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Formerly Utilized Sites Remedial Action Program (FUSRAP)

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# ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

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**US Army Corps  
of Engineers®**

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# MAYWOOD SITE GROUNDWATER EVALUATION

MAYWOOD, NEW JERSEY

MAY 1996

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U.S. Department of Energy  
Oak Ridge Operations Office  
Formerly Utilized Sites Remedial Action Program

## Introduction

The distribution and migration of contaminants in groundwater at MISS can be explained by a relatively simple conceptual model. Contaminants that have low mobility in groundwater because of chemical reactions with minerals, have remained close to the sources of contamination (the retention ponds). Those that are not mineral reactive are relatively mobile have migrated away from the sources and now form plumes of contaminated groundwater in the bedrock aquifer. Low mobility chemicals that occur above MCLs are chromium, arsenic, and lead; these chemicals contaminate groundwater close to the former ponds in the overburden but have not migrated to bedrock groundwater (Fig. 1). More mobile chemicals—lithium, boron, and volatile organic compounds (VOCs) (which exceed MCLs)—have migrated from retention ponds into the bedrock groundwater (Fig. 2). Radionuclides (uranium isotopes) have only been detected sporadically in one well once on the DeSaussure property and do not exceed MCLs.

## Hydrogeology of the Maywood Site

The formations underlying the Maywood and Lodi properties are divided into two stratigraphic units: a bedrock unit composed of interbedded, well-centered sandstone and siltstone (Passaic Formation), and an overlying section of unconsolidated clastic materials. These units are separated by an erosional unconformity. The surface of the bedrock unit was extensively eroded by both glacial and fluvial processes, and the unconsolidated sediments overlying the bedrock surface are composed of clastic materials deposited by these processes (glacial till).

Groundwater flow in the unconsolidated sediments occurs through primary porosity and is largely gradient dominated. Conversely, because of lack of significant primary (matrix) porosity, groundwater in the competent bedrock is principally along fractures. Recharge to the overburden occurs throughout the site. Through the middle section of the site, a downward vertical flow component exists from the overburden to the bedrock. Recharge to the bedrock occurs at the groundwater divide and from the overburden (Figs. 1 and 2). To the southwest, the vertical component reverses, with an upward hydraulic gradient from the bedrock to the overburden. The predominant direction of flow of the groundwater system in the shallow unconsolidated sediment/bedrock is southwest toward the Saddle River. The hydraulic gradients in the bedrock and unconsolidated sediments are generally low.

## VOC Contamination in Groundwater

Conclusions for VOC contamination of groundwater at MISS have not changed significantly over the last three years. Data obtained during that time frame support most of the previous conclusions.

Tetrachloroethene (PCE) is the main VOC contaminant at MISS and, in the absence of organic matter in the subsurface, is generally mobile in groundwater. Contamination is primarily located in bedrock wells MISS-1B, -4B, -5B, -7B, B38W14D, B38W15D, and in downgradient shallow wells B38W14S, B38W15S, and MISS-7A (Fig. 3). In general, concentrations of VOCs have increased since the introduction of low flow sampling. This would be expected, and the results are probably more representative of true groundwater concentrations, as this method causes less turbulence in the groundwater during sampling. With the exception of MISS-5B, the VOC contaminants are PCE and its breakdown products—TCE and vinyl chloride. MISS-5B is contaminated with BTEX compound, however, the total BTEX concentrations between 1993 and 1995 are low (83  $\mu\text{g/L}$  - 170  $\mu\text{g/L}$ ).

The VOC plume at MISS is located in the bedrock wells and further downgradient (Ballod property) in both bedrock and shallow wells. This could be a function either of more contamination in the shallow groundwater from the former ponds on Ballod or transport of VOCs in the bedrock upward into the shallow groundwater with ultimate discharge to surface water (Fig. 2). Surface water from Westerly Brook had low concentrations of PCE breakdown products that the RI attributed to other sources.

The wells with the highest concentrations of PCE are located the furthest downgradient (B38W14S, B38W14D, and B38W15D). The extent of the PCE plume downgradient from MISS and Ballod has not been defined. The site conceptual model for groundwater flow at MISS includes flow in the bedrock aquifer toward the Saddle River, and it is likely that this PCE plume extends further downgradient of where current monitoring wells are located. The conceptual model also includes discharge of bedrock groundwater to surface water bodies so the likely ultimate fate of PCE in bedrock groundwater is to be discharged into Westerly Brook or the Saddle River.

**Conclusions:** A plume of groundwater contaminated with PCE and its daughter products exists in bedrock below MISS and Ballod. This plume is probably contiguous beneath the former retention ponds. The extent of the PCE plume downgradient has not been defined and needs to be characterized (refer to Attachment 1 for proposed field activities). Based on the hydrogeological conceptual model in the RI, the fate of PCE contaminated groundwater is likely to be downgradient transport to Westerly Brook or the Saddle River. Additional data are needed to proceed with evaluating remedial strategies for VOCs in groundwater. These data are needed to define the extent of the groundwater plume. Attachment 1 contains a summary of the proposed additional data collection to define the extent of this plume.

