



**Proposed Work Plan
Site Investigation/Treatability Study
Sherwin-Williams Plant, Emeryville, California**

June 8, 1990
1563.02

Prepared for:

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CONSULTING ENGINEERS AND HYDROGEOLOGISTS

June 8, 1990

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Mr. Tom Gandesbury
RWQCB
1800 Harrison St. Suite 700
Oakland, CA 94612

Subject: Workplan for Proposed Treatability Study for Interim Remedial Measures and Additional Site Characterization at the Sherwin-Williams Emeryville Plant

Dear Tom:

Enclosed is a copy of a workplan for activities we discussed in our meeting with you and representatives of Sherwin-Williams Company on May 9, 1990.

The proposed workplan outlines the information collected to date and identifies the approach to evaluating and selecting a suitable interim remedial measure for the site.

The workplan also identifies some additional data collection such as the collection of soil samples on-site and a "B" zone well for water-level observation, along with other proposed additional investigations. Please take a look at the proposed well location for both shallowest ground water and the "B" zone. We are aiming to install these wells the last week of June to coincide with quarterly sampling. We would like your concurrence on the location and installation methods prior to proceeding. We will call you the week of June 18, 1990 to get your comments.

In the meantime if you have any questions please give either of us a call.

Sincerely,

Charles Panchini
for

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Project Hydrogeologist

John M. Lambie

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May 23, 1990

LF-1563.02

**PROPOSED WORK PLAN
SITE INVESTIGATION/TREATABILITY STUDY
SHERWIN-WILLIAMS PLANT, EMERYVILLE, CALIFORNIA**

1.0 INTRODUCTION

This Site Investigation/Treatability Study Work Plan ("the Work Plan") has been prepared for The Sherwin-Williams Company ("Sherwin-Williams") for the interim remediation of soil and ground water affected by the release of certain chemical compounds at the Sherwin-Williams Plant in Emeryville, California ("the Site"). The location of the Site is shown in Figure 1.

Chemical compounds have been reported to be present in soil and ground water as a result of a phased environmental investigation of the Site. (See Levine·Fricke, July 17, 1989, "Results of Environmental Investigation, Sherwin-Williams Plant, Emeryville, California"; and Levine·Fricke, April 4, 1990, "Results of Second Phase of Environmental Investigation, Sherwin-Williams Plant, Emeryville, California.") This investigation was voluntarily initiated by Sherwin-Williams upon the closure and dismantling of two former tank farm facilities, which included a former oils tank farm and a former solvent tank farm. The results of both the first and second phases of environmental investigation have provided considerable information regarding the types of compounds present, the areas of greatest concentrations, and the lateral and vertical extent of affected soil and ground water.

The first phase of this environmental investigation identified chemical compounds in three general areas of the Site: the former solvent tank farm area, the former oils tank farm area, and an apparent arsenic source area (Figure 2). The results of the recently completed second phase, which included an expanded investigation of soil and ground-water quality, helped assess the extent of these affected areas.

The objective of this Work Plan is to gather sufficient data to select appropriate interim remedial measures for soil and ground water at the Site (described in more detail in Section 1.2).

1.1 Background

A phased environmental investigation voluntarily initiated by Sherwin-Williams upon the closure and dismantling of two former tank farm facilities identified the presence of organic compounds and some metals in soil and ground water at the Site. The results of the first phase of environmental investigation,

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completed in July 1989, reported a complex mixture of certain volatile organic compounds (VOCs), semi-volatile organic compounds, and some metals (notably arsenic) as detected in soil and ground-water samples collected from on-site locations (Levine·Fricke, July 17, 1989). The first phase of investigation also provided certain hydrogeologic information, including identification of shallow ground water at depths of between 5 and 10 feet below land surface. Information from seven shallow monitoring wells (generally 15 to 20 feet deep) indicated that shallow ground water was found in relatively thin (2 to 5 feet thick) beds of sand and/or gravel within a silty clay lithology. The thin unsaturated zone was found to generally consist of a few feet of fill material underlain by silty clay.

The recently completed second phase of investigation has provided additional information regarding site geology, ground-water flow directions, hydraulic conductivities of screened aquifer units, and the types and concentrations of detected compounds, as well as the lateral and vertical extent of affected soil and ground water (Levine·Fricke, April 4, 1990). During the second phase investigation, five more shallow-zone wells were installed, generally 15 to 20 feet deep, and three wells were installed at depths between 30 and 40 feet below land surface. The deeper wells have been designated as B-zone wells. The B-zone was found to consist of distinct sand and gravel beds 5 to 10 feet in thickness. A clay to silty clay interval, approximately 12 to 15 feet thick, has been found to separate the shallow zone from the B-zone in the areas where B-zone wells have been installed. Ground-water flow direction in shallow ground water was found to be to the northwest.

The types of compounds detected in soil and ground water have indicated the occurrence of a complex mixture of volatile and semi-volatile organic compounds and some metals; namely, arsenic, barium, cadmium, copper, lead, and zinc. The two former tank farm areas have been identified as the areas with the greatest concentrations of organic compounds. A third area that underlies the foundation of a dismantled building at the Site has been identified as an apparent arsenic source area. This area is upgradient from the former tank farm locations. These three source areas are identified in Figure 2.

The results of the analysis of soil samples collected in the first and second phases of investigation are discussed in Appendix A and are summarized in Figures 3A, 3B, 3C, 4A, 4B, 4C, and 5.

The results of the analysis of ground-water samples collected in the first and second phases of investigation are also discussed in Appendix A and illustrated in Figures 6 through 9. The results from the soil and ground-water investigations of the

first and second phases of environmental investigation indicated that, although the areas of greatest concentration have been identified, the lateral and vertical extent of affected soil and ground water have not been fully defined. Analysis of ground-water samples from wells located on the downgradient margin of the Site indicated that off-site migration of some compounds may have occurred.

1.1.1 OVERVIEW OF SHALLOW-ZONE RESULTS

Mapping of the results for the shallow-zone ground-water samples showed that: the highest concentrations of VOCs were generally observed in ground-water samples from wells located in the former solvent tank farm area; the highest concentrations of semi-volatile organic compounds were generally observed in the former oils tank farm area; and the highest concentration of arsenic in ground water was observed in the sample from well LF-1, which is located in the apparent arsenic source area. Significant concentrations of arsenic (above 1 ppm) were also observed in wells LF-2 and LF-3 (former oils tank farm area), and LF-6 (former solvent tank farm area).

The laboratory results showed that there were several groups of tentatively identified organic compounds that have semi-quantified estimates of significant concentrations. These groups included straight chain hydrocarbons, alcohols, ketones, esters, organic acids, alkyl benzene isomers, and molecular sulfur.

Information from shallow-zone wells showed the following:

- o Contour mapping of the shallow-zone results for the total concentration of quantified VOCs showed that the highest total concentrations of quantified VOCs were centered around the former tank farm areas. The results of upgradient and downgradient wells indicated that the downgradient limits of the VOC-affected shallow-zone ground water could generally be determined by the 0.100 ppm iso-concentration line, but could not be determined by a 0.010 ppm iso-concentration line for downgradient well LF-9. This indicated that the extent of the area affected by concentrations of 0.010 ppm may extend to the northwest, beyond the limits of the Site (Figure 10).
- o Contour mapping of the total quantified results for semi-volatile organic compounds similarly indicated that the former tank farm areas have the highest concentrations of these compounds (Figure 11). The ND (not detected) results for downgradient wells LF-8, LF-9, and LF-11 indicated the limits of affected ground water. However, a result of

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0.140 ppm of total quantified semi-volatile organic compounds for LF-10 indicated that there may be off-site migration to the west in this area (see Figure 11).

- o A review of the total quantified and semi-quantified concentrations for semi-volatile organic compounds further indicated that the area affected with concentrations greater than 0.100 ppm for these compounds probably extends to the north and northwest beyond the site boundaries.
- o Contour mapping of arsenic concentrations in shallow-zone ground water indicated that the affected area probably extends from the apparent arsenic source area (centered around well LF-1) through the central reaches of the Site to the northwestern, downgradient boundary of the Site (Figure 12). Arsenic-affected ground water may be migrating off site in the area of well LF-10. A QA/QC review of arsenic data has limited interpretation to all data greater than 0.065 ppm (i.e., five times the concentration of 0.013 ppm arsenic found in a trip blank). Arsenic had also been previously detected in a field blank collected in June 1989 (see the results for LF-1-FB, June 1, 1989 as reported in the Levine·Fricke, July 17, 1989 report.) Additional monitoring with greater QA/QC controls will be required to further evaluate the presence of arsenic at the Site in concentrations of less than 0.065 ppm.

1.1.2 OVERVIEW OF B-ZONE RESULTS

The results from the deeper B-zone wells indicate that the B-zone has only slightly elevated or barely detectable concentrations of some chemical compounds, including propylether (up to 0.070 ppm), 1,2-dichloroethane (up to 0.100 ppm), vinyl acetate (0.001 ppm), methyl ethyl ketone (0.001 ppm), methyl isobutyl ketone (0.001 ppm), 2-hexanone (0.001 ppm), and arsenic (up to 0.027 ppm [which is below the QA/QC validated limit of 0.065 ppm]). Some of these chemicals (1,2-dichloroethane [1,2-DCA], vinyl acetate, methyl isobutyl ketone) were not detected in the shallow-zone samples.

The low results for arsenic indicate that arsenic has not migrated significantly into B-zone ground water.

1.2 Objective of the Work Plan

The overall objective of this proposed Work Plan is to select an appropriate action plan for interim remedial measures at the Site. These interim remedial measures would attempt, at a minimum, to address on-site containment of affected ground water and potential soil source abatement, or mitigation, to protect ground water. In support of this objective, the goals of this Work Plan are as follows:

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- o to develop additional data on the presence and extent of VOCs in soil in the former oils tank farm area (including the area affected by a recent spill of Texanol on March 25, 1990), and to develop additional data on the extent of arsenic and other metals in soil in the apparent arsenic source area.
- o to investigate one other potential source area in the parking lot near well LF-10 where traces of a brown oily liquid (characterized as a residual petroleum product) were observed in soil during drilling in this area.
- o to further characterize the downgradient extent of VOCs and arsenic in shallow-zone ground water.
- o to identify and evaluate potential methods for the technically feasible and cost-effective treatment of affected soil and ground water.
- o to identify and evaluate interim remedial measures that would meet the interim objectives of containing and cleaning up potential on-site affected ground water and reducing or eliminating sources of chemicals to ground water.
- o to develop a plan of action and schedule of activities for the remediation of affected soil and ground water at the Site.

In order to develop the interim remedial measures, additional data need to be collected and evaluated and an analysis of technology options needs to be performed. Thus the proposed Work Plan includes the following:

- o further investigation of the extent of affected ground water in downgradient locations.
- o further investigation of the extent of affected soil in the former oils tank farm area, the apparent arsenic source area, and a third potential source area in the area near well LF-10.
- o bench-scale and treatability studies by vendors to assess which methods have the greatest potential for remediation of soil and ground water.
- o development and evaluation of treatability options for the appropriate remediation of affected soil and ground water.
- o development and evaluation of interim remedial measures to address the potential off-site migration of affected ground water.

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- o development of a plan for the interim control, collection, and remediation of affected soil and ground water.

The proposed Work Plan also provides for the investigation and characterization of soil in an area affected by a recent spill on March 25, 1990 of a semi-volatile organic solvent known as Texanol. A letter report on the extent of this spill and related cleanup activities has been forwarded to the Regional Water Quality Control Board - San Francisco Bay Region (RWQCB) (letter from Mr. Bob Burke of Sherwin-Williams to Mr. Hossain Kazemi of the RWQCB, dated April 17, 1990). The area affected with Texanol overlaps the former oils tank farm area.

In addition, supporting work would be done to ensure the accurate and timely collection of data. These activities include:

- o further enhancement of quality assurance and quality control (QA/QC) through the development of a plan for QA/QC measures intended to maintain standards for data validation and acceptance.
- o definition of the sampling methods to be used for the collection of soil and ground-water samples as part of the overall QA/QC and data integrity program.
- o development of a plan for the continued monitoring of ground-water quality and ground-water flow directions to aid in assessing changes in water quality and other program objectives.

1.3 Reporting of Results

The results of the first and second phases of investigation have been reported to the RWQCB (Levine·Fricke, July 17, 1989, "Results of Environmental Investigation, Sherwin-Williams Plant, Emeryville, California" and Levine·Fricke, April 4, 1990, "Results of Second Phase of Environmental Investigation, Sherwin-Williams Plant, Emeryville, California"). The results of the first phase of investigation were reviewed in a meeting in August 1989 between representatives of the RWQCB, Sherwin-Williams, and Levine·Fricke. A plan was subsequently developed for a second phase of investigation for further characterization of the presence and extent of the previously detected organic and inorganic compounds at the Site. The results of the recently completed second phase investigation and the goals of this Work Plan were discussed with the RWQCB at a meeting on May 9, 1990. Future reports and work plans will be submitted to RWQCB for their review and comment at the appropriate junctures.

2.0 SCOPE OF FURTHER SITE INVESTIGATION WORK

2.1 Soil Investigation

2.1.1 FORMER SOLVENT AND OILS TANK FARM AREAS

A total of 20 soil borings have been drilled in the general vicinity of the former solvent tank farm area (SW-4, SW-5, and SW-6; SB-7, SB-8, SB-9, SB-10, SB-11, SB-12, SB-13, SB-14, SB-15, SB-16, SB-17, SB-18, SB-19, SB-20, SB-21, SB-25, and SB-26) and six soil borings have been drilled in the general vicinity of the former oils tank farm area (SW-1, SW-2, and SW-3; SB-22, SB-23, and SB-24). These borings were drilled in areas located within the former tank farm boundaries and in exterior perimeter areas to evaluate the lateral and vertical extent of affected soil and ground water. The laboratory results for the analyzed soil samples indicated the presence of a complex mixture of VOCs, semi-volatile organic compounds, and some metals. The laboratory results generally indicated that concentrations of detected chemical compounds decreased with increasing distance from the former tank farm boundaries.

Detailed diagrams showing the results of soil sample analyses from each of the former tank farm areas have been developed to illustrate the lateral and vertical extent of affected soil (Figures 3A, 3B, 3C, 4A, 4B, and 4C). These diagrams have been developed for specific depth intervals (i.e., 0 to 2.5 feet, 2.5 to 4.5 feet, and 4.5 to 6.0 feet) for three general types of compounds, including VOCs, semi-volatile organic compounds, and metals.

This Work Plan proposes additional soil sampling to further define the extent of potential source areas.

2.1.2 APPARENT ARSENIC SOURCE AREA

In April 1990, 14 soil borings were drilled through the foundation of the dismantled building that covers the apparent arsenic source area to evaluate the lateral and vertical extent of these arsenic-affected soils. The locations of the soil borings in this area are illustrated in Figure 13. Soil borings generally extended to a depth of 6 feet and samples were collected at 2-foot intervals for laboratory analysis for six metals (arsenic, barium, cadmium, copper, lead, and zinc). The samples from the 6-foot depth interval have been held for analysis pending results from samples from the 2- and 4-foot depth intervals.

Detailed diagrams showing the results of soil sample analyses for soil borings from the apparent arsenic source area will be developed to illustrate the lateral and vertical extent of

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affected soil. These diagrams will be developed for specific depth intervals (i.e., 0 to 2.5 feet, 2.5 to 4.5 feet, and 4.5 to 6.5 feet). Additional soil sampling in this area will be recommended as necessary, pending Levine·Fricke review and interpretation of the forthcoming results.

