	No sample required

Samples are analyzed monthly for the above parameters, except TPH and pH, for which samples are analyzed quarterly

The key parameter requiring treatment is benzene. The concentration of benzene in RW-13 in July 2003 was 21 ug/L (the total BTEX concentration was 1,543 ug/L). No MTBE or TBA have been detected in this well since initial sampling in 1997.

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of EPA, NJDEP, and the public. These observations obviously have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, it is likely that site conditions and general knowledge of ground water remediation have changed over time.

The RSE team notes a lack of formal reporting at this site over time. This makes it extremely difficult to review this site for protectiveness, compliance with NPDES and air discharge requirements, and progress toward meeting cleanup goals.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 PLUME CAPTURE

The NJDEP project manager at the site, Ted Hayes, believes in “splitting” the plume by containing the source and high concentration areas and allowing the dilute plume to attenuate. This practice is used at many sites and is generally reasonable. RW-13, which is screened in the overburden, is being used to provide hydraulic containment, but data are not being collected or evaluated to indicate how effective the hydraulic containment is. Concentrations in downgradient wells (MW-32, MW-37) remained well above NJ standards in May 2001.

A simple water balance calculation indicates that at a pumping rate of about 20 gpm, a 77-foot wide capture zone might be expected in the overburden based on previous estimates of hydraulic conductivity and hydraulic gradient (see Section 1.5.3).

$$Q = WBKi$$

where

W (capture zone width)
Q (extraction rate)
B (saturated thickness) = 60 feet
K (hydraulic conductivity) = 38.1 feet/day
i (gradient) = 0.022 feet/feet

when Q = 20gpm (3,850 ft^3/day), W = 77 feet

This capture zone width is likely not sufficient to contain the plume. The distance between Lou-Ann Boulevard and St. George Street is approximately 300 feet, and the plume appears to be wider than this distance. Contamination stretches from northeast of Lou-Ann Boulevard (MW-24) to southwest of St.

George Street (MW-13), which is a distance of approximately 700 feet. Because of an irregular plume shape, however, this 700 feet may overestimate the width of the plume. Regardless, the estimated width of the capture zone appears to be insufficient to provide adequate capture.

A pumping test was run in 1999 by pumping at RW-13. The analysis of this pumping test was not provided for review by the RSE team. Results of that test could be used to confirm the estimate of hydraulic conductivity.

4.2.2 AQUIFER RESTORATION

Significant volume of free product has been removed since remediation was initiated. For example, approximately 4,500 gallons of product was collected over a one year period between 2001 and 2002. The progress toward cleanup is commendable as nearly all wells show significant decreasing concentration trends, and many have reached concentration levels below NJDEP ground water standards.

Dissolved BTEX and MTBE contamination exceed standards in 15 of the 46 sampled wells sampled since 2001. The following table presents concentrations for wells where dissolved contamination exceeded standards in the latest sample taken at that well since 2000. For clarity, an analytical result for a particular parameter from a particular well is not shown if it is less than the NJDEP standard.

Monitoring Well	Well Location	Date of Most Recent Sample	MTBE (ug/L)	Benzene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)
NJDEP Standard			**70**	**1**	**700**	**1000**
MW-6	near source area	5/01	946			
MW-8	50' SE	7/03		20		2,680
MW-12	250' SE	7/03				3,480
MW-16	50' SE	7/03			908	3,480
MW-19	150' SE	7/03	1.1			
MW-24	400' East	7/03	1.1			
MW-26	600' SE	7/03	87			
MW-29	400' East, (Bedrock)	5/01		12		
MW-31	200' SE	5/01	479			
MW-32	600' SE	7/03		6		
MW-37	700' East	7/01	126	815		
MW-38	700' East (Bedrock)	7/01		18.4		
RW-11	St. G. St.	7/03				2,280
RW-13	300' SE	7/03		21		1,290
RW-14	600' SE	5/01	13.8			

Based on the July 2003 sampling of RW-13 (approximately 1,500 ug/L of VOCs), and using a flow rate of 20 gpm, the P&T system was removing about 0.4 pounds of BTEX per day.

$$\frac{20\,\text{gal.}}{\text{min.}} \times \frac{1{,}500\,\text{ug BTEX}}{\text{L}} \times \frac{3.785\,\text{L}}{\text{gal.}} \times \frac{1440\,\text{min.}}{\text{day}} \times \frac{2.2\,\text{lbs}}{10^{9}\,\text{ug}} = \frac{0.36\,\text{lbs BTEX}}{\text{day}}$$

This is significantly less than the 5.3 pounds per day being removed based on the May 2001 sampling, (when concentrations were much higher). This drop in mass removal between 2001 and 2003 may be due to the aggressive remediation that occurred with the internal combustion engine between 2001 and 2003.