### Metal Contamination in Groundwater

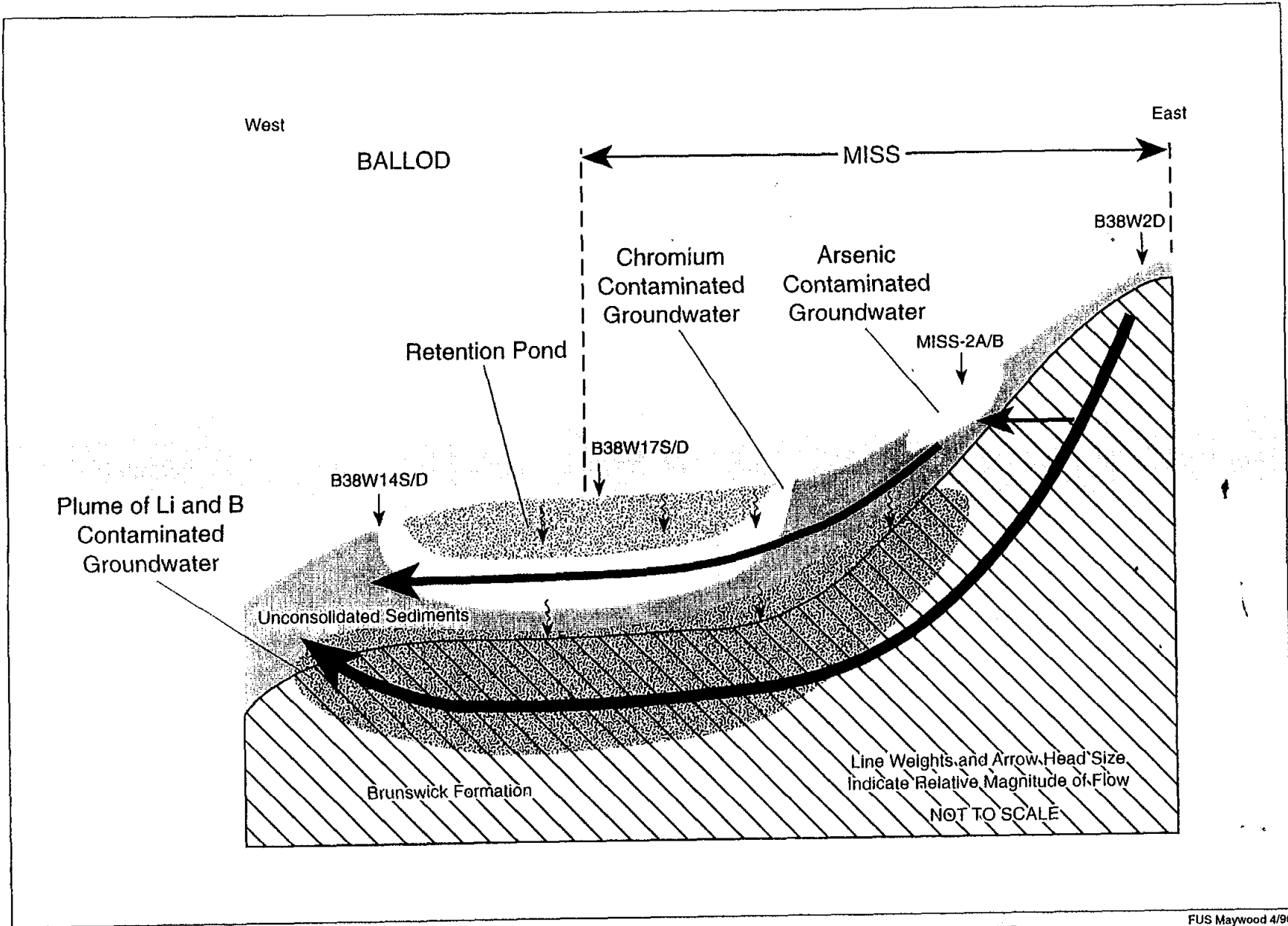
Conclusions for metal contamination of groundwater have not changed over the last three years. Data obtained during that time frame support most of the previous conclusions. The following is a summary:

- Metals that have occurred above MCLs are (1993 to 1995 sampling only, Fig. 4):  
arsenic (SDWA MCL = 50 µg/L, NJGQS = 8 µg/L) - 2 to 93 µg/L (MISS-2A - 6,000 µg/L),  
chromium (SDWA MCL = 100 µg/L) - 5 to 285 µg/L,  
iron (NJGQS = 300 µg/L) - 32 to 116,000 µg/L,  
lead (SDWA MCLG = 15 µg/L, NJGQS = 10 µg/L) - 2 to 37 µg/L, and  
manganese (NJGQS = 50 µg/L) - 9 to 63,100 µg/L.
- The background well (B38W02D) contains elevated concentrations of manganese, iron, and aluminum. These mineral reactive metals are common components of the sandstones that constitute the bedrock aquifer, occurring usually as oxide coatings on the surface of mineral grains. The occurrence of these metals in elevated concentrations in the bedrock wells and in the overburden wells can be attributed in most cases to fine grained minerals entrained in the sample. The iron/manganese/aluminum coatings of these minerals will tend to dissolve into solution when the sample is acidified.
- Use of low flow sampling has reduced the concentrations of iron and aluminum in the background well. However, concentrations of manganese remain high, suggesting that this metal is present

in fine colloidal material or is dissolved. Bedrock wells have concentrations of manganese ranging from ~0.5 to 7.5 mg/L. The background well has a concentration range of 1.2 - 2.5 mg/L (NJGQS = 50 µg/L).

- Mineral reactive metals (aluminum, chromium, iron, and lead) occur as contaminants mainly in the overburden wells, in particular MISS-2A (arsenic - 6,000 µg/L and chromium 141 µg/L), MISS-1AA (chromium - 285 µg/L), MISS-7B (arsenic - 62 µg/L), and B38W17A (chromium - 21,000 µg/L) (Fig. 4). With the exception of MISS-2A these wells are associated with the former retention ponds. Concentrations of chromium in samples taken in 1994 and 1995 range from 36 to 285 µg/L. Use of low flow sampling in 1994 and 1995 has resulted in lower concentrations of these metals: the concentrations of chromium are approximately half those from pre-1994 samples.
- Other metals that occur in elevated concentrations on MISS are lithium (50 - 14,000 µg/L) and boron (56 - 2080 µg/L). Lithium and boron are both elevated above background in bedrock and are attributed to contamination from MISS (Figs. 5 and 6). These metals are mobile because they do not tend to react with minerals and have migrated away from the retention ponds into the bedrock. There are no MCLs for either lithium or boron in groundwater.