2.1.3 TEXANOL SPILL AREA

A total of five soil borings, drilled to a depth of 6 feet, are proposed for the area affected by the March 25, 1990 spill of Texanol, an ester alcohol-based semi-volatile solvent. The spill area is located on the southeastern side of the former oils tank farm area. The planned locations for these borings are illustrated in Figure 14. Soil samples will be collected at 2-foot intervals for potential laboratory analysis for volatile and semi-volatile organic compounds. The samples will be screened in the field for evidence of organic compounds and at least two samples from each boring will be analyzed in the laboratory to evaluate the extent of the affected area. The investigation of this area represents an extension of the former oils tank farm area investigation and the results from these two areas will be combined for characterization purposes. Additional soil sampling will be recommended as necessary to define the extent of the affected area.

2.1.4 PAVED PARKING LOT AREA

A total of three soil borings are proposed to be drilled in the paved parking lot area in the vicinity of monitoring well LF-10 to investigate the extent of the brown oily liquid (characterized by thin layer chromatography as a heavy petroleum-based compound) that was encountered in soil during drilling of monitoring wells LF-10 and LF-B3. The planned locations for these borings are illustrated in Figure 15. Soil borings will be drilled to the depth of ground water and soil samples will be collected at approximately 2-foot intervals. Soil samples will be screened in the field for evidence of affected soil and at least two samples from each boring are planned to be submitted for laboratory analysis for volatile and semi-volatile organic compounds. Additional soil sampling will be recommended as necessary to define the extent of the affected area.

2.2 Ground-Water Investigation

A total of 13 shallow-zone and three B-zone monitoring wells have been installed at the Site, including two shallow-zone wells located off site in upgradient locations. The locations of the existing monitoring wells are illustrated in Figure 16. As illustrated in Figures 10, 11, and 12, analytical results from ground-water samples collected from the second phase of

investigation indicated that the lateral extent of affected ground water in downgradient locations has not been fully defined.

2.2.1 ADDITIONAL SHALLOW-ZONE WELLS

Three additional shallow-zone wells are proposed for off-site downgradient locations on the western margin of the Site in locations that are part of the Southern Pacific Transportation Company (SPTC) railroad right-of-way. Permission for right of access to install monitoring wells at these locations has been requested from SPTC and the wells will be installed upon granting of this right of access. The shallow-zone wells will be drilled with a hollow-stem auger and will be constructed of 2-inch diameter PVC casing. These wells will be screened through the water table to enable detection of floating compounds. Wells will be properly developed and sampled for VOCs, semi-volatile organic compounds, and selected inorganic compounds using EPA Methods 8240, 8270, and 200/7000, respectively.

2.2.2 ADDITIONAL B-ZONE WELL

While there is no evidence at this point of significant impacts from the Site to B-zone ground-water quality, there are man-made chemicals in the B-zone. At the request of the RWQCB, we are proposing to install one additional B-zone well off site to enable better determination of the ground-water flow direction and ground water quality. The proposed B-zone well would be located in the vicinity of shallow-zone wells LF-12 and LF-13, at the intersection of Horton Street and 45th Avenue in Emeryville, California.

The proposed well will be screened in the first sand and gravel layer found below 30 feet in depth. It will be single-cased, since this area does not show significant VOCs or metals in shallow-zone ground water. The well will be developed and sampled for VOCs using EPA Method 8240. Rounds of water-level measurements of existing wells will be extended to include this new well. These water-level data should aid in assessing from which direction the chemicals in the B-zone may be coming.

2.3 Plans For Continued Ground-Water Monitoring

2.3.1 QUARTERLY MONITORING PROGRAM

A quarterly monitoring program is planned for a period of one year to observe changes in ground-water quality and ground-water flow directions at the Site. This program will monitor: downgradient shallow-zone wells located on the northern and western margins of the Site (including wells LF-8, LF-9, and LF-10, LF-11, and the three proposed wells [LF-14, LF-15, and

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LF-16]); off-site upgradient wells LF-12 and LF-13, for continued evaluation of background conditions; and the four B-zone wells LF-B1, LF-B2, LF-B3, and LF-B4 (proposed), which will be monitored to evaluate the quality of ground water at the sampled well locations.

Ground-water samples from the monitored wells will be analyzed for VOCs, semi-volatile organic compounds, and arsenic using appropriate EPA methods. The EPA methods that will be used will be defined in the QA/QC and Sampling Plan (see Section 2.3.2 of this Work Plan). Laboratory standards will be obtained, if feasible, for tentatively identified compounds (TICs) that will be identified in the next sampling round, presently scheduled for June 1990.

The quarterly monitoring program will include measurement of ground-water levels from all wells to evaluate ground-water flow directions in both the shallow-zone and the B-zone. The surface-water level of Temescal Creek, located on the northern border of the Site, will be included in the quarterly water-level program.

It is proposed to initiate this quarterly monitoring program upon installation and sampling of the four proposed monitoring wells (LF-14, LF-15, LF-16, and LF-B4). Reports of the results of the quarterly monitoring of ground-water quality and ground-water flow directions will be issued to the RWQCB within 45 days after the end of each calendar quarter.

Commencing in 1990, for each June there will be a sampling event regarded as "annual" for wells located in the identified source areas. This would provide a complete data set for comparison with the second phase of investigation and for monitoring changes in ground-water quality over time.

2.3.2 QUALITY CONTROLS FOR DATA

A QA/QC Plan and a Sampling Plan will be developed to define controls, procedures, and methods for the data collection. The goal of the QA/QC and Sampling Plan will be to provide controls essential for checking the validity and acceptance of collected data. The results of the analysis of field blank and trip blank water samples from the first and second phases of investigation indicated cross and/or residual contamination of field and/or laboratory equipment that has limited interpretation of some data, notably arsenic and bis(2-ethylhexyl)phthalate. Development of appropriate QA/QC guidelines will help limit the potential for such future occurrences.

2.3.3 SUMMARY INVESTIGATION REPORT

A summary of the investigations performed under this Work Plan will be presented at the conclusion of the treatability studies, along with the proposed interim remedial action plan in the Interim Remedial Action Plan Report is described in Section 4.0.

3.0 TREATABILITY STUDIES

3.1 Introduction to Soil Treatment Issues

The completed site investigation results indicated that the soil in three areas of the property has been affected by various organic and inorganic constituents (Levine·Fricke, July 17, 1989, "Results of Environmental Investigation, Sherwin-Williams Plant, Emeryville, California" and Levine·Fricke, April 4, 1990, "Results of Second Phase of Environmental Investigation, Sherwin-Williams Plant, Emeryville, California"). Soil in the former solvent tank farm area has volatile and semi-volatile organics and several inorganics reportedly present at concentrations which normally require remediation. The former oils tank farm area has volatile and semi-volatile organics reported in soil samples. The area around monitoring wells LF-1 and LF-B1 has elevated concentrations of arsenic and lead. Because of the widely reported difficulties in treating soils affected by arsenic, this area may present some difficulties that should be evaluated during the treatability study.

There are three general strategies for soil remediation which can be considered.

The first would be to install a geotechnical solution such as a cap and slurry wall containment. This approach could, however, limit the future use of the Site and would require a disclosure clause in the deed to the property.

The second approach would be to excavate and treat on site, with either on- or off-site disposal of the treatment product. Treatment could be done in a variety of ways for the different types of chemicals present in soil in the three areas. These are discussed below, area by area. The disadvantage of this approach would be that a RCRA permit or variance might be required. If the treated material were left on site, a disclosure clause in the property deed might be required.

The third soil remediation approach would be to excavate and transport the soil to a permitted Treatment, Storage, and Disposal Facility (TSDF). This choice would be comparatively

fast to implement and would not involve restrictions on future site use but, in the case of soils affected by only organics, would likely be the most expensive alternative.

The recent Federal Land Disposal Restriction regulations will have an impact on the treatment evaluations. For instance, if on-site treatment with off-site disposal were under consideration, the product from the treatment process would have to meet the treatment standards in these new regulations before disposal would be allowed. Also, the third approach of soil excavation and disposal would be subject to certain portions of the Land Disposal Restrictions.

Evaluation of soil treatment alternatives for the Site will be done for each of these three options that appears feasible for the particular area of soil to be treated. Those options that prove feasible in the treatability study will be evaluated further for cost and benefits during evaluation of interim remedial measures.

3.2 Evaluation and Review of Potential Treatment Methods for Soil

Soil treatability studies will be divided according to the three areas identified as sources: (1) the former oils tank farm area; (2) the apparent arsenic source area; and (3) the former solvent tank farm area.

3.2.1 FORMER OILS TANK FARM AREA

The portion of the Site identified as the former oils tank farm area appears to be affected by VOCs and semi-volatiles. If this is confirmed by further site investigation work, it may be possible to apply one of several types of treatment to the soil. The options for this area that will be investigated include:

- a) geotechnical containment
 - b) TSDF profiling to determine whether the soil can be accepted under the Land Disposal Restrictions
 - c) landfarming on site to induce biodegradation of the organics in soil.
- a) The only proven and available in situ option for soil in the former oils tank farm area is geotechnical containment. This technology option would involve placing low permeability engineered materials on top of, and potentially all around, the soils in question. This option will be evaluated for technical feasibility and a cost estimate will be prepared.

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- b) The acceptability of the soil from the former oils tank farm area will be investigated with permitted TSDF facilities. One important aspect of the Land Disposal Restrictions which could be relevant to soil in the former oils tank farm is the national capacity extension until June 1991 for those wastes with an EPA-identified Best Demonstrated Available Technology (BDAT) of incineration. If incineration were the BDAT for these soils, as it would appear, and if the soil could be removed and transported prior to the June 1991 extension deadline, then off-site disposal would become a viable technology option. Therefore, Levine·Fricke will discuss the issue of disposal with several appropriate TSDFs.
- c) Some treatability testing will be done to evaluate the removal of the semi-volatile compounds found in the former solvent tank farm area, most notably the large aromatic hydrocarbons. Aeration alone would not remove these compounds, but the controlled addition of water and nutrients to the soil might enhance biological breakdown of these compounds. It is conceivable that after landfarming the soil could either be put back in place on site or disposed off site at a municipal landfill.

If none of these three options appeared feasible, then treatability studies would be performed by vendors to determine whether the soil could be stabilized. One feature of the Land Disposal Restriction program is that, when treatment standards are based on concentration, the technology used to reach that standard is the decision of the generator. Therefore, if a less expensive method achieves the standard, it can be used.

The mixture of chemicals reportedly present in the soils in this area of the Site will likely make treatment difficult. Many researchers have reported that organics interfere with stabilization technology; however, several treatment vendors claim to have proprietary solutions to such problems. As part of this evaluation, several of the most likely vendors will be contacted and two or three selected to perform treatment tests on samples from the former oils tank farm area.

3.2.2 APPARENT ARSENIC SOURCE AREA

The soil in the area of monitoring wells LF-B1 and LF-1 is suspected as a source for the arsenic found in the ground water beneath the Site. Two initial options will be evaluated for this area:

- a) geotechnical containment
- b) excavation and removal to a TSDF facility.

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If these options prove infeasible, then the following additional studies would be performed to evaluate further options:

- c) treatability studies by vendors
 - d) fixation studies by Levine·Fricke.
- a) The only in situ source control option that can be considered proven and available for arsenic in soils would be to apply geotechnical containment methods. This alternative will be briefly evaluated for technical feasibility and costing.
- b) Off-site treatment and disposal will be evaluated once the new site characterization data become available. This option would probably be expensive, but would offer the advantage of removing the material from the Site. Furthermore, if the affected volume of soil proved to be small, this could be an attractive choice. The recent extension of the Land Disposal Restrictions for the final third of classified wastes until August 8, 1990 may allow enough time to characterize this soil, and remove, and dispose of appropriate portions of the soil before disposal restrictions take effect.
- c) If the first two options were found to be infeasible or ineffective, then treatability studies would be performed by vendors on arsenic stabilization in this soil. Several commercial treatment vendors claim success with soils containing arsenic, although EPA and other regulatory agencies have reported difficulty with treating arsenic to current standards. As part of this evaluation, Levine·Fricke would contact commercial vendors, select up to three of them based on their permit status and experience with arsenic, and arrange for tests with soil samples from this area of the Site. The vendor reports would document the success (or failure) of their process and provide cost estimates for further alternatives evaluation.
- d) The other possible option for this area would be for Levine·Fricke to perform treatability tests in our Emeryville laboratory. If the arsenic can be immobilized or "fixed" with cement and/or silicates, Levine·Fricke can design a process to treat soil on site. The decision on whether to leave the treated soil on site or remove it for off-site disposal would depend on the quantity of material and the results of leaching tests (both Federal and State) on the final product.

3.2.3 FORMER SOLVENT TANK FARM

The portion of the Site known as the former solvent tank farm area appears to be the most complicated in terms of the types of chemicals reportedly present. The soil in this area contains volatile and semi-volatile organic chemicals, as well as lead and

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zinc at concentrations that would typically require some remediation. Thus, several treatment options will be tested and evaluated. These include:

- a) geotechnical containment
 - b) soil aeration and/or landfarming
 - c) TSDF profiling for possible disposal.
- a) Because of site hydrogeologic conditions and the mixture of metals and organic chemicals in soil, the only proven and available in situ option for this area would be geotechnical containment. As with the arsenic-affected area, this alternative will be evaluated for technical feasibility and a cost estimate will be prepared.
- b) Soil aeration could be successful in removing volatile and semi-volatile organic chemicals in soil. The aeration of soil could be done in compliance with local Bay Area Air Quality Management District (BAAQMD) guidelines. However, some treatability testing will be needed to evaluate the removal of the semi-volatile compounds found in these soils, most notably the long-chain (C7-C20) aliphatic hydrocarbons. Aeration alone may not remove these compounds, but the controlled addition of water and nutrients to the soil may enhance biological breakdown of these degradable compounds. The portion of soil containing metals will be evaluated to see if this will cause additional concerns about the eventual fate of the treated soil. It is conceivable that after aeration or landfarming some of the soil would have to be stabilized before placing it back on site or before disposing it off site.
- c) The acceptability of the soil from the former solvent tank farm area will be investigated with permitted TSDF facilities. Again, one important aspect of the Land Disposal Restrictions which could be relevant to soil in the former solvent tank farm is the national capacity extension until June 1991 for those wastes with an EPA-identified BDAT of incineration. It is not clear from the regulations when a waste has several characteristics simultaneously, whether the organics present make the BDAT incineration, or whether the metals present make the BDAT stabilization. If a permitted TSDF can be persuaded that the BDAT is incineration, and if the soil can be removed and transported prior to the June 1991 extension deadline, then this would become a viable option. Therefore, Levine·Fricke will discuss the issue of disposal with several appropriate TSDFs.

If none of these technologies appears feasible, then treatability tests will be performed by vendors to determine whether the soil can be stabilized.

One feature of the Land Disposal Restrictions is that, when treatment standards are based on concentration, the technology used to reach that standard is the decision of the generator. Therefore, if a less expensive method achieves the standard, it can be used. The mixture of chemicals reportedly present in the soils in this area of the Site will likely make treatment difficult.

Many researchers have reported that organics interfere with stabilization technology aimed, for example, at treating metals; however, several treatment vendors claim to have proprietary solutions to such problems. As part of this evaluation, several of the most likely vendors will be contacted and two or three selected to perform treatability tests on samples from the former solvent tank farm area.