The SVE system, when operating at about 100 cfm with an influent concentration of 10 ppm (approximately 40 mg/m^3 of benzene, toluene, ethylbenzene and xylene) is also removing about 0.4 pounds of VOCs per day.

$$\frac{100\ \text{ft}^3}{\text{min.}} \times \frac{40\ \text{mg BTEX}}{\text{m}^3} \times \frac{0.0283\ \text{m}^3}{\text{ft}^3} \times \frac{1440\ \text{min.}}{\text{day}} \times \frac{2.2\ \text{lbs}}{10^{6}\ \text{mg}} = \frac{0.36\ \text{lbs BTEX}}{\text{day}}$$

In addition to continuing P&T and SVE, NJDEP is conducting air sparging tests in St. George Street area wells to determine if significant petroleum mass remains in the area. If petroleum mass is found, ground water pumping to expose soil to SVE (or possibly an air sparging system) will be implemented.

4.3 COMPONENT PERFORMANCE

4.3.1 EXTRACTION SYSTEM WELLS, PUMPS, AND HEADER

The current system has one main recovery well, RW-13, which has an electric submersible pump. The line from the extraction well to the equalization sump near the treatment system building was upgraded in 1999 and allows 20 gpm or greater flow rates. Other wells, primarily located along St. George Street, are periodically pumped to lower the water table for SVE application. The ground water extraction system apparently functions as designed.

Vapor extraction is applied at various wells, primarily along St. George Street (including MW-16). Vapor extraction header lines lead to these wells and valving allows application of a vacuum at these wells when desired.

4.3.2 GAC

Water from the equalization sump is pumped on a batch basis at about 45 gpm through two bag filters, followed by two 1,500-pound GAC units prior to discharge. Samples are taken at the effluent of the first GAC unit on a weekly basis to check for breakthrough. It was reported that GAC is changed out about 12 times per year, which appears to be extremely high based on the most recent recovery well sampling data from July 2003. These sampling data indicated an influent concentration of about 1,500 ug/L from RW-13. At this concentration, the GAC usage should be approximately eight pounds of GAC per pound of contaminant using isotherms from Dobbs and Cohen, 1980 (EPA-600/8-80-023). As calculated in Section 4.2.2 of this report, the mass loading to the GAC based on the July 2003 data is approximately 0.4 pounds per day. Therefore, over the course of a year, the GAC usage should be approximately 1,200 pounds, unless substantial mass loading results from temporary pumping in other wells. By contrast, 1,500 pounds is replaced every month for a total GAC usage of 18,000 pounds per year. This change out frequency would have been appropriate for the higher influent concentrations in previous years, but if the influent concentrations remain this low, the site team should consider a reduced GAC replacement frequency. System influent and effluent analytical results were not provided for this review. We therefore cannot determine actual GAC usage or if treatment plant operational standards are being met.

4.3.3 CATALYTIC OXIDIZER

The catalytic oxidizer, likely a 100 cfm unit, is appropriately sized for the application. The electrical costs to run the unit are $680 per month (approximately $8,000 per year), which is relatively high for the contaminant mass that is treated. As calculated in Section 4.2.2 of this report, approximately 0.4 pounds per day of contaminants are extracted in vapor form. This translates to approximately 150 pounds per year, or approximately $50 per pound. By contrast, vapor phase GAC could likely provide treatment for about half that cost or less.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

The approximate annual O&M costs were discussed during the RSE site visit. Based on the input from NJDEP and review of the July 25, 2001 memo describing the Handex engagement, the RSE team estimates that O&M will cost approximately $225,000 per year in the upcoming years. More recent scopes and associated costs were not provided to the RSE team, so these estimates may be somewhat out of date. However, the provided breakdown allows a clear picture of where the larger percentages of costs were being spent and potentially where savings are possible.

Item Description	Estimated Cost per Year
Weekly inspections (8-hrs/wk)	$22,880
P&T operations laboratory analysis	$8,012
P&T/SVE equipment rental	$51,280
1500 pound LGAC unit changeouts (12 per year)	$27,000
Bag filters and VGAC changeouts	$2,884
Monitoring well sampling labor	$10,560
Monitoring well sampling analysis	$9,825
Electricity	$20,000
System maintenance/upgrades	$12,240
Operations review/management/permitting	$17,750
POET system sampling and GAC changeouts + bottled water	$42,945
Total Estimated Cost	**$225,376**

The Handex engagement scope also included piping repairs at $29,556 and an upgrade to the injection gallery at $25,204. These items should not be recurring annual costs, so they are not included in the cost breakdown.