**Conclusions:** Use of low flow sampling has helped to reduce concentrations of some metals. However, the general distributions of metals are the same as in 1991 and the conclusions have not changed. Arsenic and chromium exceed MCLs in the overburden and are most likely attributed to metal contamination of groundwater by the retention ponds and contaminated soils. Manganese exceeds MCLs in most bedrock wells but is attributed to natural phenomena and not to MISS. Elevated concentrations of lithium and boron are attributable to MISS. Concentrations of arsenic and chromium in groundwater in the overburden close to the Retention Ponds will probably continue to sporadically exceed MCLs in the future. No additional data are needed to proceed with evaluating remedial strategies for metals in groundwater.



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Fig. 1. Conceptual Model for Metal Contamination of Groundwater at MISS

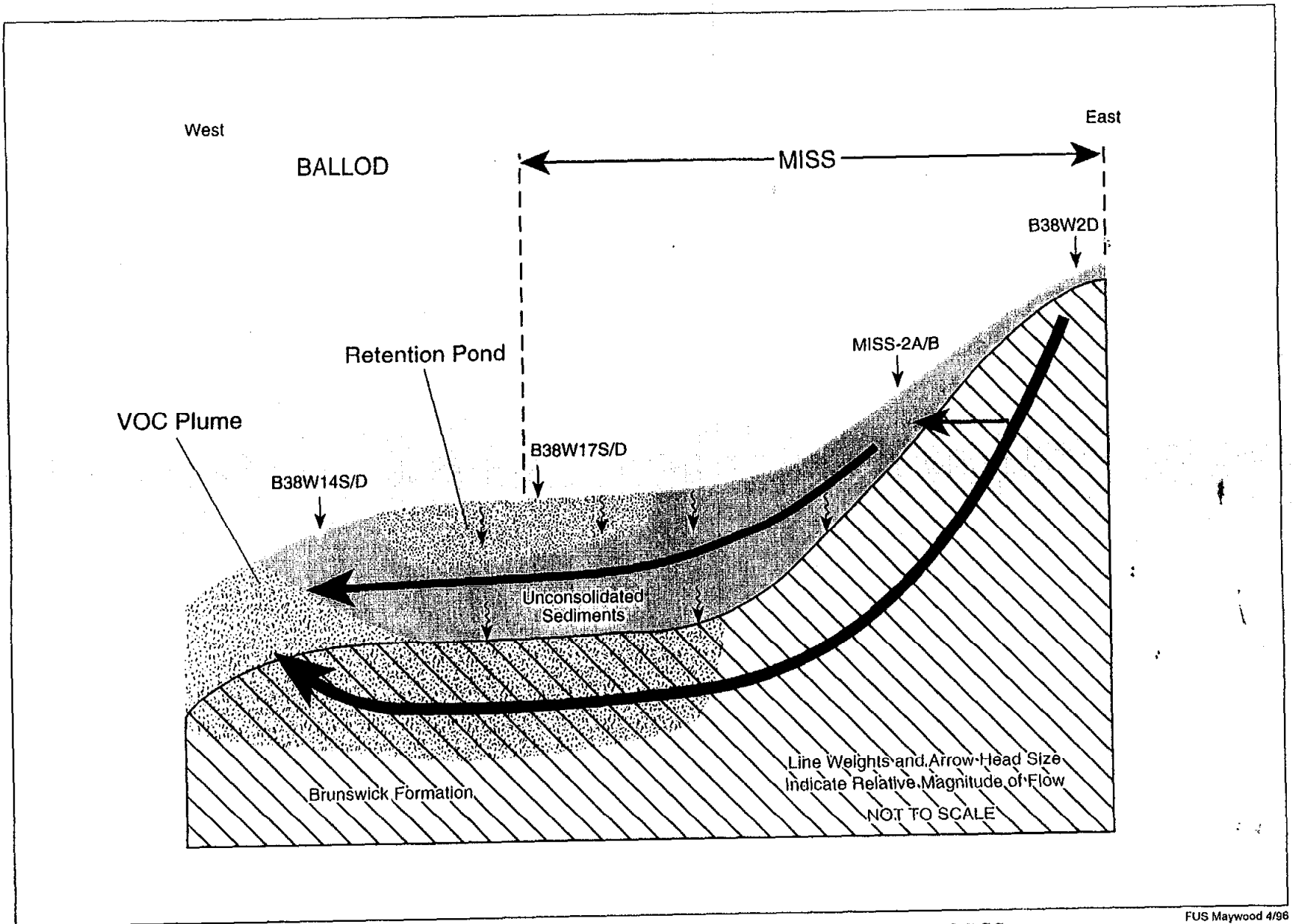


Fig. 2. Conceptual Model of VOC Contamination of Groundwater at MISS

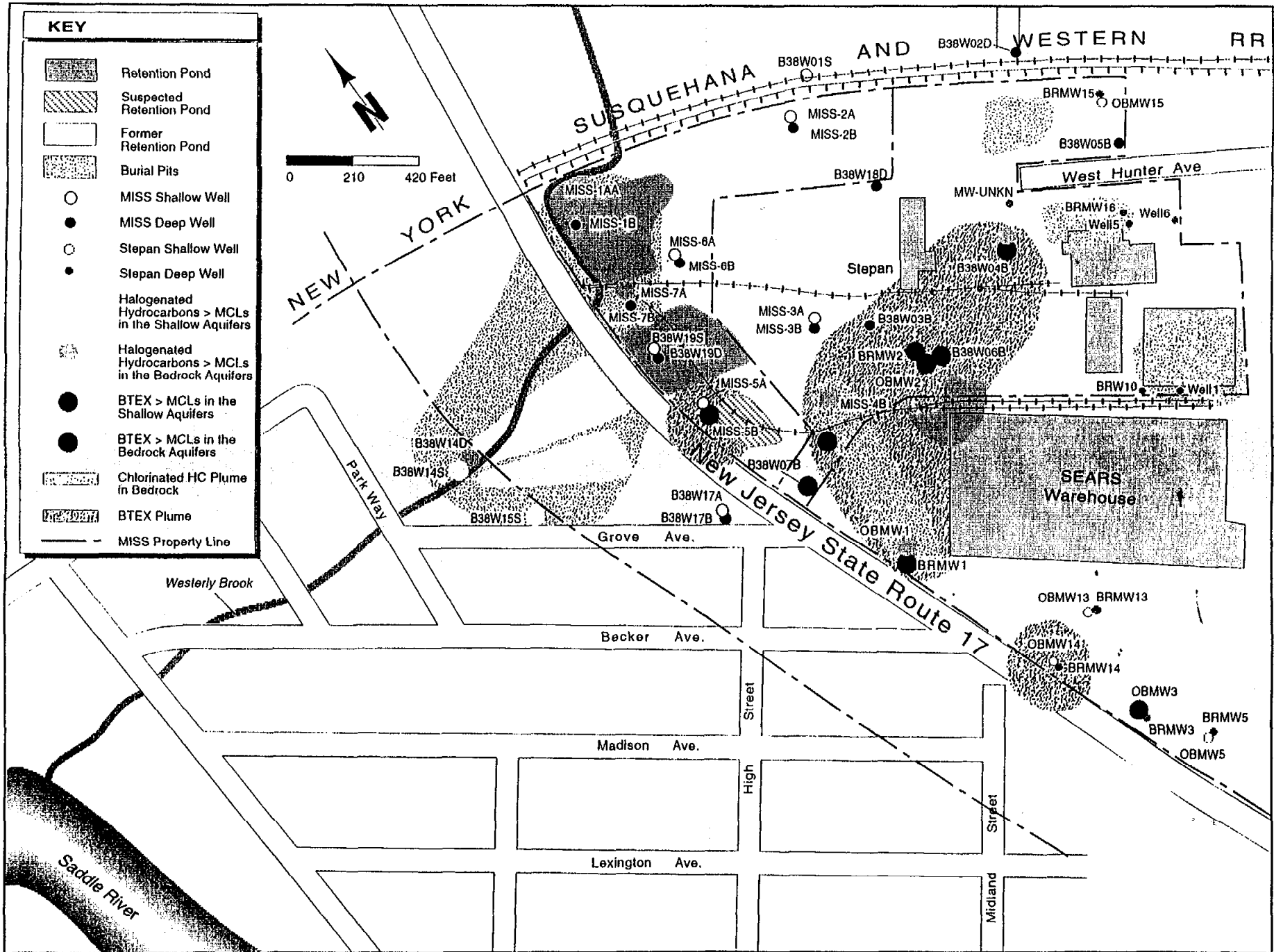


Fig. 3. VOC Contamination in Groundwater (Shallow and Deep Differentiated)