3.3 Ground-Water Treatment Issues and Options

It is not likely that the ground water at this Site can be segregated according to the type of constituents requiring treatment. Therefore, it will be necessary to develop a sequential process to remove the wide variety of organics and some metals reportedly present.

The most likely treatment sequence would be: (1) pretreatment to remove any free and/or emulsified oils; (2) removal of the arsenic; (3) organics removal; and (4) final polishing to meet effluent standards, if necessary.

One of the primary concerns in developing the treatment system will be the generation of any wastes or residues and their impact on the overall cost and operability of the treatment process. Any residues or wastes produced in the treatment process will also be subject to the Land Disposal Restrictions, and this could have an impact on the selection of treatment options.

Any free and/or emulsified oils must be removed from the water to prevent fouling of subsequent treatment steps. A bed of Klensorb absorbent material, available from Calgon Corporation, will be evaluated for the pretreatment step.

Arsenic is difficult to treat by simple precipitation methods; therefore, an electrochemical co-precipitation process will be evaluated first. If this option proves unable to treat to effluent requirements, or appears too costly, then other options such as ion exchange will be evaluated. The electrochemical process will be evaluated by supplying the vendor with a representative sample of ground water from the Site. Their treatability test report will demonstrate the success (or

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failure) of their process and provide a cost estimate for that option. This treatment option will generate a solid waste that will require recycling or disposal.

If it becomes necessary to consider ion exchange, this option will be tested with bench-scale studies in the Levine·Fricke Emeryville laboratory and a report will be prepared for the evaluation of its success (or failure). The major problem with this option is that it does generate a concentrated waste regenerant solution which requires further treatment. Its major advantage is that, when it works, it is very effective at achieving effluent requirements.

The wide variety of organics and their relatively high concentrations reported in the ground water make biological treatment a likely alternative for the next step in the sequence. This option will be tested in a bench-scale study in the Levine·Fricke laboratory after arsenic removal. (Prior arsenic removal is necessary to prevent inhibition of biological growth.) A three-month long treatability study will be done to evaluate the efficacy of biological treatment of the organics and to determine the appropriate nutrient and oxygen addition.

If biological treatment appears unable to remove enough of the organic compounds in the water, then ultraviolet-light enhanced oxidation (UV-OX) will be evaluated as both an added treatment step and as a possible substitute for biological treatment. Thus one might have a treatment process in which first biological treatment is done then followed by UV-OX, or in which only UV-OX provides the organics removal. One version of this process uses UV lamps and the addition of hydrogen peroxide to destroy the organics on site, with no waste or residue generation. Treatability tests by vendors will be used to establish effectiveness and costs.

Polishing may be necessary if one or more of the steps discussed above does not meet effluent requirements. For example, if the electrochemical process removes most of the arsenic but does not achieve permit requirements, it might still be cost-effective to use that process and polish the water with activated carbon before discharge. At this time, the scope of work does not include evaluation of polishing process, since it is likely that UV-OX will provide sufficient polishing on its own.

4.0 INTERIM REMEDIAL ACTION PLAN REPORT

A summary report that will identify an interim remedial plan of action will be submitted to the RWQCB upon completion and evaluation of the results of site investigation and treatability studies. The interim remedial action plan will contain the following:

- 1) a report of additional site investigations and summary of current and prior investigations.
- 2) identification of interim cleanup objectives for affected soil and ground water.
- 3) identification and evaluation of treatability processes for the cost-effective interim remediation of affected soil and ground water.
- 4) identification of a plan of action intended to address the potential off-site migration of affected ground water (this plan of action will include identification and evaluation of alternate measures intended to provide for the control and collection of affected ground water), and a schedule of activities for the implementation of the identified plan of action for the interim control and remediation of affected soil and ground water at the Site.

4.1 Summary of Additional Site Investigations

The Interim Remedial Action Plan Report will detail the findings of the additional investigations proposed in this Work Plan and will amalgamate those findings with the findings of the first two phases of investigation.

4.2 Identification of Interim Cleanup Objectives

Objectives for the potential interim cleanup for soil and ground water at the Site will be identified. Legislative requirements regarding soil and ground-water quality will be reviewed as necessary. Cleanup objectives will be conceptual with regard to addressing impacts to ground water.

4.3 Identification of Treatment Processes

Viable treatment processes for soil or ground water will be identified and listed. Most of these processes have already been given a cursory review in this Work Plan. Those treatment processes that have been shown to be effective in either the literature or in treatability studies performed as part of this Work Plan will be identified and described. The list of potential processes will be reviewed with respect to

implementability, overall effectiveness in addressing the chemicals or media of concern, and estimated cost. This list of treatment processes or combinations thereof will be used to develop a range of potential interim remedial actions, which will be detailed in the report.

4.4 Identification of an Interim Remedial Action Plan

A range of viable alternatives for interim remedial actions that meet or attempt to meet the cleanup objectives will be evaluated. These alternatives will consist of the viable technologies identified. There will be at least three alternatives for conceptual remediation. Each alternative will be evaluated for implementability, effectiveness, and estimated cost. Other factors such as potential risks associated with an alternative may be considered. The evaluation of each of the alternatives will be documented in both tabular and written form in order that others may review the analysis. From this evaluation a preferred alternative will be identified and an Interim Remedial Action Plan developed. The Interim Remedial Action Plan Report will identify the necessary steps for implementing the preferred alternative and a schedule for implementation.

5.0 SCHEDULE

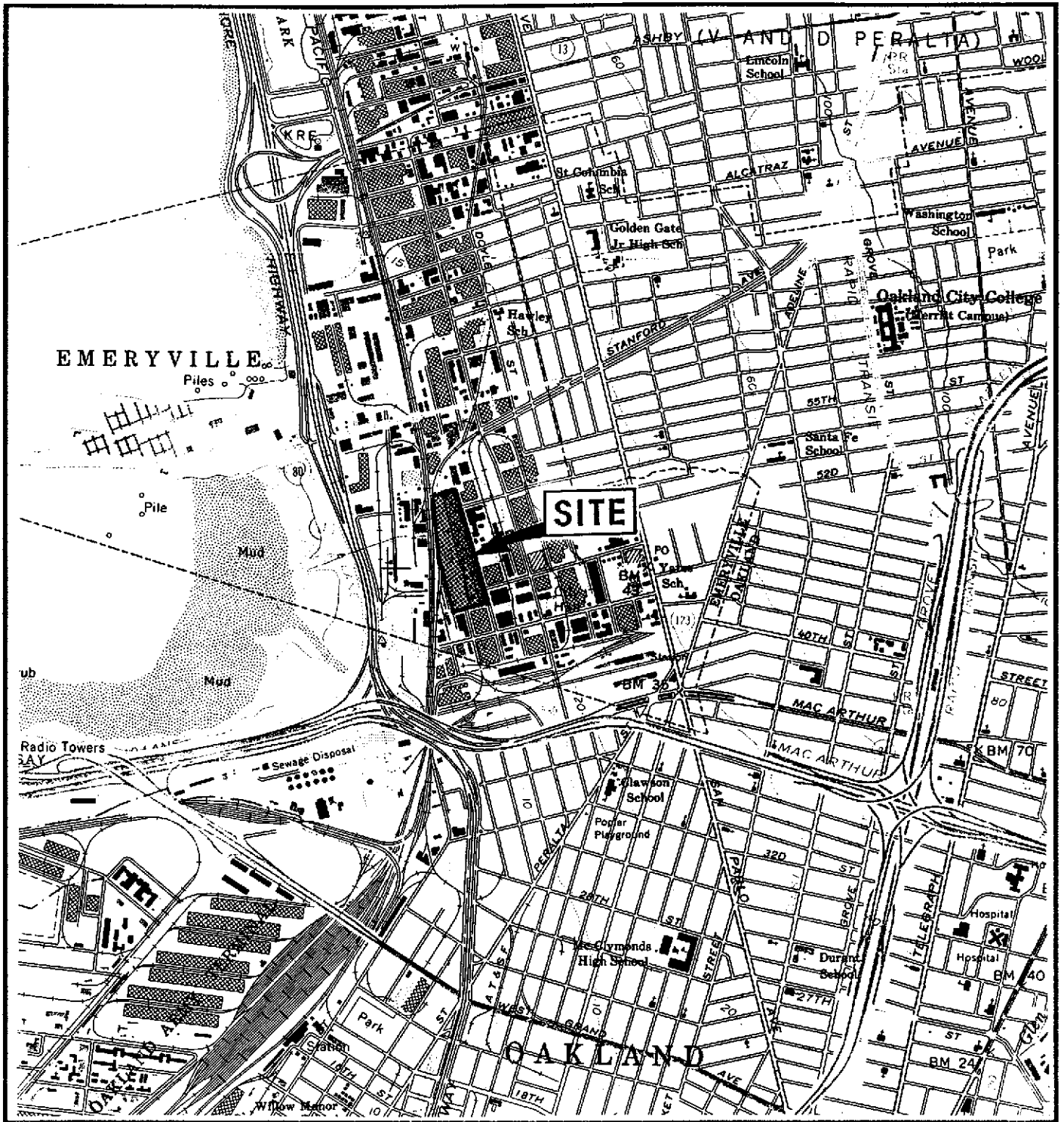
The proposed schedule for the implementation and completion of the tasks identified in this Work Plan, including further site investigation activities, treatability studies, and development of a plan of action for the interim remediation of affected soil and ground water is illustrated in Schedule A, which is attached at the end of this section.

Schedule A identifies those elements of the Work Plan that will control the time frame for developing an interim remedial action plan. Per the schedule, an Interim Remedial Action Plan Report could be expected by January 31, 1991.

Schedule A

Schedule For Site Investigation/Treatability Study
 Work Plan Activities
 Sherwin-Williams Plant, Emeryville, California

Tasks	M o n t h s									
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
1 Develop Work Plan, QA/QC Plan and Sampling Plan	█									
2 Perform further Site Investigation Activities	█									
3 Implement Quarterly Monitoring Program			█			█			█	
4 Evaluate Treatment Processes and Assess Need for Bench Scale Testing	█									
5 Bench-Scale Testing			█							
6 Interim Report on Technology Process Options					█					
7 Develop and Evaluate Alternatives		█			█					
8 Develop Plan of Action						█				



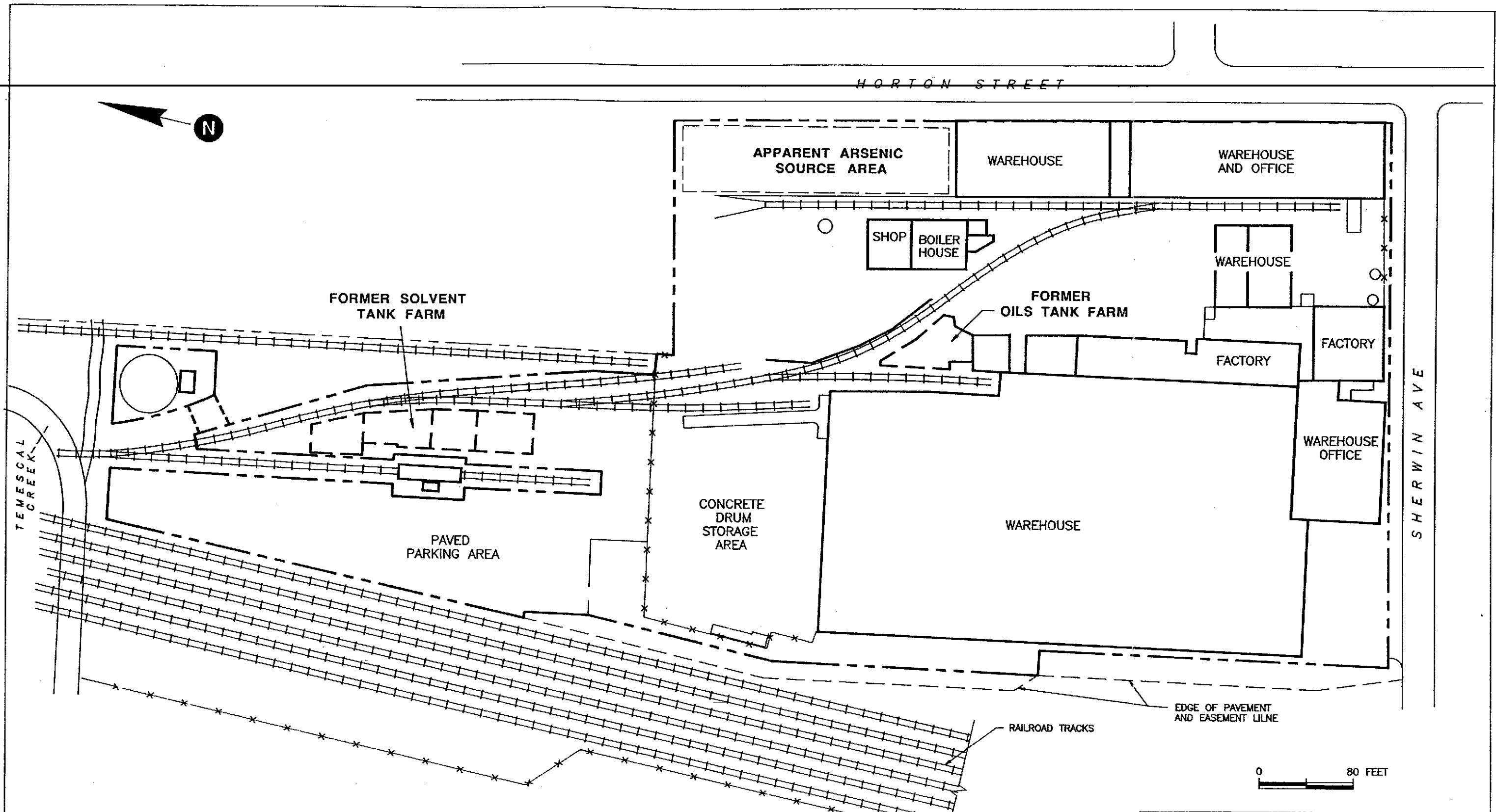
MAP SOURCE:
 U.S.G.S. Oakland West Quadrangle,
 Oakland, California
 7.5 Minute Series