4.4.1 UTILITIES

The site utilities costs are mainly related to electricity requirements for the catalytic oxidizer (reported to be about $680 per month), pump operation, and building heating.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Replacement of the 1,500 pound GAC units used for adsorbing VOCs from ground water is the main consumable cost item.

4.4.3 LABOR

Labor consists of weekly inspections and monitoring well sampling plus operations review, management, and permitting.

- Eight hours per week are allocated for weekly site inspections including inspection of ground water recovery, vapor recovery, and POET systems (including pressure and flow readings, weekly visual inspections of the storm sewer discharge, recovery pump operation, and maintaining the on-site compressor). Also included are water level and product thickness measurements.

- Weekly entries in the site log book showing pressure and flow measurements indicate that system checks are being accomplished. The frequency of water level measurements is not clear.

- System operations review and permitting is allocated 290 hours over a year period in the Handex engagement. It is not clear how this time is (or would be) spent because the RSE team was not provided with any recent reports regarding system operation.

- Labor is allocated for sampling 35 monitoring wells on a quarterly frequency; however, only one sampling event was reported to the RSE team between June 2001 and August 2003.

4.4.4 CHEMICAL ANALYSIS

Chemical analysis costs include those for POET sampling, P&T system process sampling, and monitoring well sampling. With decreasing influent concentrations, the weekly frequency of sampling the first GAC unit effluent may be excessive. The Handex engagement has analysis of 140 well samples per year scheduled based on a quarterly sampling frequency, but actual sampling has occurred much less frequently.

4.4.5 System Maintenance

The Handex engagement allocates 80 hours each for a plumber, electrician, and laborer for repairs or replacement of treatment equipment.

4.5 Recurring Problems or Issues

The area residents are very interested in the remediation progress. It was reported that relations between NJDEP and the residents are generally good at this time.

4.6 Treatment Process Excursions and Upsets, Accidental Contaminant/Reagent Releases

The site team did not indicate any treatment process excursions or releases.

4.7 Safety Record

The site team did not indicate any reportable incidents.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The release from the site has impacted numerous residential potable wells. Point of entry treatment (POET) systems were installed and are maintained at several residences and other potable wells are sampled on a regular basis. Bottled water is also supplied to affected residents. The RSE team is not aware of any reports of recent problems with potable wells in the area above and beyond those addressed by the remedy.

Some of the highest dissolved contaminant concentrations recently detected at the site were in MW-37, a well about 900 feet east of the contaminant source area. Contaminants were also detected in the bedrock well at this location. Given that no monitoring wells are located further east in overburden or northeast in bedrock from these wells, it is unclear how far the plume extends toward the supply wells to the northeast.

5.2 SURFACE WATER

It is not known if any contaminants are discharging to Belcher Creek about 900 feet downgradient of the closest monitoring well. The RSE team does not know of any surface water sampling efforts. Modeling in the Alternatives Analysis report indicates that the contaminant plume would be expected to reach the creek. The RSE team notes that contaminants would likely be diluted in the surface water and/or volatilize such that detection in surface water would be unlikely.

5.3 AIR

Vapor intrusion has been a problem in at least three residences. The site soil vapor extraction systems have been effectively operated to prevent continued vapor migration into the houses. Vapor concentrations have apparently decreased considerably, but it is not clear if the vapor sources have been completely removed. NJDEP is investigating if additional VOCs can be removed by air sparging.

5.4 SOILS

Contaminated soil has been removed from the site on several occasions and soil vapor extraction has been conducted with wells in the former tank field and dispenser areas. Depth to water at the former service station site is about 30 feet bgs, which suggests that all of the impacted vadose zone soil was not removed with the excavations at the site. The SVE system has likely been effective at removing much of the remaining source mass above the water table, based on the significantly decreased concentrations in monitoring wells near the source area. Due to the presence of an asphalt cover, there is no exposure pathway to contaminated soils.