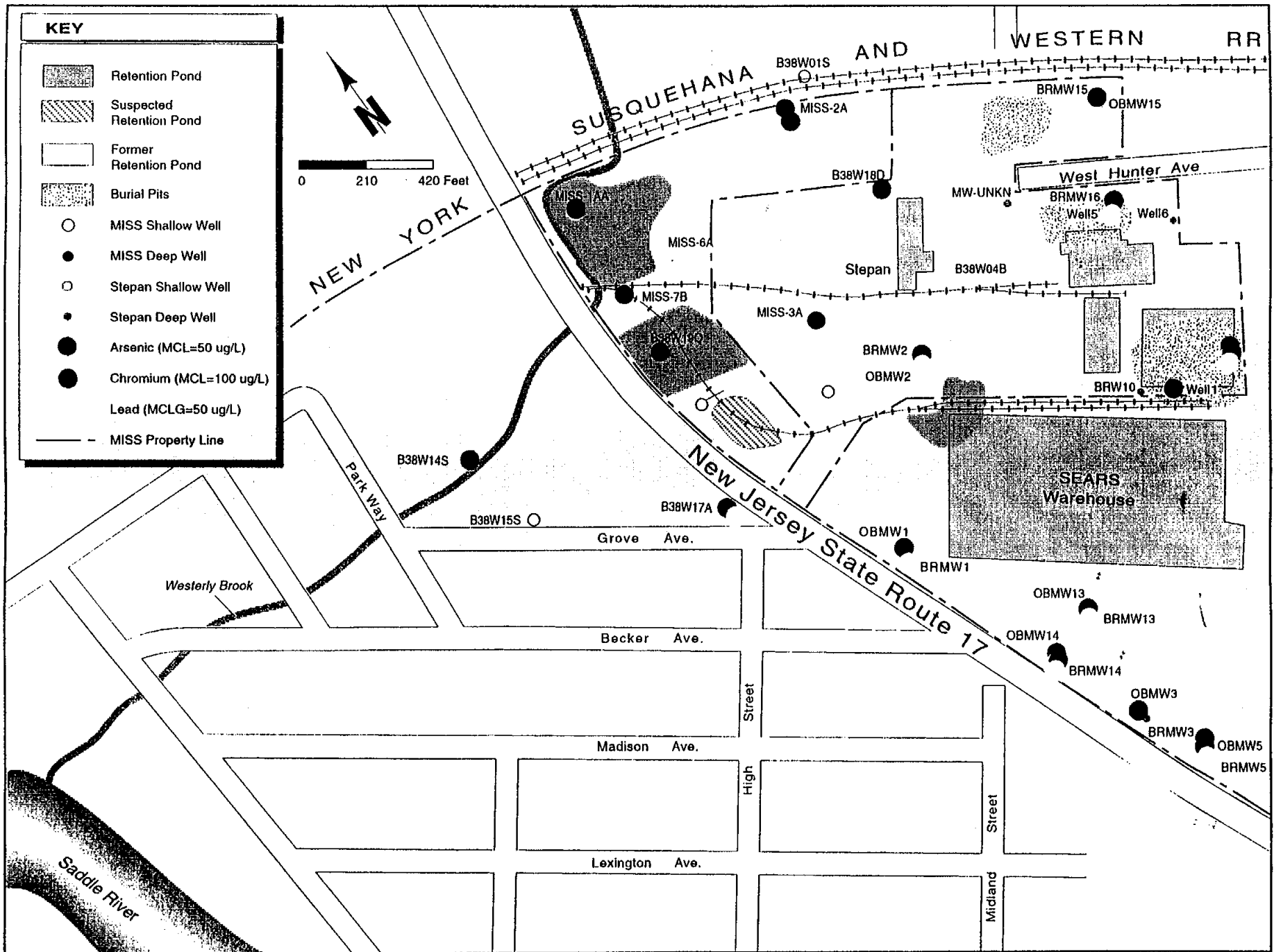


Fig. 4. Arsenic, Chromium, and Lead in the Shallow Aquifer

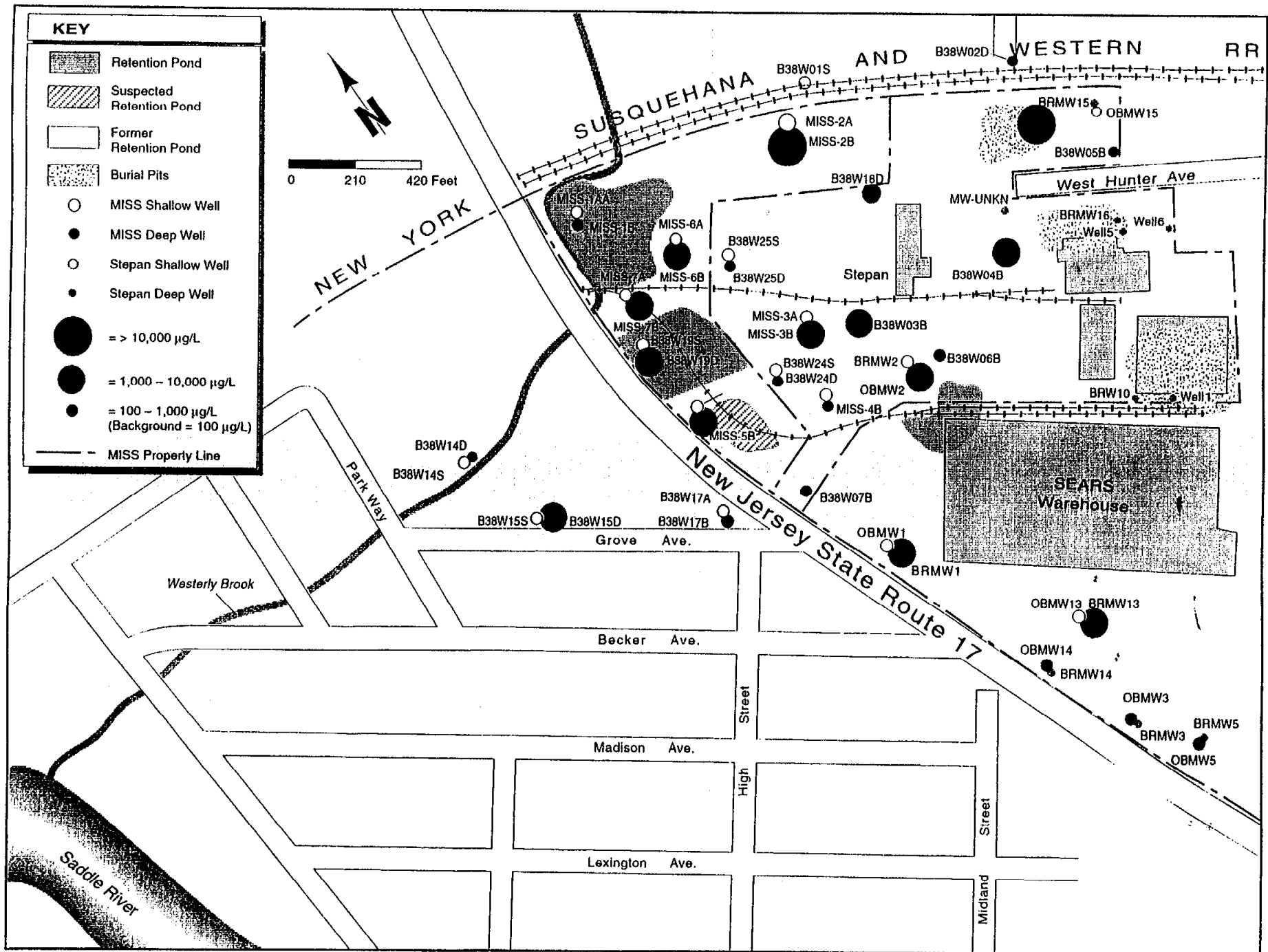


Fig. 5. Lithium Contamination in Groundwater (Shallow and Deep)