Figure 1: SITE LOCATION MAP

Project No. 1563

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EXPLANATION

----- Property line

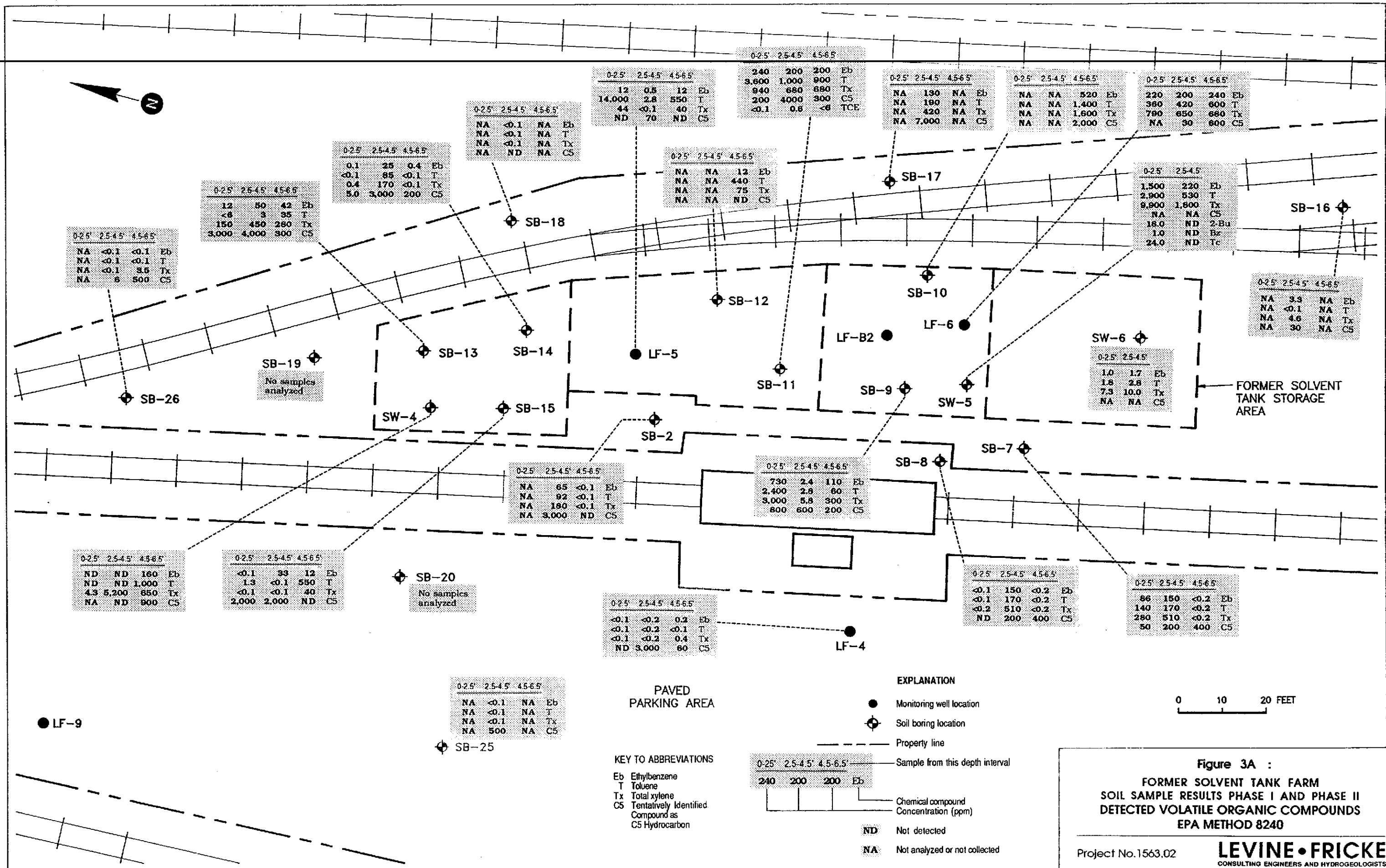


**Figure 2 :
SITE PLAN MAP**

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JDR26 APR 90 mpa



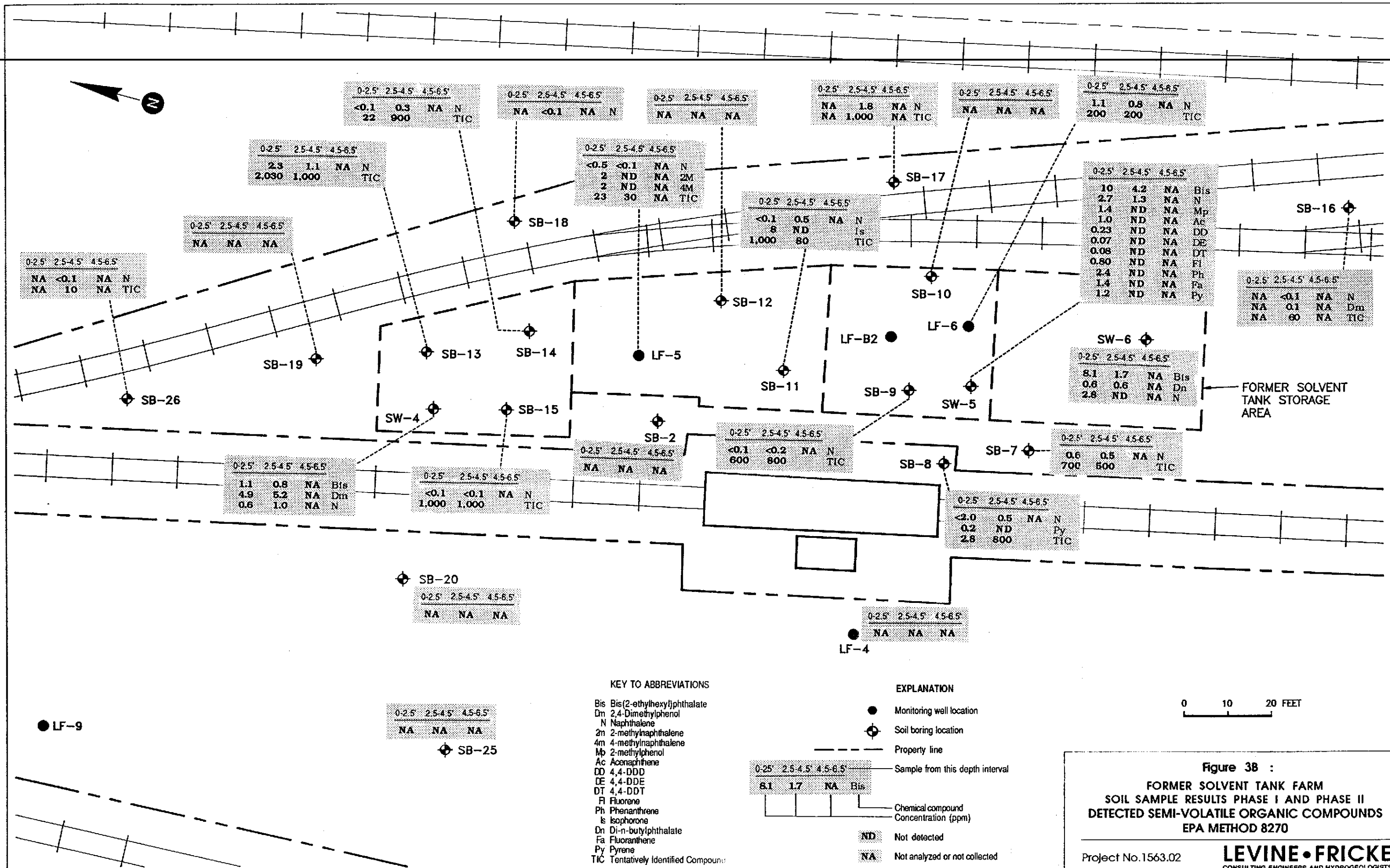
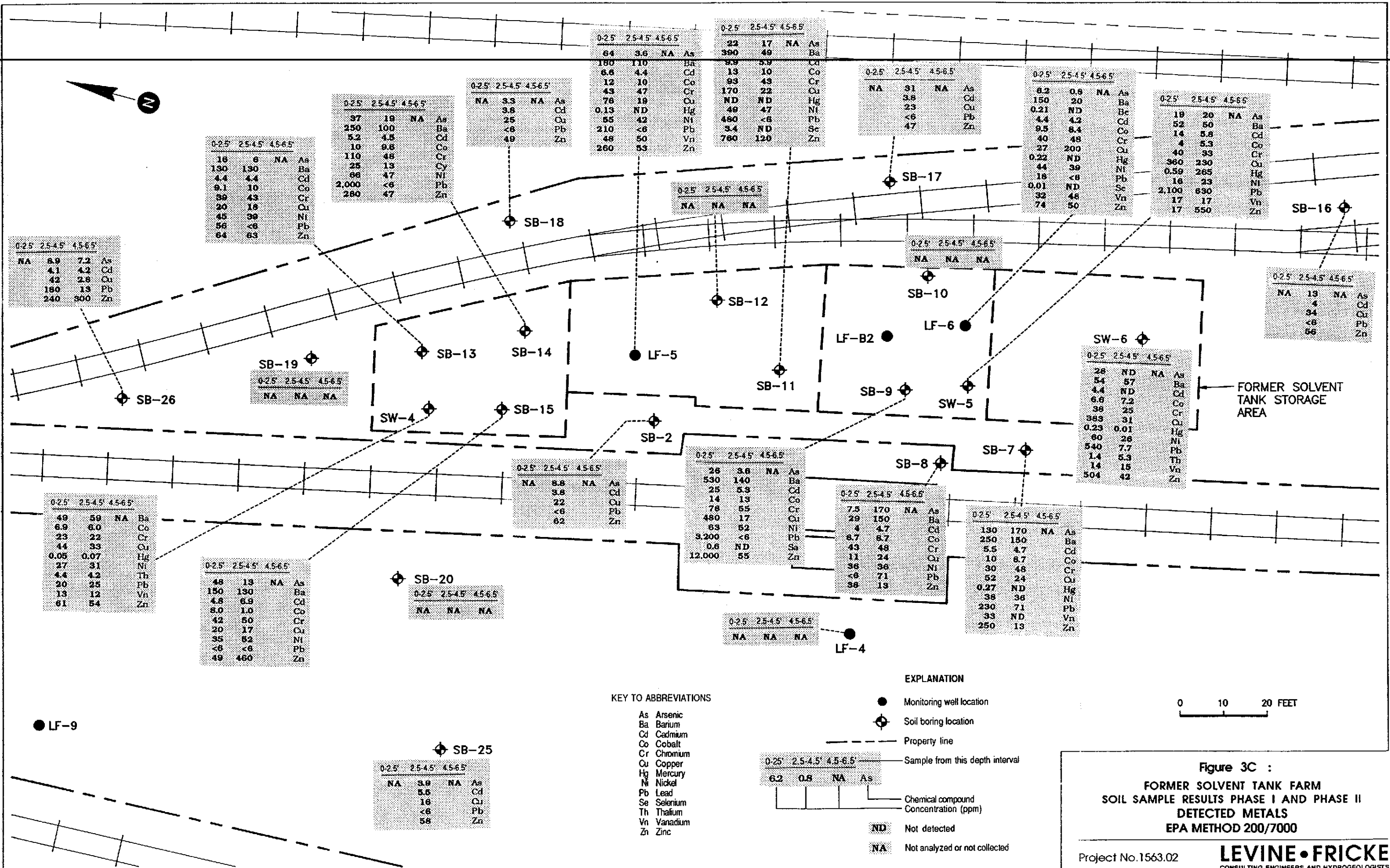


Figure 38 :
FORMER SOLVENT TANK FARM
SOIL SAMPLE RESULTS PHASE I AND PHASE II
DETECTED SEMI-VOLATILE ORGANIC COMPOUNDS
EPA METHOD 8270

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KEY TO ABBREVIATIONS

- As Arsenic
- Ba Barium
- Cd Cadmium
- Co Cobalt
- Cr Chromium
- Cu Copper
- Hg Mercury
- Ni Nickel
- Pb Lead
- Se Selenium
- Th Thallium
- Vn Vanadium
- Zn Zinc

EXPLANATION

- Monitoring well location
- ⊕ Soil boring location
- - - Property line
- Sample from this depth interval
- Chemical compound
- Concentration (ppm)
- ND Not detected
- NA Not analyzed or not collected

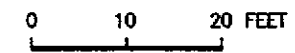


Figure 3C :
 FORMER SOLVENT TANK FARM
 SOIL SAMPLE RESULTS PHASE I AND PHASE II
 DETECTED METALS
 EPA METHOD 200/7000

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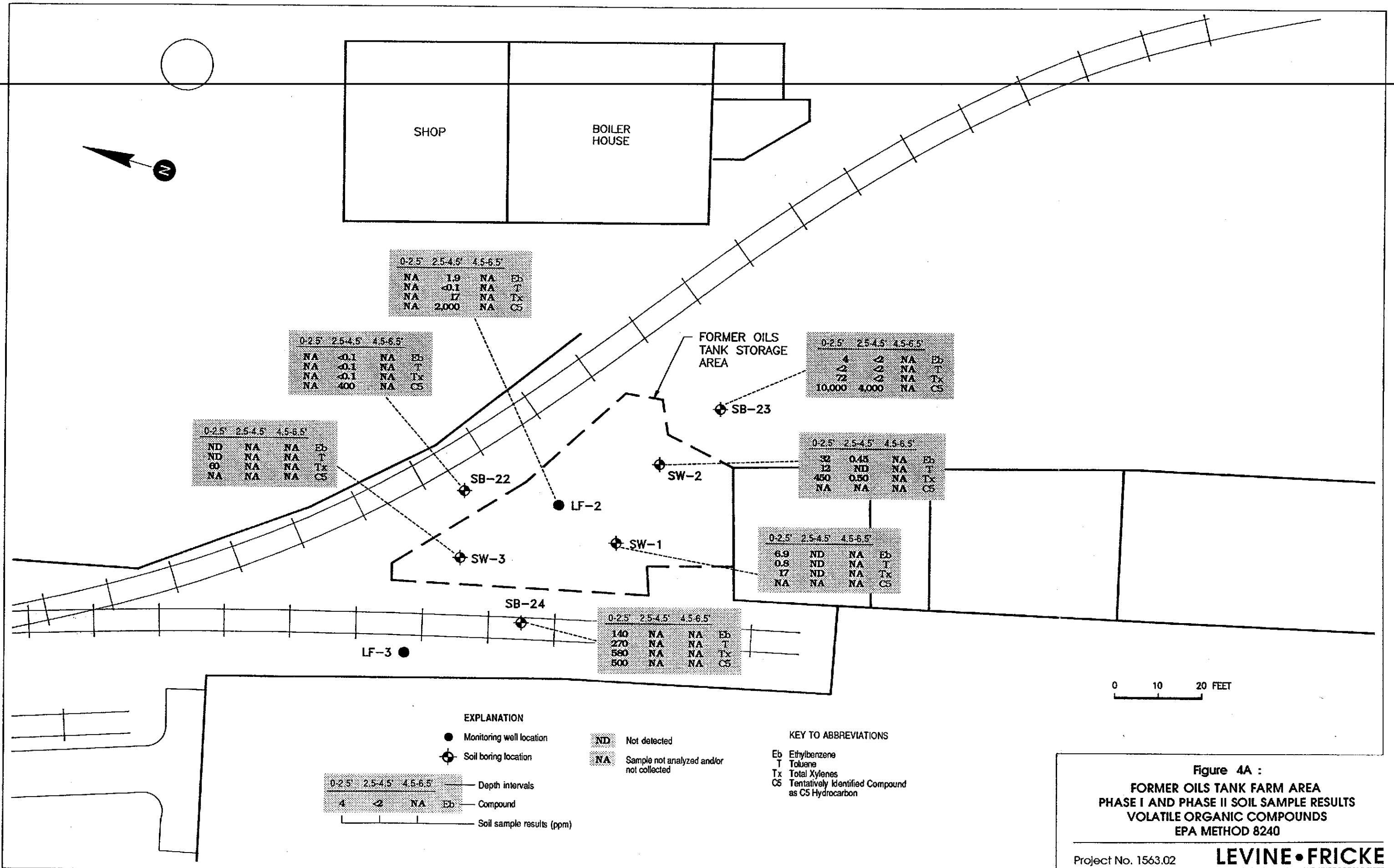
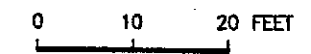
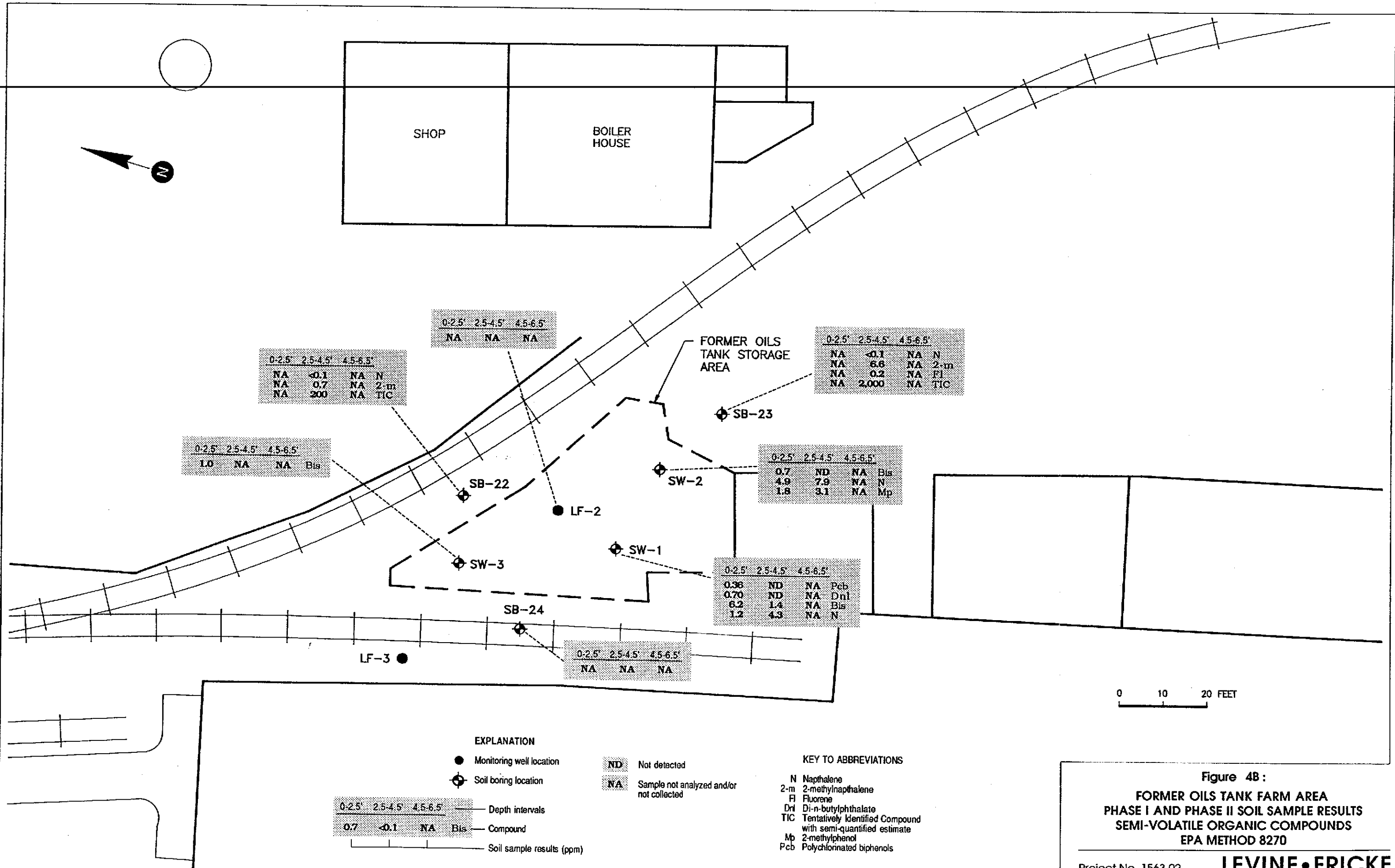