5.5 SURFACE WATER AND SEDIMENTS

The highest levels of dissolved contaminants at the site are currently found in MW-37, which is the closest well to the nearby wetlands and Belcher Creek. No information is available to assess any potential impacts to wetlands. Contaminants would likely volatilize such that detection in surface water of wetlands would be unlikely. The contaminants at this site do not generally sorb strongly on sediments.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30/+50%), and these cost estimates have been prepared in a manner consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July 2000.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 DELINEATE CONTAMINATION IN OVERBURDEN AND BEDROCK TO THE EAST AND NORTHEAST

Based on the July 2001 sampling results, the well furthest downgradient to the east (MW-37), had levels of benzene and MTBE at 815 ug/L and 126 ug/L, respectively. MW-38, the bedrock well at this location, also has elevated contaminant levels. This is a concern for contaminant delineation in the overburden, and more importantly, in bedrock. The 1995 Alternative Analysis Report indicated that contamination could migrate in bedrock from the site toward potable supply wells to the northeast. This concern is not addressed by the current monitoring well network. We understand that installing additional wells to the east of MW-37/38 is difficult. At a minimum, an overburden and bedrock well pair should be installed about 500 to 1,000 feet north-northeast of MW-37/38 to serve as a sentinel well for migration toward Camp Hope and the Greenbrook Water Company wells. The cost for this well installation should be about $25,000.

In addition, water levels from bedrock and overburden wells should be analyzed on at least an annual basis, and piezometric and cross section maps should be produced to indicate the direction of ground water flow and contaminant migration laterally and vertically. This information should be included in the annual report discussed in Section 6.3.1. Naming bedrock wells with a “B” identifier (such as “MW-38B”) would assist in data analysis, reporting, and review efforts.

6.1.2 EVALUATE CAPTURE ZONE

A simple water budget analysis (presented earlier) indicates that the capture zone due to pumping at RW-13 is likely not wide enough to capture the width of the plume. Results of the pumping test in 1999 should be reviewed. A target capture zone should be clearly specified and illustrated, and this target capture zone should be consistent with the goals of the remedy. Additional evaluation of the capture zone should then be conducted, using various potential lines of evidence. In addition to a simple water budget analysis, potential lines of evidence that are appropriate for this site might include interpretation of potentiometric surface maps, evaluation of hydraulic gradients at well pairs, and evaluation of concentration trends at wells located downgradient of the target capture zone. This effort could require an initial expenditure of $10,000, plus an additional $3,000 per year thereafter.

6.1.3 SET UP MONITORING WELL SAMPLING PROGRAM

A regular ground water monitoring program should be initiated at the site. We recommend annual monitoring at select wells. The select wells should include the perimeter network (MW-33 through MW-42) plus MW-6, MW-16, MW-31, MW-24, MW-29, MW-26, MW-30, MW-32, and RW-13. Monitoring the wells upgradient of RW-13 will provide an indication of progress toward aquifer restoration, and monitoring wells downgradient of RW-13 should provide information with regard to capture and aquifer restoration.

NJDEP is currently contracting for quarterly sampling at 35 to 40 wells. The sampling program suggested above would have a total of 19 wells with a lower sampling frequency. This program might reduce sampling and analysis costs by about $10,000 to $15,000 per year.

6.1.4 VAPOR MONITORING AT NEARBY RESIDENCES

NJDEP has run the SVE system on and off to recover vapor and prevent vapor intrusion at residences on St. George Street, and there are and have been vapor monitoring points with alarms within four houses in this area. The monitoring points likely were based on lower-explosive limit (LEL) sensors and activated the secondary SVE blowers at specific residences. However, there does not appear to be any recent indoor air sampling events. It would seem reasonable that all of the houses with POET systems should have indoor air checked at least once, especially those that historically had relatively elevated concentrations in ground water or soil vapor on the property. This would involve sampling up to 19 houses. With sampling labor and analyses, this sampling event might cost $10,000.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 CLARIFY CONTRACTOR SCOPE

Activities at the site do not appear to be organized effectively enough to control costs systematically. Handex's engagement letter includes activities that are not occurring and "extra" activities occur frequently. This may cause difficulty in tracking costs relative to forecasts or budgets. The control also includes a significant expense in long-term equipment rental. The money spent on the rental of this equipment is likely more than enough to have purchased it. If P&T and SVE or other activities are to continue for several years, we encourage NJDEP to produce a clear scope of work for actual continuing regular activities, including reporting and contract with Handex based on the revised scope. Equipment that is currently rented and still needed should be available at a purchase price that is a fraction of the new cost. Any non-routine work, such as air-sparging testing, should be described in a brief work plan, and contractor assistance can be contracted as a contingent work order. The exact cost savings possible from this recommendation cannot be estimated.