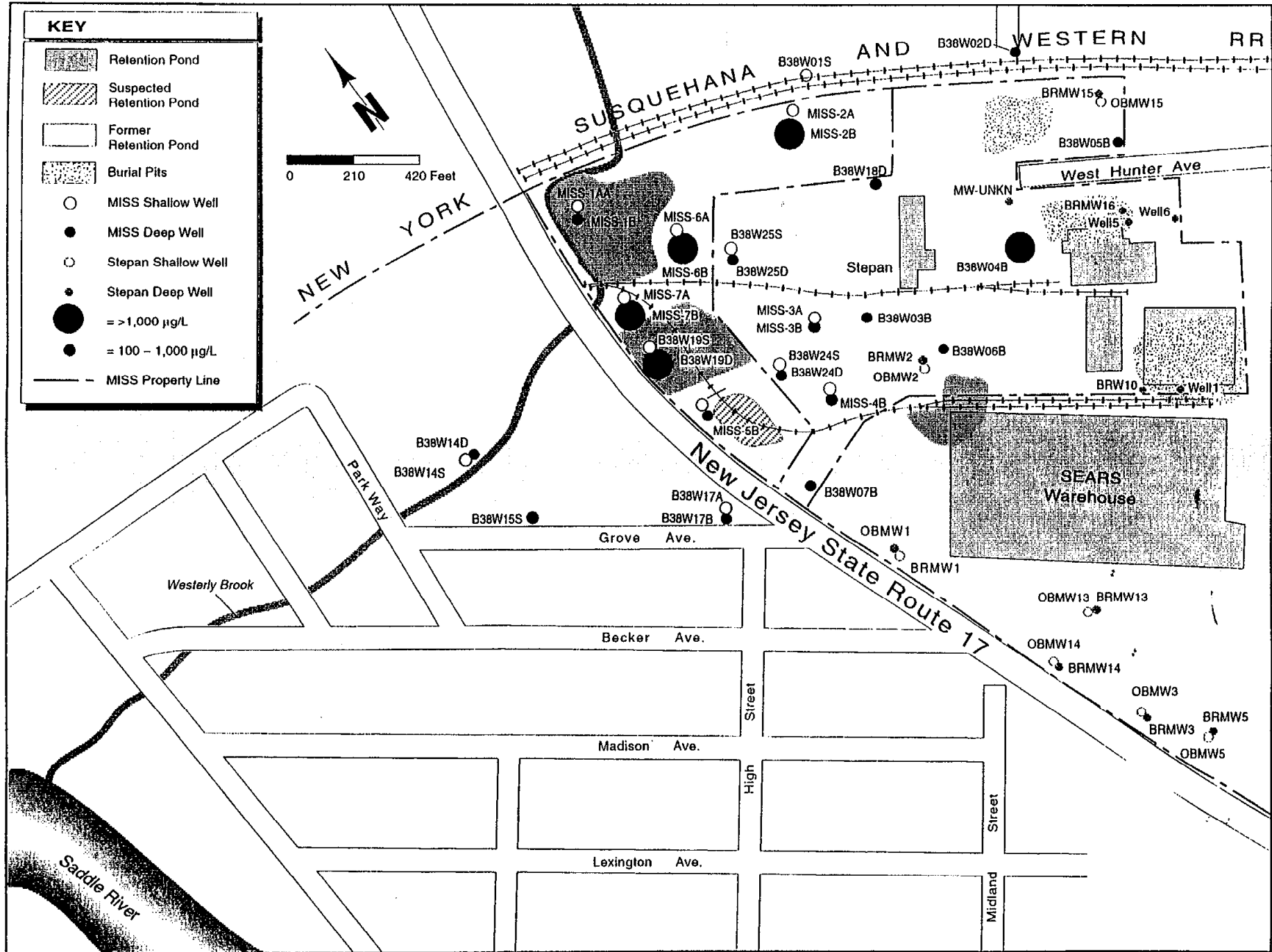


Fig. 6. Boron Contamination in Groundwater (Both Shallow and Deep)

**Attachment 1**  
**Proposed Characterization PCE Groundwater Plume at MISS**

The proposed characterization of the PCE plume at MISS has two main components: screening sampling over a wide area to delineate the plume and limited confirmatory sampling to fully characterize the plume geochemistry and to confirm the results of screening sampling.

The rationale for sampling is based on the conceptual model for movement of VOCs in groundwater at MISS. The initial screening investigation uses rapid and cost effective field techniques to guide the installation of more costly bedrock monitoring wells. The aim is to limit to a minimum the number of bedrock monitoring wells needed to define bedrock groundwater contamination and to provide optimum locations for those wells. Figure 7 outlines the decision making process for determining geoprobe sampling and monitoring well locations.

It is assumed that downgradient of MISS and Ballod, groundwater in bedrock that may be contaminated with VOCs is discharging to shallow groundwater. Thus, the presence of VOC contamination in bedrock groundwater can be anticipated by the extent of VOC contamination in shallow groundwater. The screening level investigation of PCE contamination in the shallow groundwater will be a quick and cost effective manner to provide a mechanism for estimating the extent of contamination in bedrock. In addition to investigating shallow groundwater contamination, new bedrock wells will be used to confirm the presence or absence of PCE in bedrock groundwater introduced by the screening. The intent of the bedrock monitoring wells will be to confirm the assumptions made about VOC movement in groundwater at MISS in developing this sampling rationale.

The following is a brief description of the proposed sampling strategy.