Figure 4A :
FORMER OILS TANK FARM AREA
PHASE I AND PHASE II SOIL SAMPLE RESULTS
VOLATILE ORGANIC COMPOUNDS
EPA METHOD 8240

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EXPLANATION

- Monitoring well location
- ⊕ Soil boring location

- ND Not detected
- NA Sample not analyzed and/or not collected

KEY TO ABBREVIATIONS

- N Naphthalene
- 2-m 2-methylnaphthalene
- F Fluorene
- Dnl Di-n-butylphthalate
- TIC Tentatively Identified Compound with semi-quantified estimate
- Mp 2-methylphenol
- Pcb Polychlorinated biphenols

0-2.5'	2.5-4.5'	4.5-6.5'
0.7	<0.1	NA
		Bis

— Depth intervals

— Compound

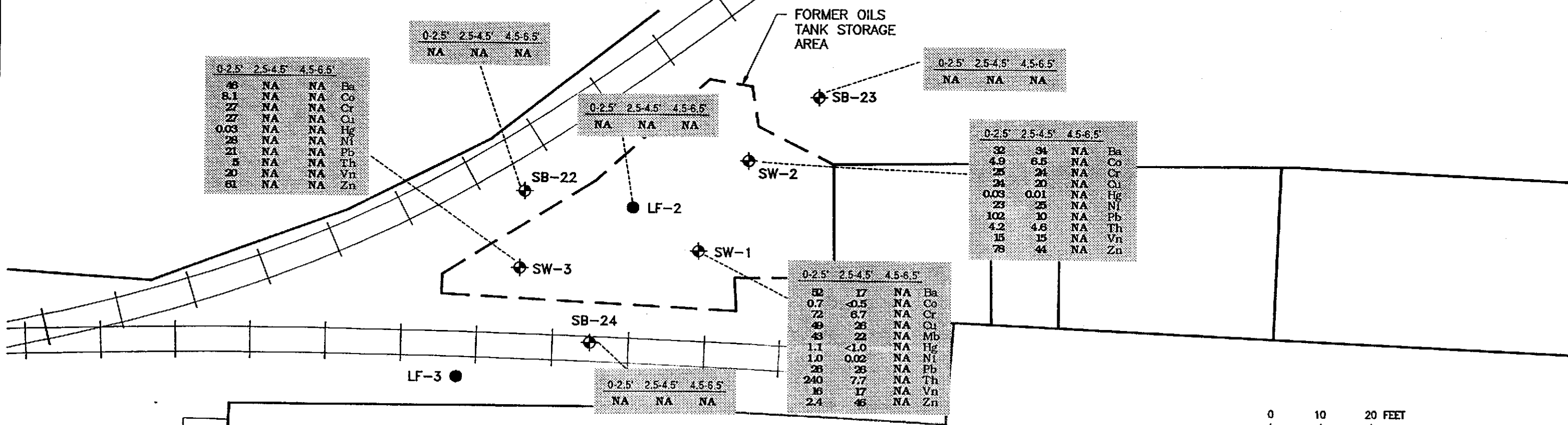
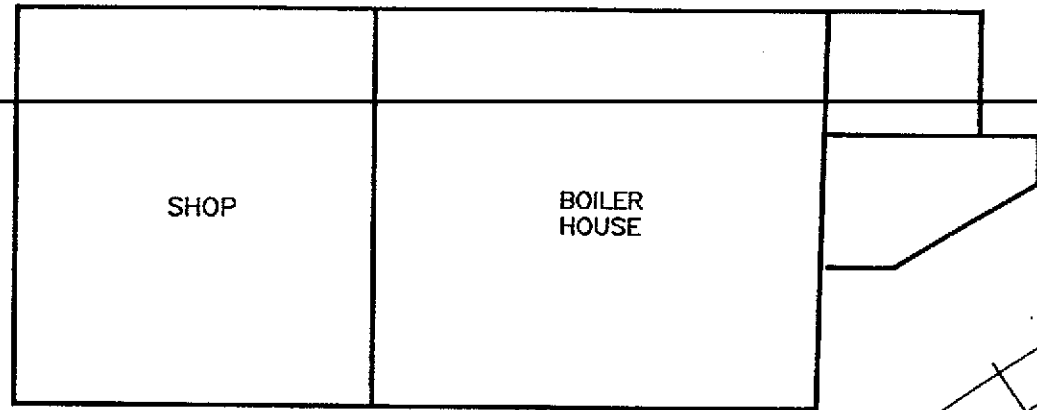
— Soil sample results (ppm)

Figure 4B:
FORMER OILS TANK FARM AREA
PHASE I AND PHASE II SOIL SAMPLE RESULTS
SEMI-VOLATILE ORGANIC COMPOUNDS
EPA METHOD 8270

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	0-2.5'	2.5-4.5'	4.5-6.5'	
46	NA	NA	NA	Ba
8.1	NA	NA	NA	Co
27	NA	NA	NA	Cr
27	NA	NA	NA	Cu
0.03	NA	NA	NA	Hg
28	NA	NA	NA	Ni
21	NA	NA	NA	Pb
5	NA	NA	NA	Th
20	NA	NA	NA	Vn
61	NA	NA	NA	Zn

	0-2.5'	2.5-4.5'	4.5-6.5'
	NA	NA	NA

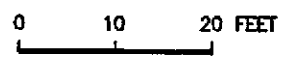
	0-2.5'	2.5-4.5'	4.5-6.5'
	NA	NA	NA

	0-2.5'	2.5-4.5'	4.5-6.5'
	NA	NA	NA

	0-2.5'	2.5-4.5'	4.5-6.5'	
32	34	NA	NA	Ba
4.9	6.5	NA	NA	Co
25	24	NA	NA	Cr
24	20	NA	NA	Cu
0.03	0.01	NA	NA	Hg
23	25	NA	NA	Ni
102	10	NA	NA	Pb
4.2	4.6	NA	NA	Th
15	15	NA	NA	Vn
78	44	NA	NA	Zn

	0-2.5'	2.5-4.5'	4.5-6.5'	
12	17	NA	NA	Ba
0.7	0.5	NA	NA	Co
72	6.7	NA	NA	Cr
49	26	NA	NA	Cu
43	22	NA	NA	Mb
1.1	1.0	NA	NA	Hg
1.0	0.02	NA	NA	Ni
20	23	NA	NA	Pb
240	7.7	NA	NA	Th
16	17	NA	NA	Vn
2.4	46	NA	NA	Zn

	0-2.5'	2.5-4.5'	4.5-6.5'
	NA	NA	NA



EXPLANATION

- Monitoring well location
- ⊕ Soil boring location

- ND Not detected
- NA Sample not analyzed and/or not collected

KEY TO ABBREVIATIONS

- Ba Barium
- Co Cobalt
- Cr Chromium
- Cu Copper
- Hg Mercury
- Mb Molybdenum
- Ni Nickel
- Pb Lead
- Th Thallium
- Vn Vanadium
- Zn Zinc

	0-2.5'	2.5-4.5'	4.5-6.5'	
32	34	NA	NA	Ba

Soil sample results (ppm)

Figure 4C :
FORMER OILS TANK FARM AREA
PHASE I AND PHASE II SOIL SAMPLE RESULTS
METALS
EPA METHODS 200/7000 OR 3050/7420

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HORTON STREET

LF-B1 ●

	0-2.5'	2.5-4.5'	4.5-6.5'	
480	5.6	6.1	As	
54	85	34	Cu	
38	42	48	Cr	
50	<6.0	<6.0	Pb	
77	110	98	Zn	

APPARENT ARSENIC SOURCE AREA
UNDER FOUNDATION OF
DISMANTLED BUILDING (?)

EXPLANATION

● Monitoring well location

--- Property line

Sample from this depth interval

0-2.5'	2.5-4.5'	4.5-6.5'	
480	5.6	6.1	As

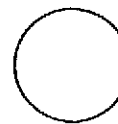
Chemical compound
Concentration (ppm)

ND Not detected

NA Not analyzed or not collected

KEY TO ABBREVIATIONS

As Arsenic
 Cu Copper
 Cr Chromium
 Pb Lead
 Zn Zinc



0 10 20 FEET

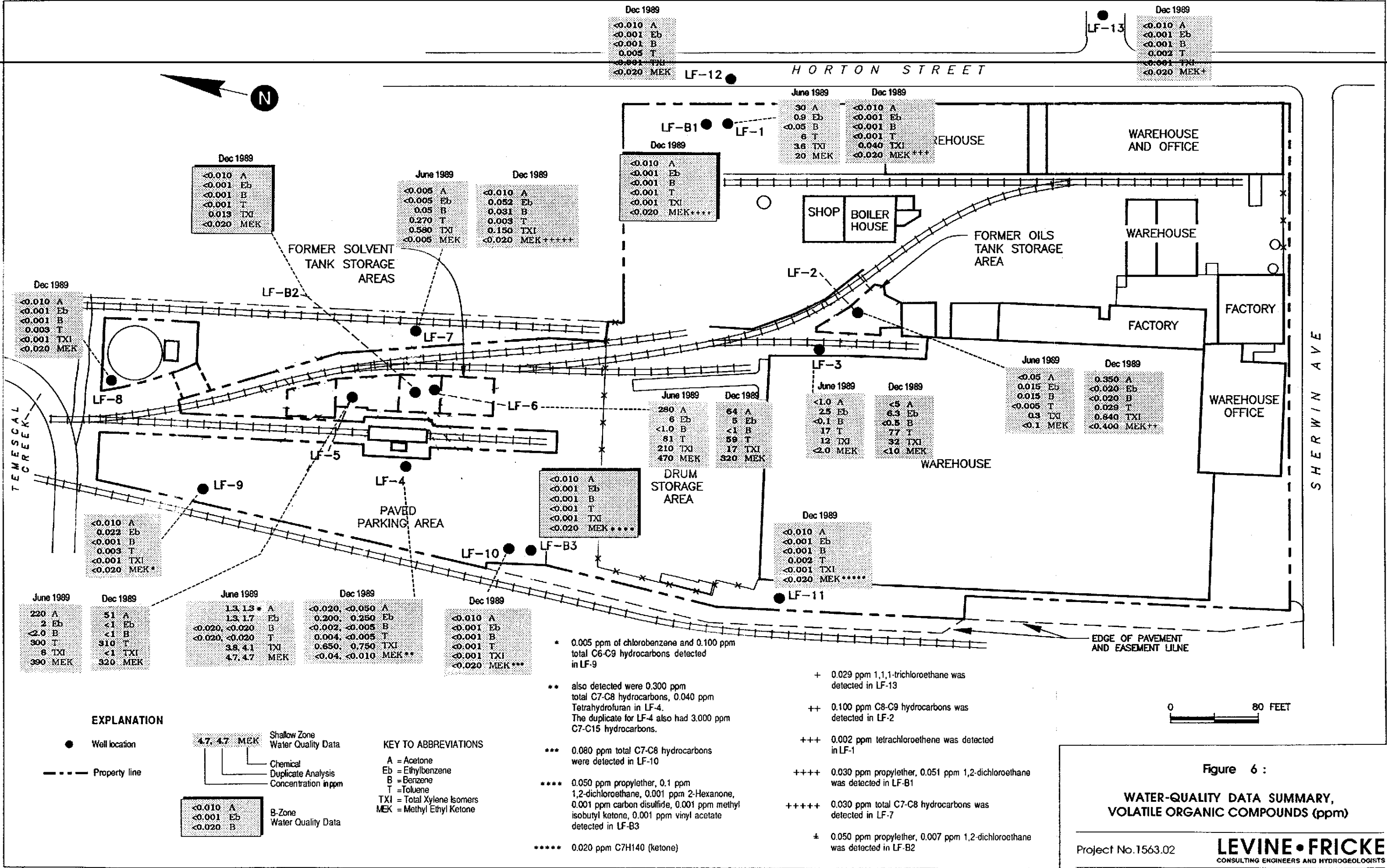


Figure 5 :
 APPARENT ARSENIC SOURCE AREA
 SOIL SAMPLE RESULTS
 METALS
 EPA METHOD 200/7000

Project No. 1563.02

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JDR30 APR90jc



EXPLANATION

- Well location
- - - Property line
- 4.7, 4.7 MEK Shallow Zone Water Quality Data
- Chemical Duplicate Analysis Concentration in ppm
- <0.010 A, <0.001 Eb, <0.020 B B-Zone Water Quality Data