6.2.2 EVALUATE CATALYTIC OXIDIZER USAGE AND GAC CHANGE-OUT FREQUENCY

The current influent vapor concentration to the catalytic oxidizer is relatively low and requires a significant electric usage to continue operating the system. Unless significant new vapor mass can be removed at the site, use of the catalytic oxidizer should be suspended. Vapor phase GAC units can be used to replace the catalytic oxidizer. At the estimated VOC removal rate of less than one pound per day, use of the vapor phase GAC should require less than $5,000 per year in comparison to the $30,000 per year in rental costs and about $8,000 per year in electric costs for the catalytic oxidizer. The predicted cost savings is approximately $33,000 per year.

With respect to the liquid phase GAC units, we did not find any documentation for the practice of changing out 12 GAC vessels per year. Influent concentrations and flow rates should be used to estimate the GAC change-out frequency. If the influent concentration remains at 1,500 ug/L or lower, monthly monitoring should be sufficient to evaluate breakthrough. Based on the July 2003 sampling at RW-13 (as discussed in Section 4.3.2), the change-out frequency should be reduced to 1-4 units per year.

If GAC replacements could be reduced to four per year, it would save at least $18,000 per year.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 START/IMPROVE REPORTING

Although this site is progressing toward cleanup and human health is apparently being protected, the lack of documentation of decisions and reporting of data is an issue. The lack of reports for this site (including treatment system operation data, such as effluent analysis, water pumped at each well, vapor extracted by well, and water level data) makes it extremely difficult to review this site for protectiveness, compliance with NPDES and air discharge requirements, and progress toward meeting cleanup goals.

At a minimum quarterly reports describing treatment system operation (wells pumped, flows, SVE wells operated, vapor concentrations) with sampling results should be produced, and annual reports with ground water concentration data/trends and capture zone evaluation should be produced. Handex is being paid for project overview which should include some reporting requirements. However, we will assume that additional funding of $15,000 per year will be needed to produce useful reports.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

6.4.1 DEFINE EXIT STRATEGY

Remediation efforts have made significant progress in reducing contaminant concentrations at the site, but mass removal rates have decreased considerably. The site remediation progress is at a good stage to define and evaluate the current state of the site and determine what will be necessary to suspend active treatment system operations.

The site project manager is already using air sparging tests to determine if there are any remaining areas where significant amounts of contaminant mass can be removed. Once this effort has concluded, an evaluation should be made as to whether or not aquifer restoration is possible with the current approach of P&T plus SVE. If so, a time frame for shutting down the system should be estimated, and a specific monitoring program to indicate when the system can be shut off (including post-shut-down monitoring) should be determined. In addition, a plan for delineating and remediating (actively or passively) contamination downgradient of the RW-13 capture zone should be developed. Review and development of this strategy should require about $8,000.

6.5 SUGGESTED APPROACH TO IMPLEMENTATION

All the recommendations are relatively straightforward and easily to implement. Using the information from the delineation efforts associated with 6.1.1, the monitoring results from 6.1.3, and useful reports (Section 6.3.1) will allow effective analysis for defining an exit strategy (Section 6.4.1). If this strategy includes capturing ground water upgradient of RW-13, then analysis of the capture zone (Section 6.1.2) should be conducted and additional actions may then be required.

7.0 SUMMARY

The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations to improve the effectiveness of the system include further delineation of ground water impacts beyond MW-37 and MW-38, performing capture zone analysis (including the development of a target capture zone), formalizing a well sampling program, and conducting vapor monitoring at nearby residences. Recommendations to reduce costs include clarifying the scope of the site contractor, switching from the catalytic oxidizer to vapor phase carbon, and reducing the frequency of GAC changeouts. A recommendation for technical improvement is to begin more formal reporting regarding the status and progress of the system. A recommendation for site closeout is to start formulating a site-specific exit strategy that includes an estimated time frame for shutting down the system, and a specific monitoring program to indicate when the system can be shut off (including post-shut-down monitoring). All of these recommendations can be easily implemented, and a prioritization of the recommendations is provided.

Table 7-1 summarizes the costs and cost savings associated with each recommendation in Sections 6.1 through 6.4. Both capital and annual costs are presented. Also presented is the expected change in life-cycle costs over a five-year period for each recommendation both with discounting (i.e., net present value) and without it.