### **Screening Sampling**

Screening sampling will consist of a combination of passive soil gas survey and push probe sampling of shallow groundwater with on-site analysis for VOCs (Fig. 8). These two methods combined an interpretation with results that account for geological conditions and provide a rapid and reliable way to delineate the VOC plume in shallow groundwater with as little intrusion as possible. The following are details of the proposed sampling:

**Soil Gas Survey.** A passive soil gas survey will be conducted over the area between MISS and the Saddle River. This method will be used to delineate possible VOC soil and groundwater contamination at and downgradient of MISS. Soil gas surveys provide a non-intrusive technique for locating and identifying subsurface VOC contaminants. Passive, time-integrative soil gas systems, as opposed to active probe systems, are suggested for this task because of easy, low-profile sample collection and more reliable analytical results. Passive, time-integrative soil gas collectors are easily deployed in shallow holes (6 in. to 1 ft) or on the surface and are unobtrusive. Collectors can be safely deployed in roads or sidewalks. Approximately 125 soil gas collectors would be used for a survey of this extent. Spacing for these collectors would be generally situated in a grid with ~300-ft spacing, depending on the presence of surface features and site access in the survey area. If access to private properties in the survey area is not available, the survey could be conducted only on roads or easements, but with less reliable results.

After a period of time in the ground (usually one day to one week) the collector is retrieved and sent to a laboratory for analysis by mass spectroscopy or gas chromatography/mass spectroscopy. Soil gas survey results should be used as a qualitative indication of the presence and relative concentrations of target analytes in the subsurface. The flux rates are mapped across the survey grid to display the possible lateral extent of target analytes across a site and provide a strategy for intrusive soil and/or groundwater sampling with quantitative results for verification of a subsurface contaminant plume.

**Push Probe Sampling.** Push probes will be used to obtain samples of soils and groundwater in the overburden. Previously identified sample locations close to the MISS boundary line will be used to confirm the absence of VOCs in shallow groundwater immediately downgradient of MISS. Up to two lines of push probe wells are proposed. It is anticipated that this configuration will be sufficient to confirm the presence or absence of PCE or overburden groundwater in this area. The lines of wells will target shallow groundwater in the area of discharge of the bedrock VOC plume and will be used to confirm the soil gas results and define the concentrations of VOCs in groundwater. It is anticipated that a maximum of 15 push probe sample points will be required for these lines. In addition, push probe borings will be made to investigate likely soil contamination identified by the soil gas survey. The locations of push probe borings on Fig. 8 are representative of the likely configuration. The details of the push probe locations will be decided by the field geologist after the results of the soil gas survey are complete.

**Sampling Westerly Brook.** Screening samples of surface water (maximum of five) will be taken along Westerly Brook to determine discharge points for groundwater. Samples will be analyzed for VOCs using the onsite lab.

### **Confirmatory Sampling**

Up to five monitoring well pairs (overburden and bedrock) or bedrock wells will be installed, depending on the results of the screening analyses. A bedrock well will be located adjacent to the MISS property line on Ballod to evaluate bedrock VOC contamination at this location (Fig. 8). This well will be targeted on the bedrock low in this area identified in the RI. Potentially, one to five well pairs will be installed to monitor the VOC plume or the absence of contamination in bedrock and shallow groundwater downgradient of the MISS site. The locations of these wells will be determined by the results of the screening analysis. Groundwater samples will be analyzed for a full suite of metals, cations, anions, and VOCs. In addition, parameters needed to evaluate potential bioremediation options (e.g., dissolved oxygen) will also be determined. Samples of soils from each boring will be analyzed for bulk soil parameters and additional parameters needed to evaluate potential bioremediation options. Two samples of surface water from Westerly Brook will be sent for full suite analysis to define the extent of chemical contamination of this stream from groundwater downslope.