KEY TO ABBREVIATIONS

- A = Acetone
- Eb = Ethylbenzene
- B = Benzene
- T = Toluene
- TXI = Total Xylene Isomers
- MEK = Methyl Ethyl Ketone

- * 0.005 ppm of chlorobenzene and 0.100 ppm total C6-C9 hydrocarbons detected in LF-9
- ** also detected were 0.300 ppm total C7-C8 hydrocarbons, 0.040 ppm Tetrahydrofuran in LF-4. The duplicate for LF-4 also had 3.000 ppm C7-C15 hydrocarbons.
- *** 0.080 ppm total C7-C8 hydrocarbons were detected in LF-10
- **** 0.050 ppm propylether, 0.1 ppm 1,2-dichloroethane, 0.001 ppm 2-Hexanone, 0.001 ppm carbon disulfide, 0.001 ppm methyl isobutyl ketone, 0.001 ppm vinyl acetate detected in LF-B3
- ***** 0.020 ppm C7H14O (ketone)
- + 0.029 ppm 1,1,1-trichloroethane was detected in LF-13
- ++ 0.100 ppm C8-C9 hydrocarbons was detected in LF-2
- +++ 0.002 ppm tetrachloroethene was detected in LF-1
- ++++ 0.030 ppm propylether, 0.051 ppm 1,2-dichloroethane was detected in LF-B1
- +++++ 0.030 ppm total C7-C8 hydrocarbons was detected in LF-7
- ± 0.050 ppm propylether, 0.007 ppm 1,2-dichloroethane was detected in LF-B2



**Figure 6 :
WATER-QUALITY DATA SUMMARY,
VOLATILE ORGANIC COMPOUNDS (ppm)**

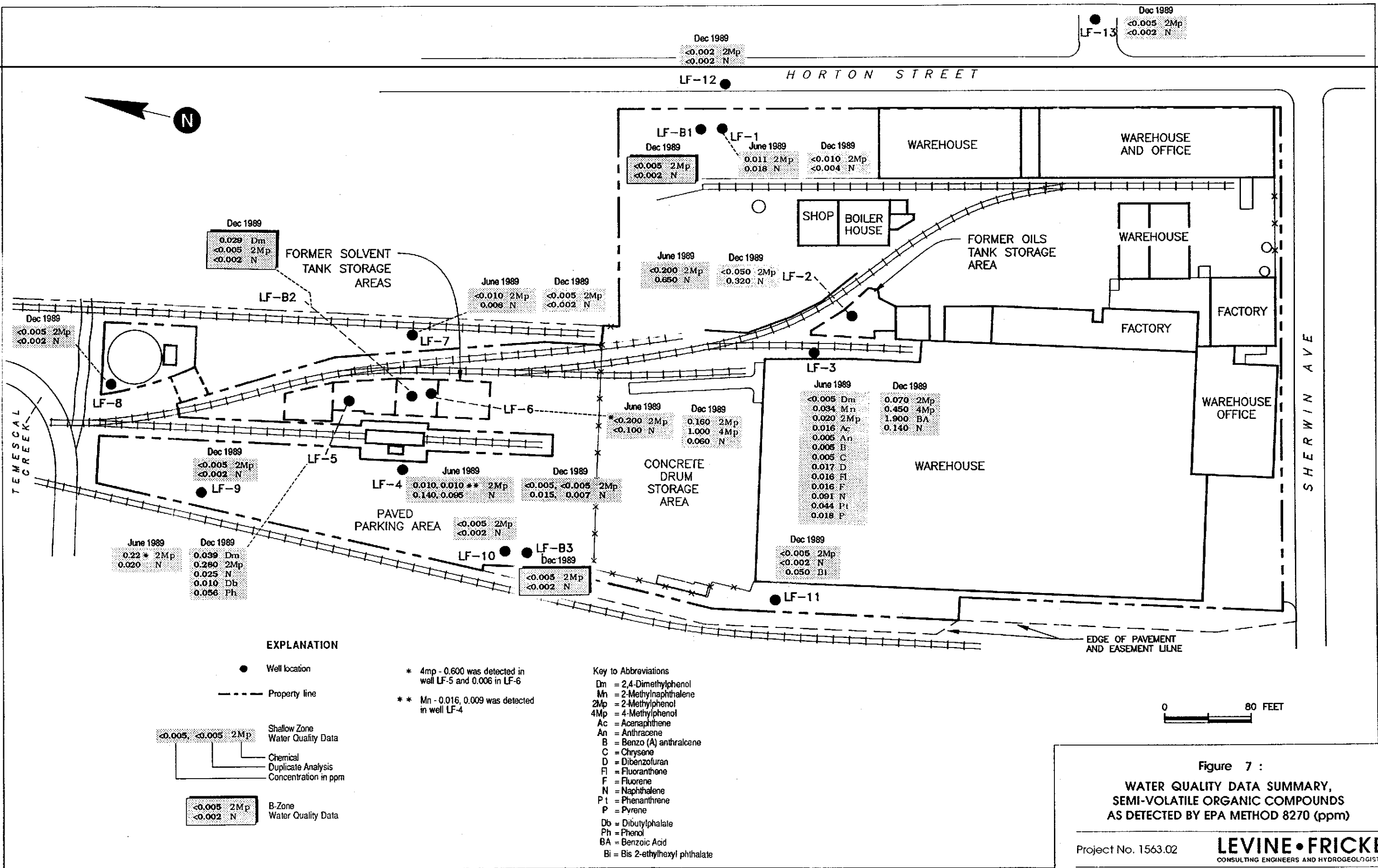
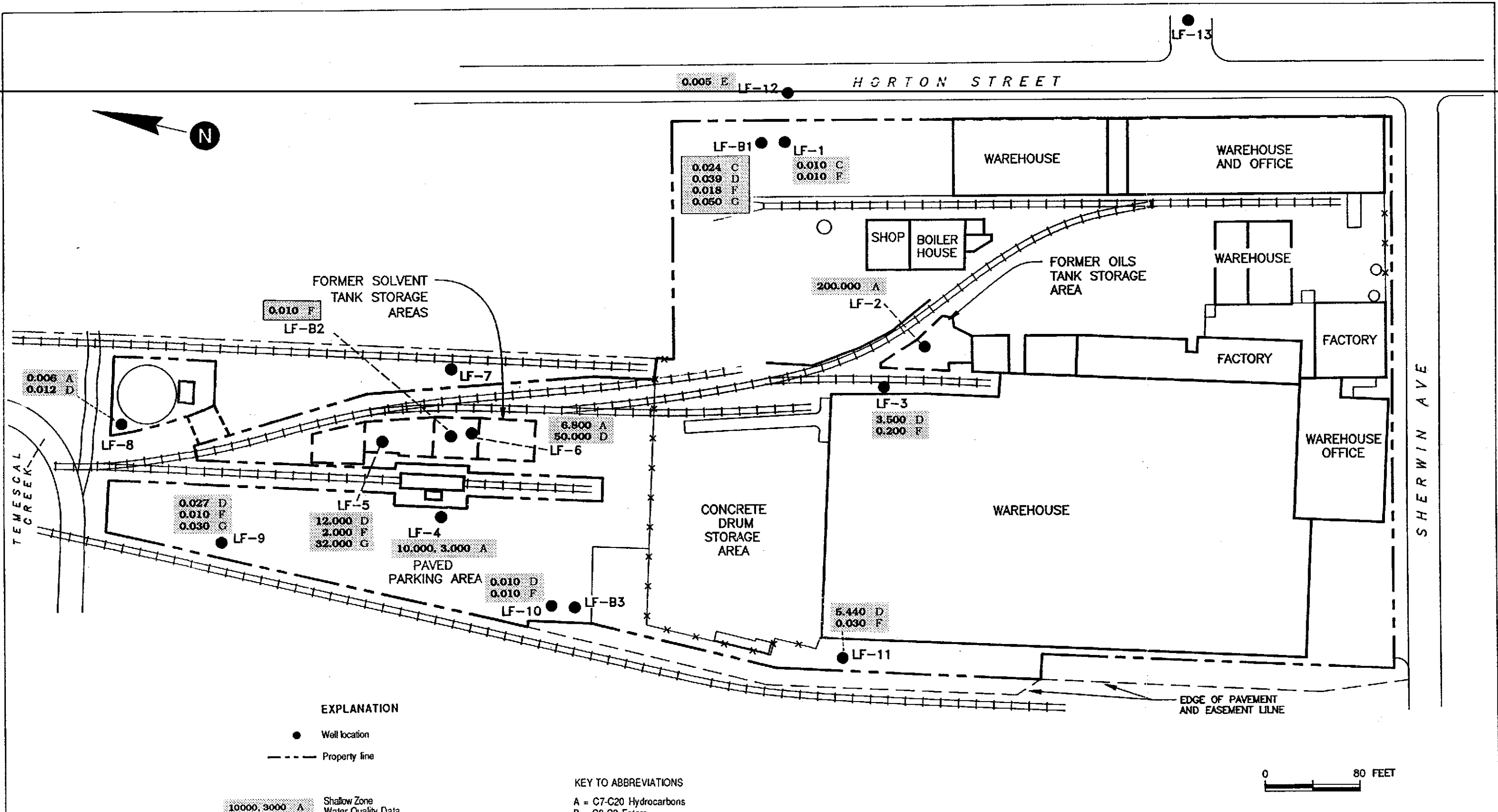


Figure 7 :
**WATER QUALITY DATA SUMMARY,
 SEMI-VOLATILE ORGANIC COMPOUNDS
 AS DETECTED BY EPA METHOD 8270 (ppm)**



EXPLANATION

- Well location
- - - Property line

- 10000, 3000 A Shallow Zone Water Quality Data
- Chemical Duplicate Analysis Concentration in ppm
- 10 F B-Zone Water Quality Data

KEY TO ABBREVIATIONS

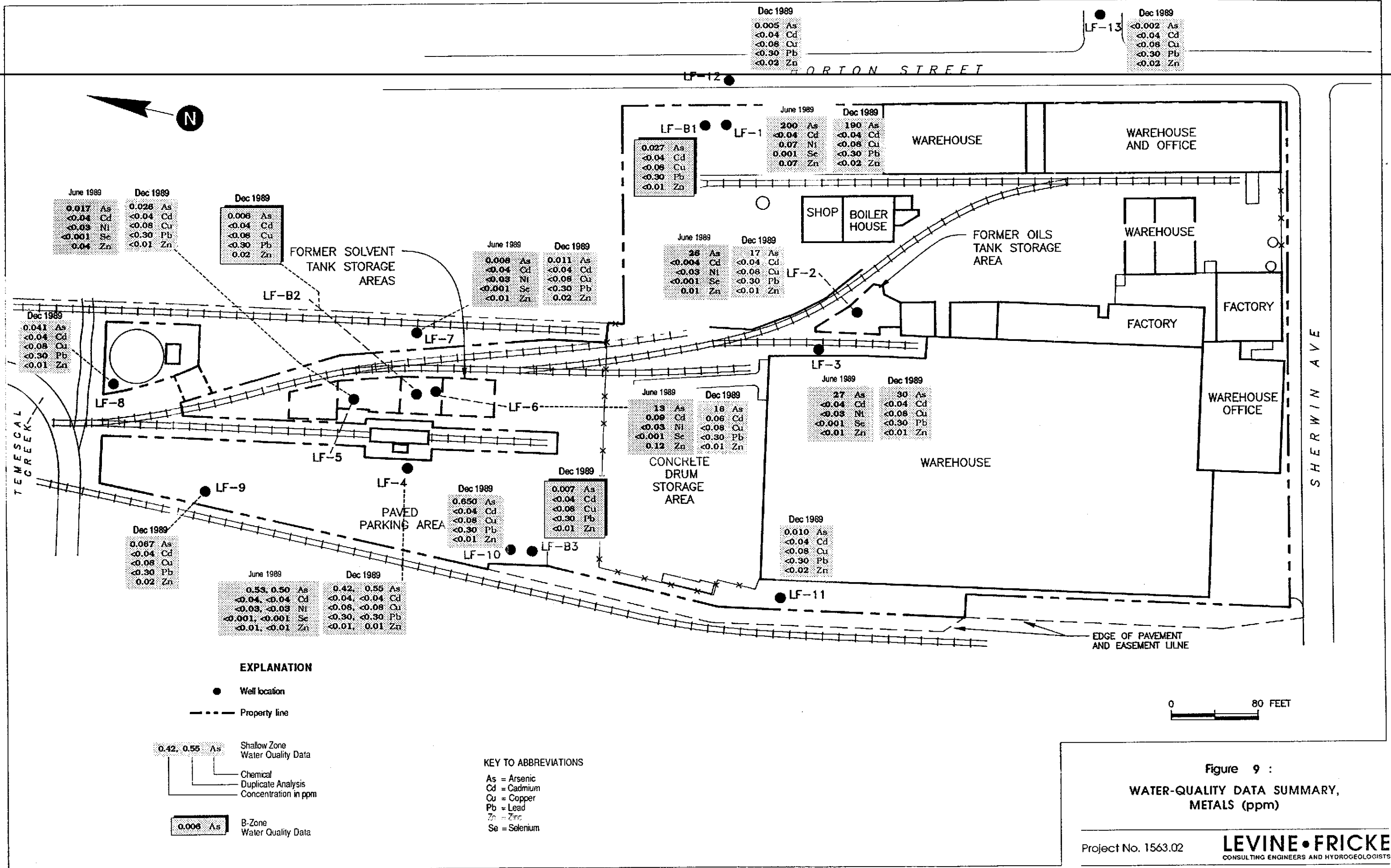
- A = C7-C20 Hydrocarbons
- B = C8-C9 Esters
- C = C6-C12 Ketones
- D = C5-C8 Organic Acids
- E = C6-C9 Alcohols
- F = Alkyl Benzene Isomers
- G = Molecular Sulfur