Table 7-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-cycle Costs ($) [1]	Estimated Change in Life-cycle Costs ($) [2]
6.1.1 Delineation to the Northeast	Effectiveness	$25,000		$25,000	$25,000
6.1.2 Evaluate Capture Zone	Effectiveness	$10,000	$3,000	$25,000	$23,600
6.1.3 Set up a Monitoring Program (*)	Effectiveness		($12,500)	($62,500)	($57,000)
6.1.4 Residence Vapor Monitoring	Effectiveness	$10,000	$0	$10,000	$10,000
6.2.1 Clarify Contractor Scope	Cost	not quantified	not quantified	not quantified	not quantified
6.2.2 Evaluate Catalytic Oxidizer Usage and GAC Change-out Frequency	Cost		($51,000)	($255,000)	($232,000)
6.3.1 Reporting	Technical Improvement		$15,000	$75,000	$68,000
6.4.1 Exit Strategy	Gain Site/System Closeout	$8,000		$8,000	$8,000

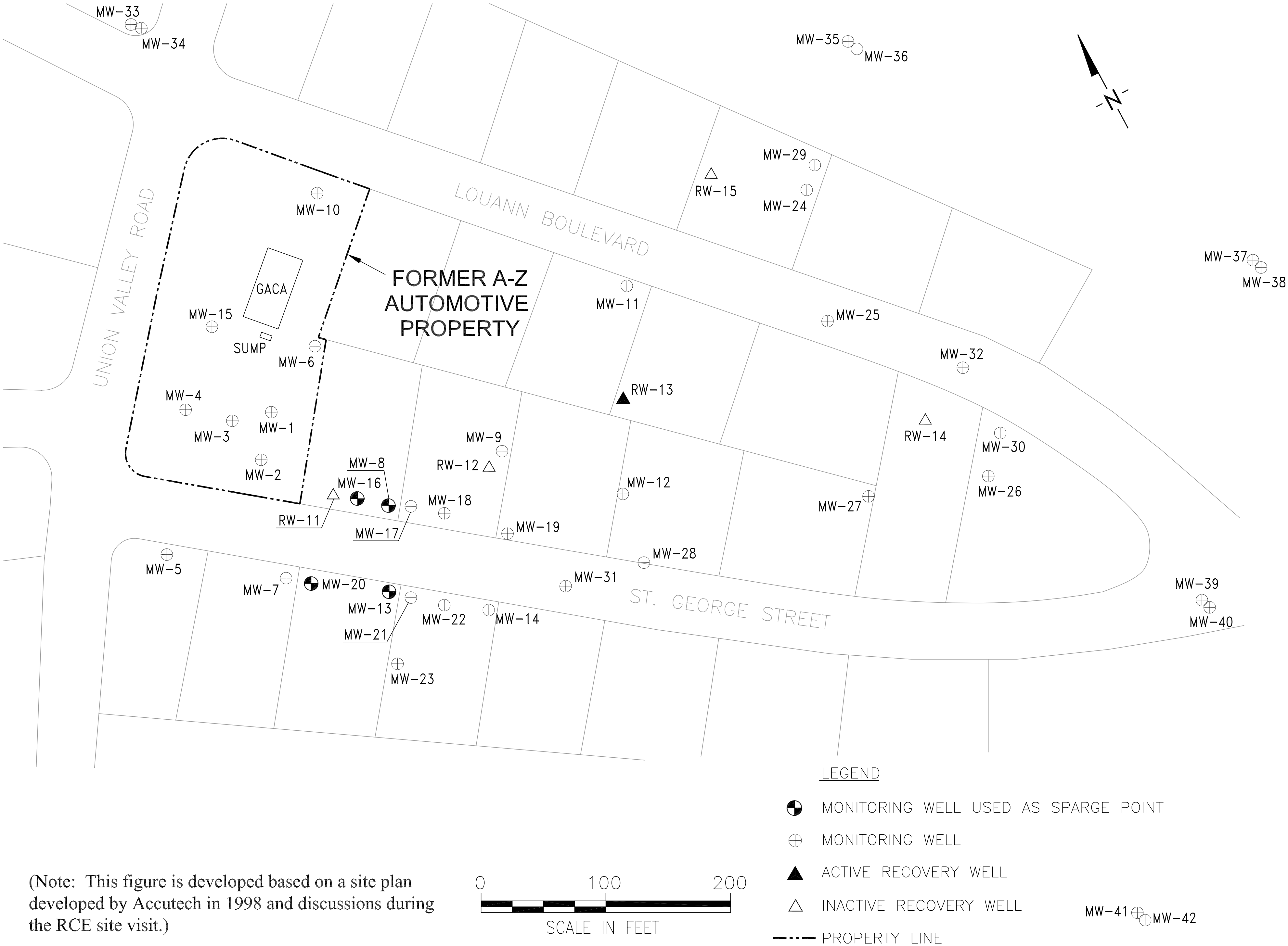
Costs in parentheses imply cost reductions.
[1] assumes five years of operation with a discount rate of 0% (i.e., no discounting)
[2] assumes five years of operation with a discount rate of 5% and no discounting in the first year
(*) Calculated savings vs. existing proposed sampling (not actual sampling program)