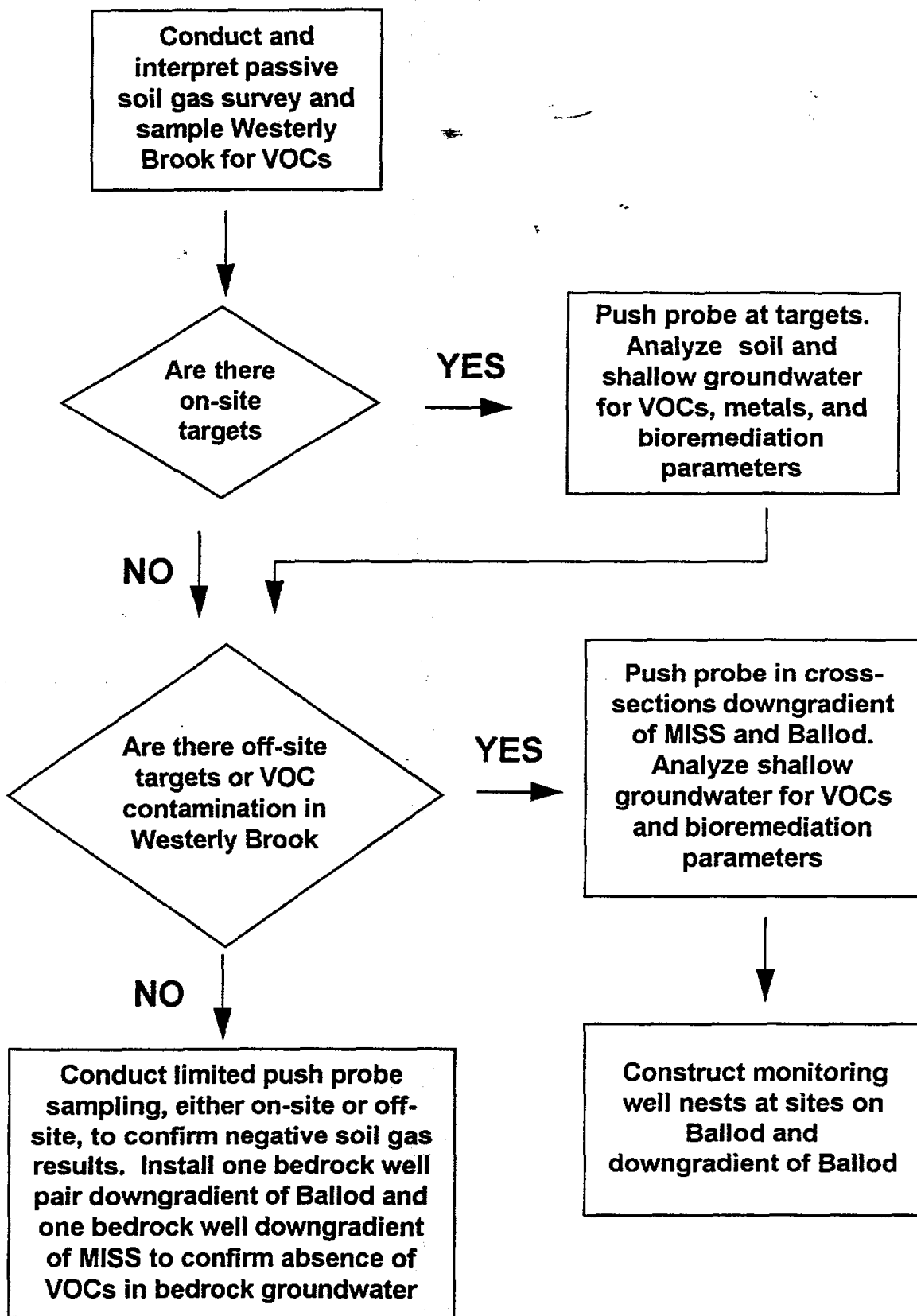


Fig. 7. Decision Flow Chart for Sampling at MISS

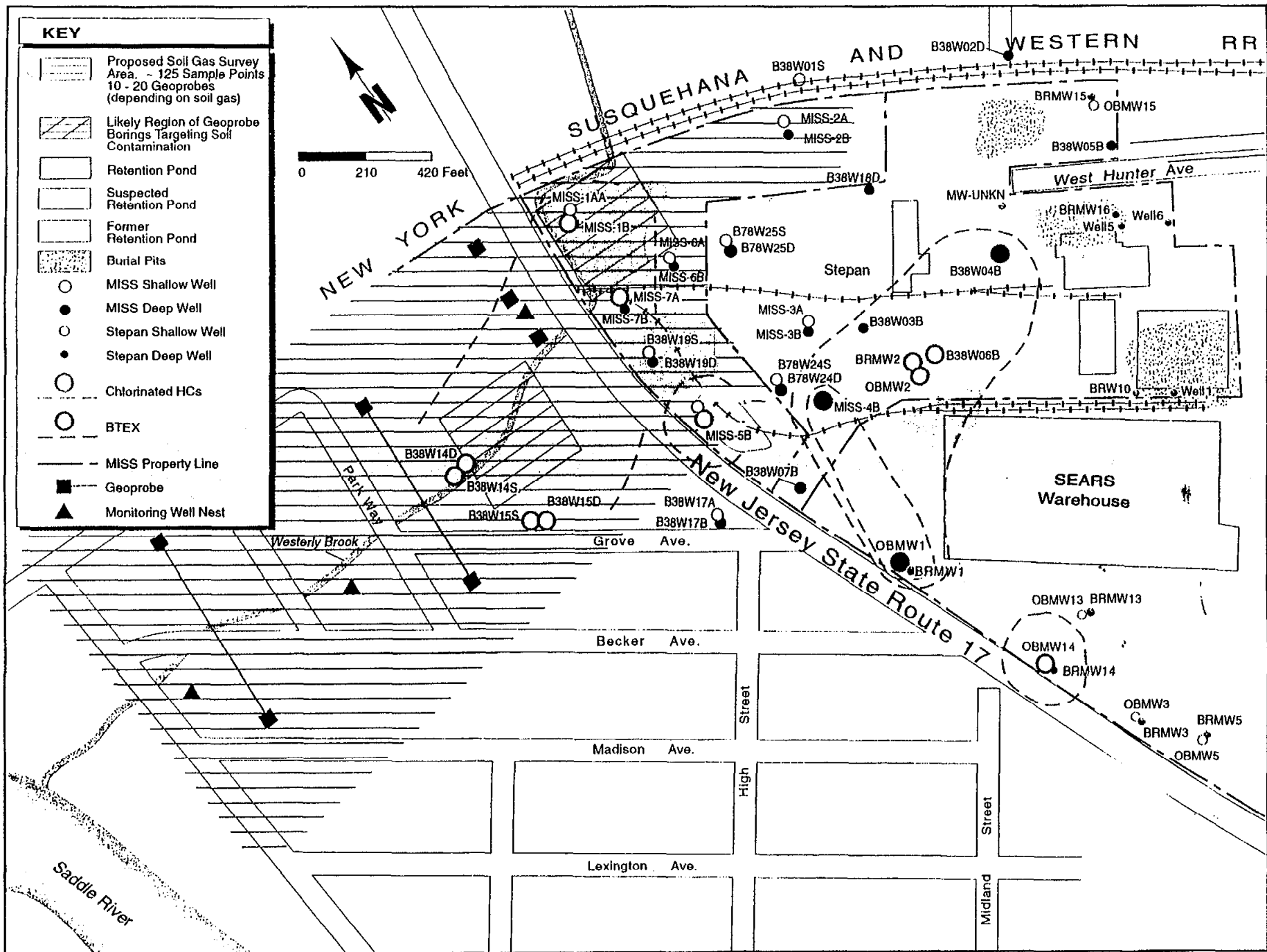


Fig. 8. Proposed Sampling Locations for Defining the VOC Plume