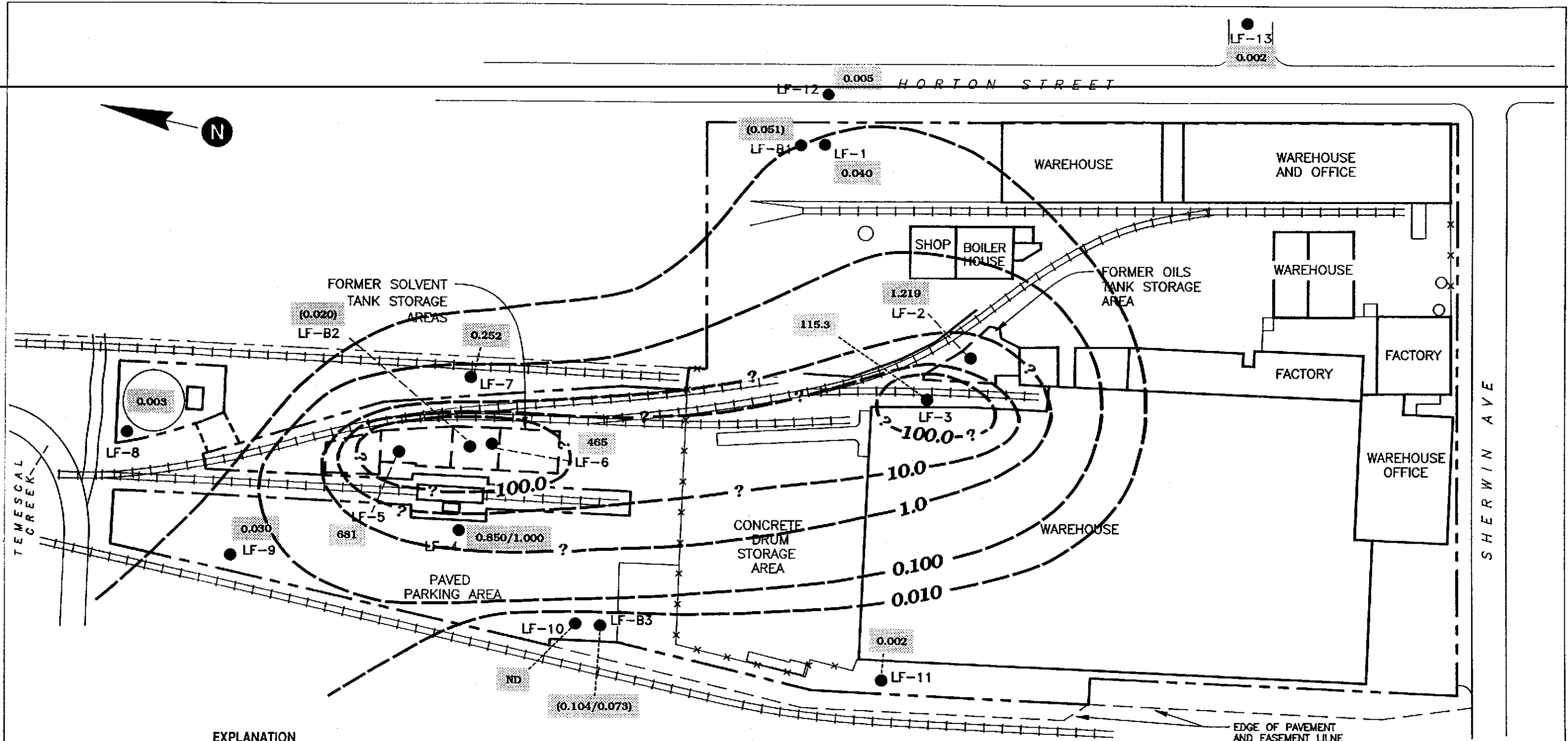
Results from December 1989

Figure 8 :
WATER-QUALITY DATA SUMMARY,
TENTATIVELY IDENTIFIED SEMI-QUANTIFIED
COMPOUNDS
EPA METHOD 8270 (ppm)

Project No. 1563.02

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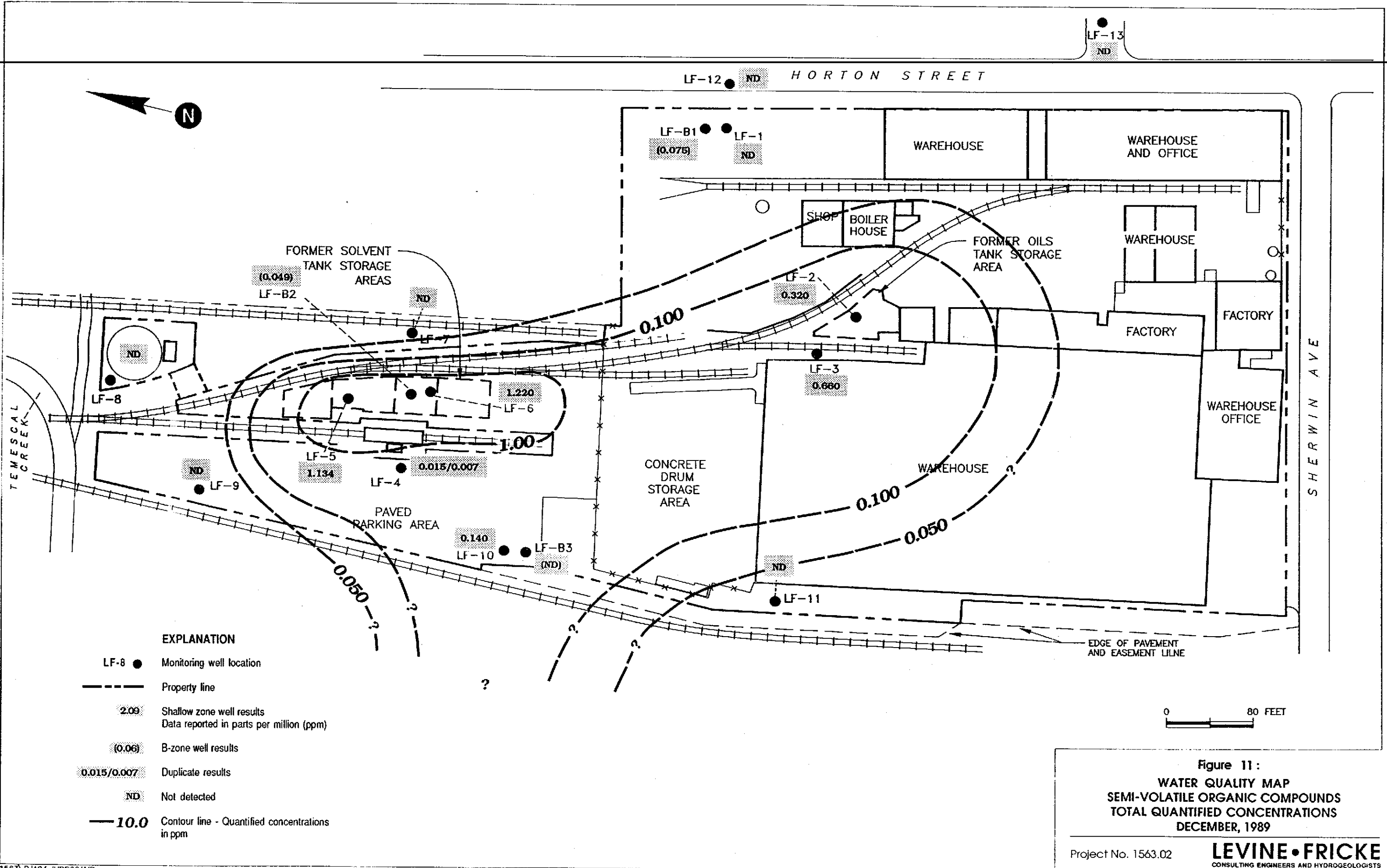


EXPLANATION

- LF-8 ● Monitoring well location
- Property line
- 0.125 Shallow zone well results
Data reported in parts per million (ppm)
- (0.063) B-zone well results
- 0.850/1.000 Duplicate results
- 10.0 Contour line - Quantified concentrations
in ppm

Figure 10 :
WATER QUALITY MAP
VOLATILE ORGANIC COMPOUNDS
TOTAL QUANTIFIED CONCENTRATIONS
DECEMBER, 1989

Project No. 1563.02
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LF-13
ND

LF-12 ND HORTON STREET

LF-B1 (0.075) LF-1 ND

WAREHOUSE

WAREHOUSE AND OFFICE

FORMER SOLVENT TANK STORAGE AREAS (0.049) LF-B2 ND

SHOP BOILER HOUSE

FORMER OILS TANK STORAGE AREA

WAREHOUSE

0.100

LF-2 0.320

FACTORY

FACTORY

LF-8 ND

1.220 LF-6

LF-5 1.134

LF-4 0.015/0.007

1.00

CONCRETE DRUM STORAGE AREA

LF-3 0.660

WAREHOUSE

WAREHOUSE OFFICE

PAVED PARKING AREA

0.140 LF-10

LF-B3 (ND)

LF-11 ND

0.050

EDGE OF PAVEMENT AND EASEMENT LINE

SHERWIN AVE

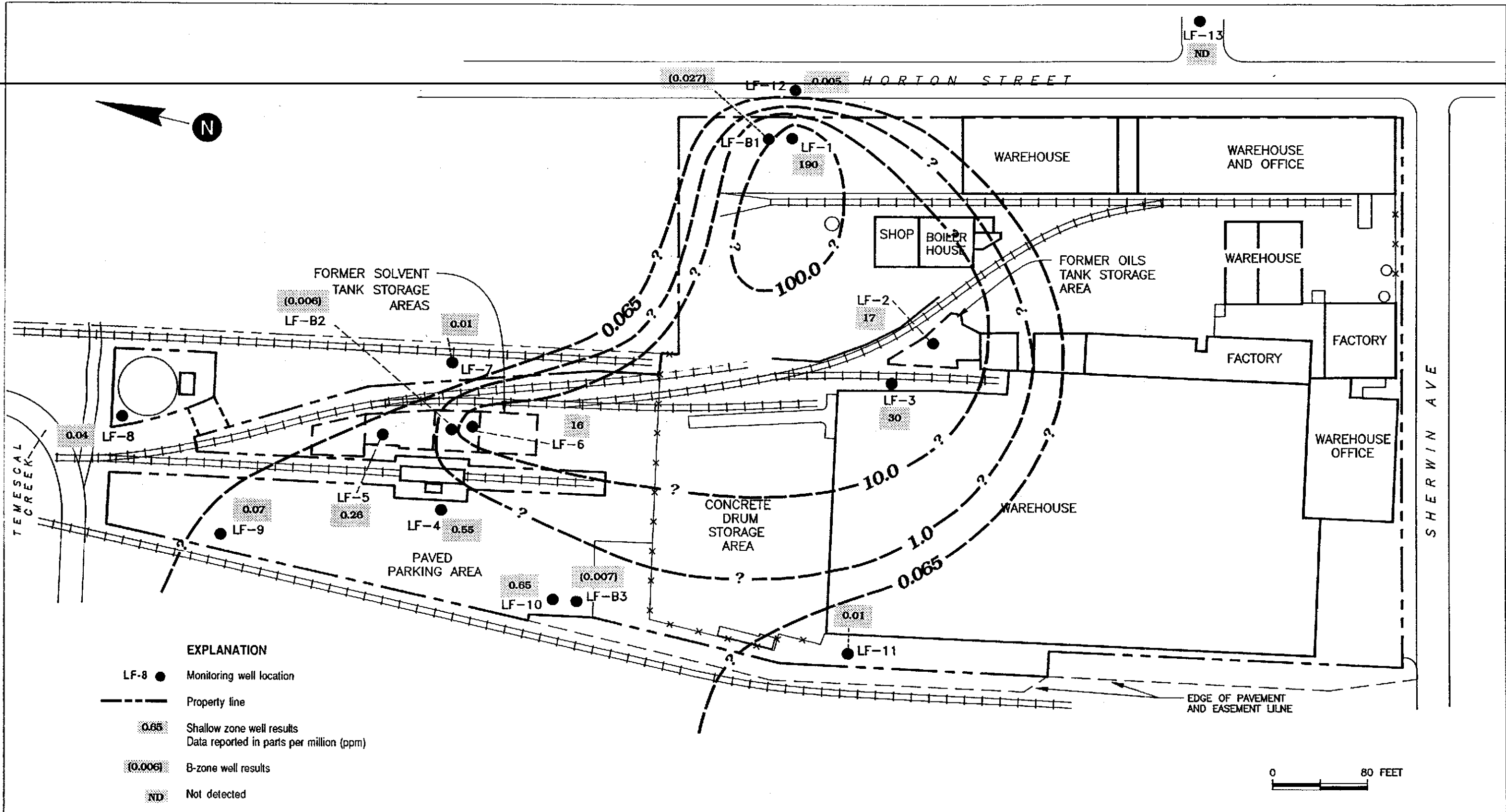
0 80 FEET

Figure 11:
WATER QUALITY MAP
SEMI-VOLATILE ORGANIC COMPOUNDS
TOTAL QUANTIFIED CONCENTRATIONS
DECEMBER, 1989

Project No. 1563.02

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JDR 6FEB90jc



- EXPLANATION**
- LF-8 ● Monitoring well location
 - Property line
 - 0.65 Shallow zone well results
Data reported in parts per million (ppm)
 - 0.006 B-zone well results
 - ND Not detected
 - 1.00 Contour line - Arsenic concentrations in ppm

Note: 0.065 considered to be the limit of valid data based on QA/QC review. See text for explanation.

Figure 12 :
 WATER QUALITY MAP
 ARSENIC CONCENTRATIONS
 DECEMBER, 1989

Project No. 1563.02

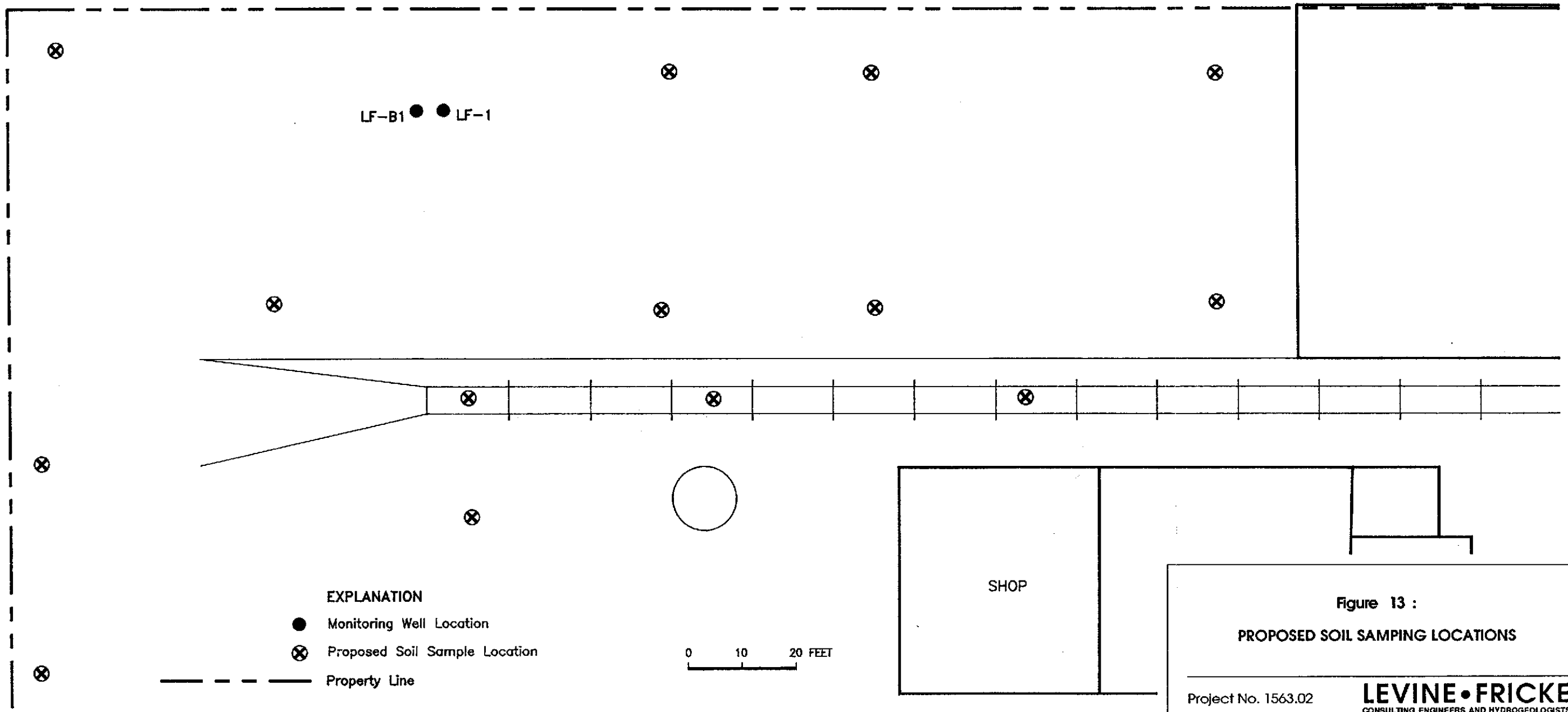
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HORTON STREET