FIGURES

FIGURE 1-1. SITE LOCATION MAP

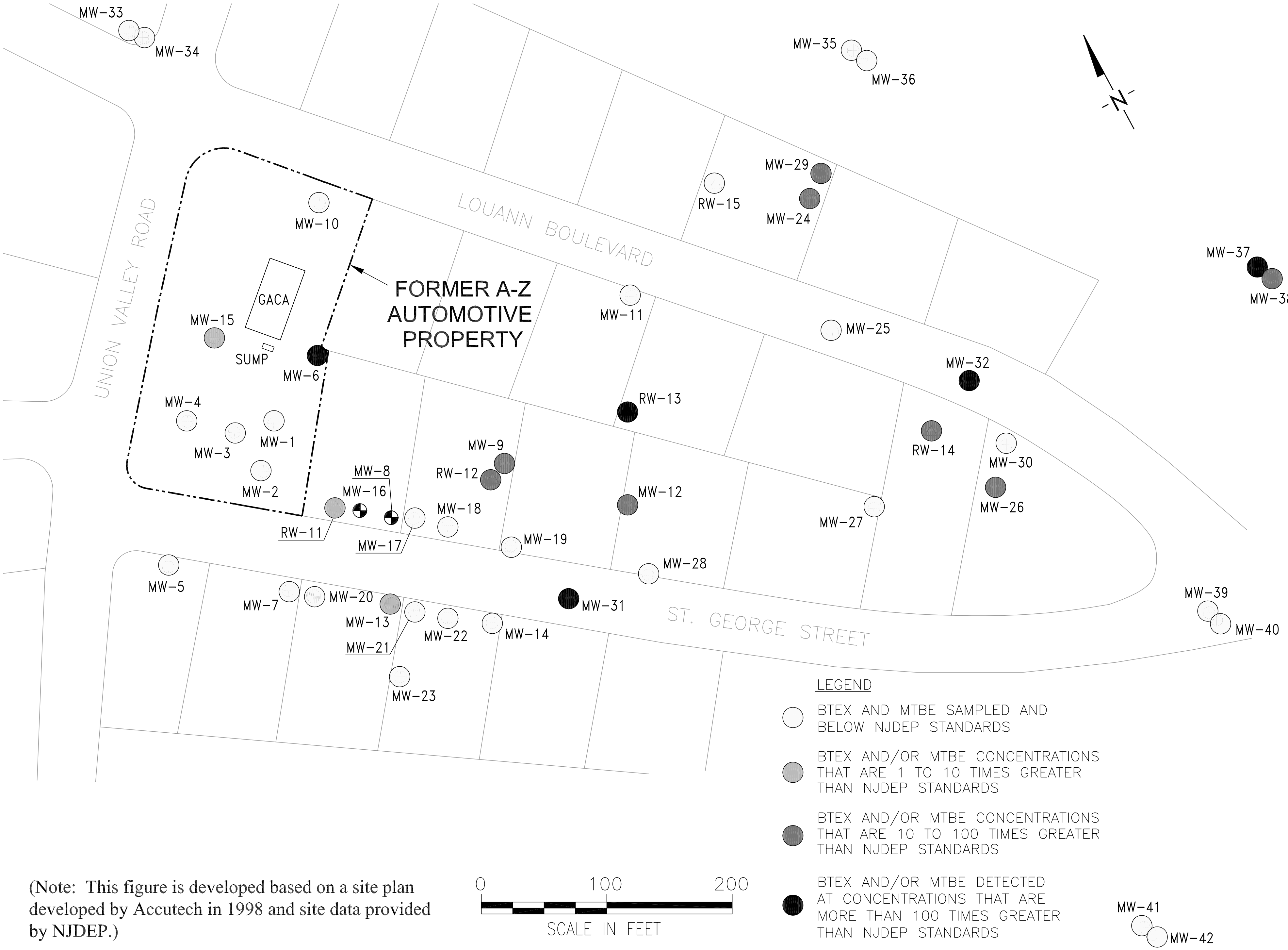
(Note: This figure is taken from Greenwood Lake, NY-NJ U.S.G.S. Quadrangle, 1954

FIGURE 1-2. WELL LOCATION MAP



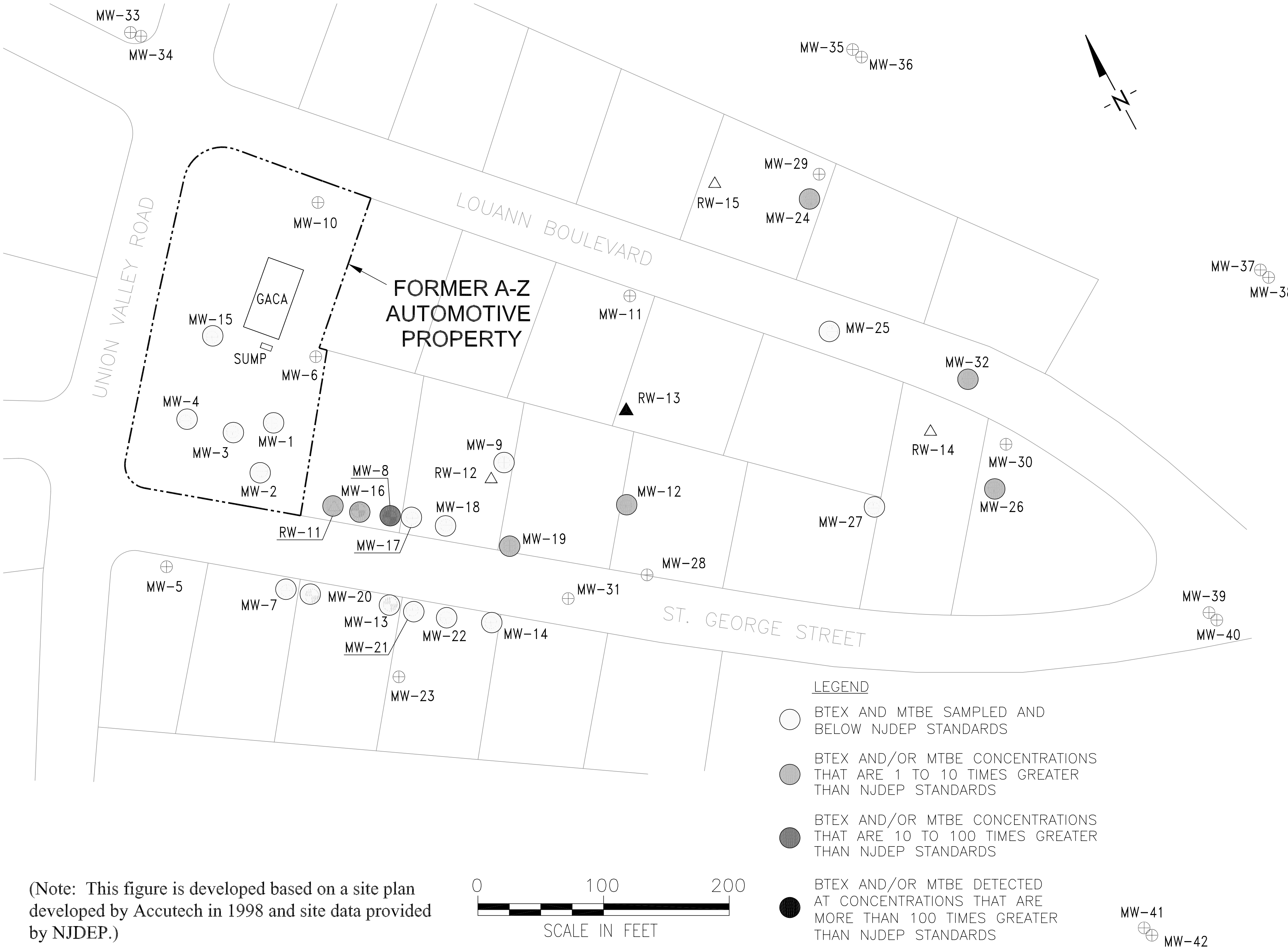
(Note: This figure is developed based on a site plan developed by Accutech in 1998 and discussions during the RCE site visit.)

FIGURE 1-3. EXTENT OF VOC CONTAMINATION IN MAY 2001



(Note: This figure is developed based on a site plan developed by Accutech in 1998 and site data provided by NJDEP.)

FIGURE 1-4. EXTENT OF VOC CONTAMINATION IN JULY 2003



(Note: This figure is developed based on a site plan developed by Accutech in 1998 and site data provided by NJDEP.)