LF-12 ●

LF-B1 ● ● LF-1



EXPLANATION

- Monitoring Well Location
- ⊗ Proposed Soil Sample Location
- - - - - Property Line

0 10 20 FEET

SHOP

Figure 13 :
PROPOSED SOIL SAMPLING LOCATIONS

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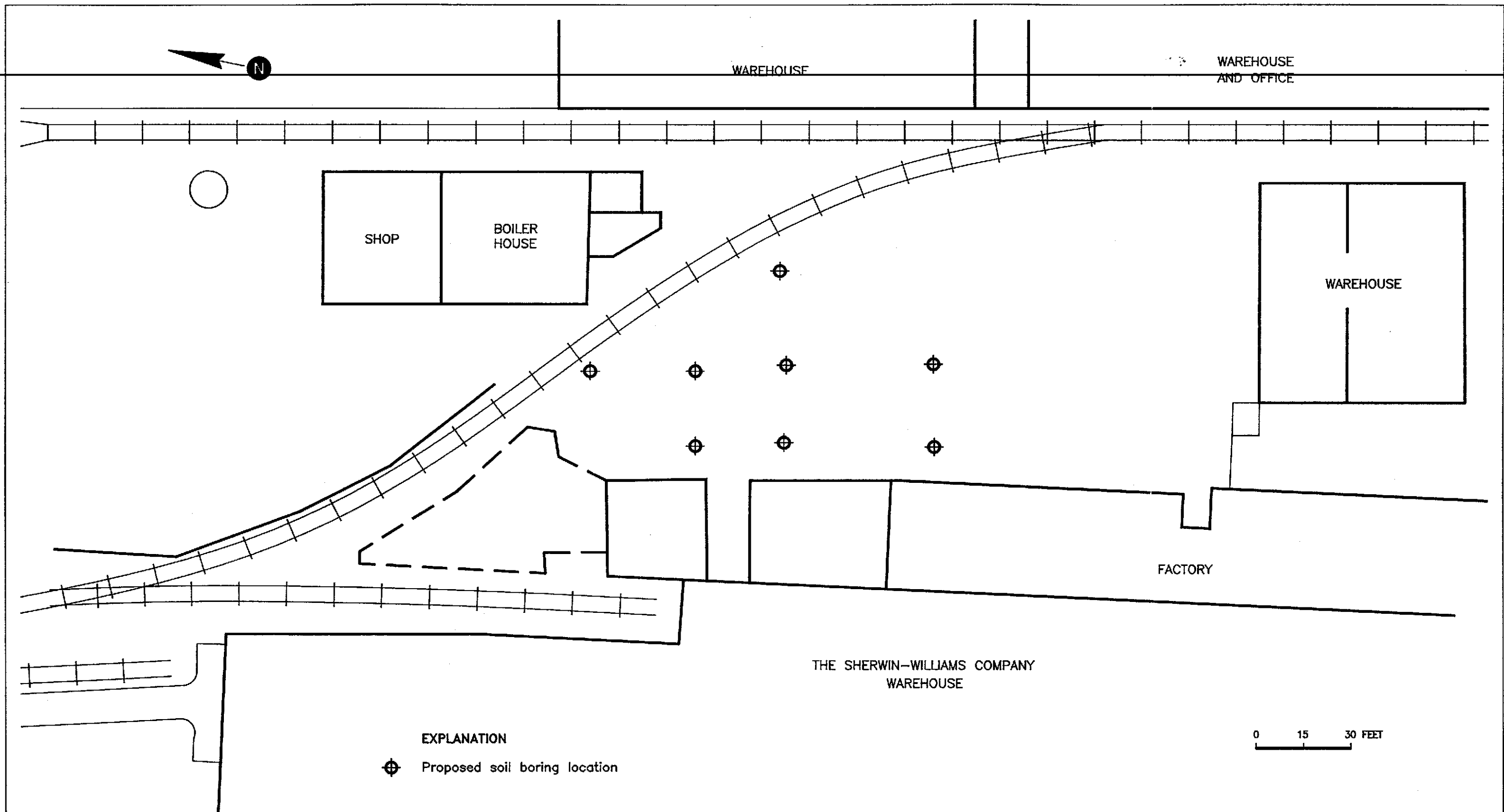
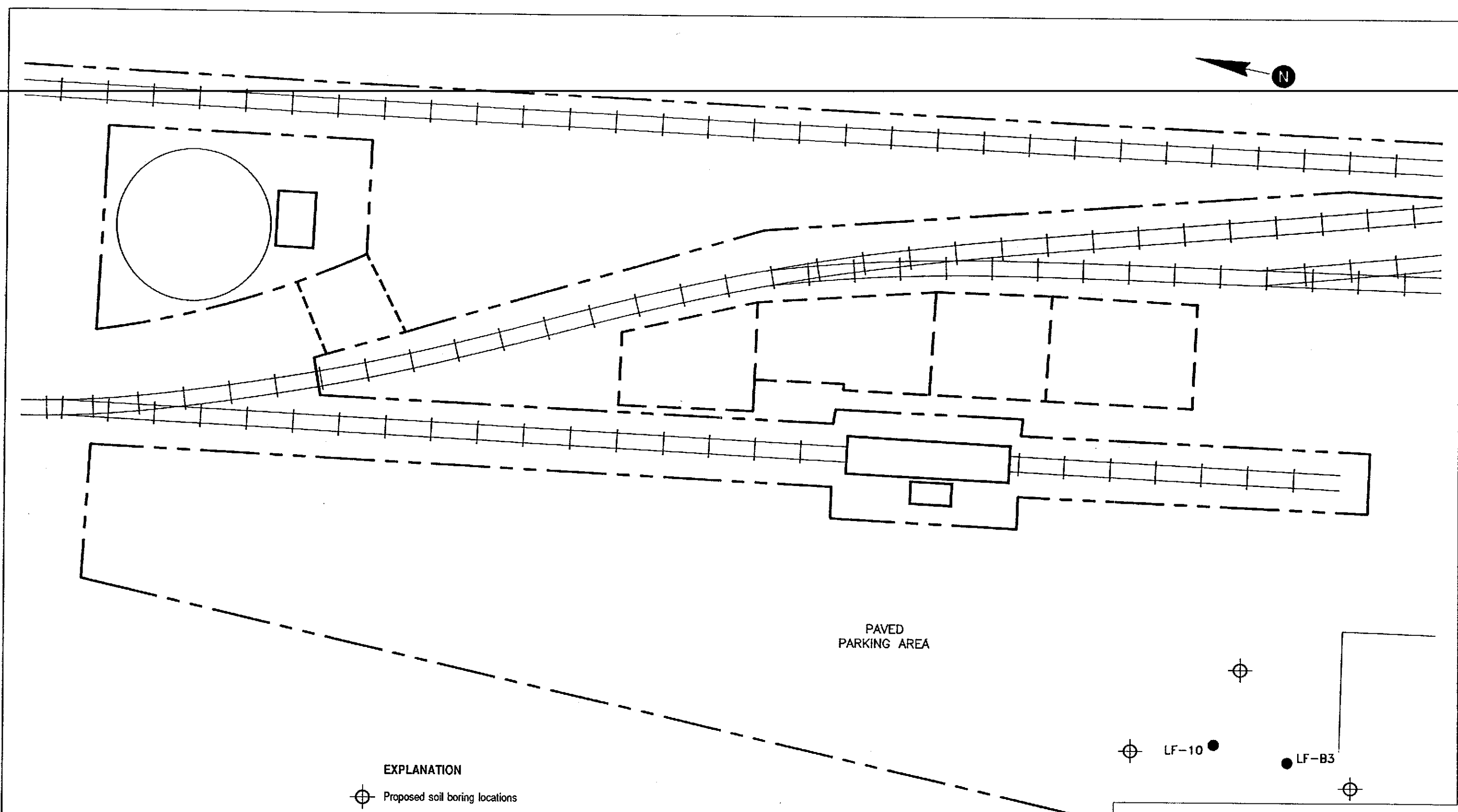


Figure 14 :
 APPROXIMATE TEXANOL SPILL AREA
 SOIL BORING LOCATIONS



- EXPLANATION**
- ⊕ Proposed soil boring locations
 - Existing monitoring well

PAVED
PARKING AREA

⊕ LF-10 ● LF-B3

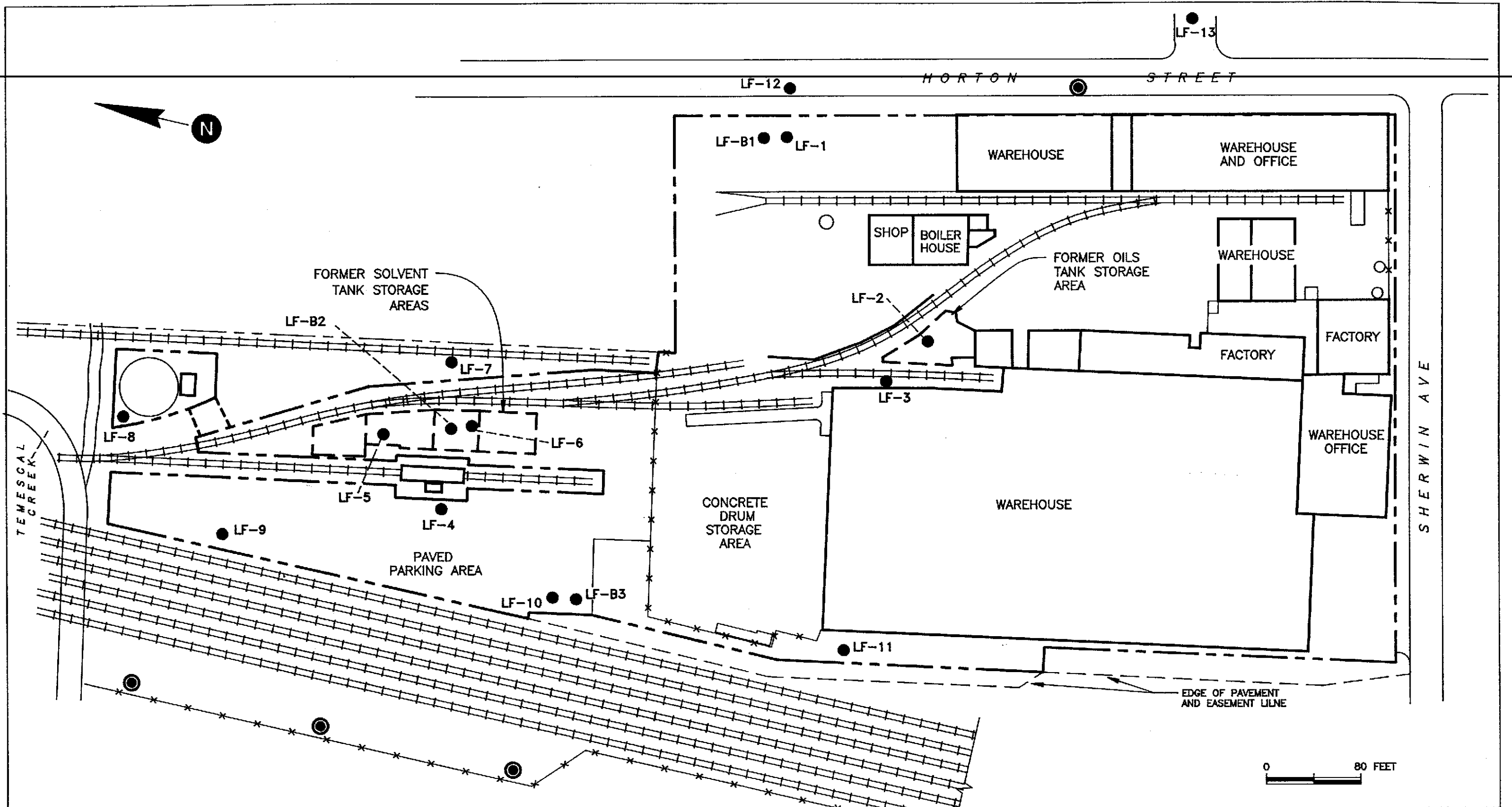
0 15 30 FEET

Figure 15 :
PAVED PARKING LOT AREA
SOIL BORING LOCATIONS

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JDP26APR90mpa



EXPLANATION

- ⊙ Proposed monitoring well location
- Monitoring well location
- - - Property line

Figure 16 :
 PROPOSED MONITORING WELL LOCATIONS

APPENDIX A
SUMMARY OF PRIOR INVESTIGATIONS

APPENDIX A

SUMMARY OF PRIOR INVESTIGATIONS

A: SUMMARY OF COMPOUNDS DETECTED IN SOIL SAMPLES

Former Solvent Tank Farm Area - Compounds that have been detected in the former solvent tank farm area are indicated in Figures 3A (volatile organic compounds), 3B (semi-volatile organic compounds), and 3C (metals). Detected volatile organic compounds include ethylbenzene (ranging from less than 0.100 ppm up to 1,500 ppm), toluene (ranging from less than 0.100 ppm up to 14,000 ppm), xylenes (ranging from less than 0.100 ppm up to 9,900 ppm), and a tentatively identified compound characterized as a C5-C13 hydrocarbon (estimated concentrations ranging from not detected up to 4,000 ppm). Detected semi-volatile organic compounds include naphthalene (ranging from less than 0.100 ppm up to 2.7 ppm), bis(2-ethylhexyl)phthalate (ranging from less than the detection limit up to 10 ppm), 2,4-dimethylphenol (ranging from less than the detection limit up to 8.1 ppm), some polynuclear aromatic compounds, including fluorene (one result at 0.8 ppm), phenanthrene (one result at 2.4 ppm), fluoranthene (one result at 1.4 ppm), pyrene (one result at 1.2 ppm), acenaphthene (one result at 1.0 ppm), and some tentatively identified longer chain hydrocarbon compounds (estimated concentrations ranging from less than the detection limit up to 1,000 ppm). The concentration of metals with elevated concentrations above background in the former solvent tank farm area include arsenic (ranging from less than the detection limit up to 170 ppm), barium (ranging from 17 ppm up to 530 ppm), cadmium (ranging from less the detection limit up to 25 ppm), copper (ranging from 13 ppm up to 470 ppm), lead (ranging from less than the detection limit up to 3,200 ppm), and zinc (ranging from 13 ppm up to 12,000 ppm).

Former Oils Tank Farm Area - Compounds that have been detected in soil in the former oils tank farm area are indicated in Figures 4A (volatile organic compounds), 4B (semi-volatile organic compounds), and 4C (metals). Detected volatile organic compounds include ethylbenzene (ranging from less than 0.100 ppm up to 140 ppm), toluene (ranging from less than 0.100 ppm up to 270 ppm), xylenes (ranging from less than 0.100 ppm up to 580 ppm), and a tentatively identified compound characterized as a C5-C13 hydrocarbon (estimated concentrations ranging from 400 ppm up to 10,000 ppm). Detected semi-volatile organic compounds include naphthalene (ranging from less than 0.100 ppm up to 4.9 ppm), 2-methylnaphthalene (ranging from not detected up to 6.6 ppm), di-n-butylphthalate (one result at 0.70 ppm), bis(2-ethylhexyl)-phthalate (ranging from 0.70 ppm up to 6.2 ppm), PCB (one result at 0.36 ppm), 2,4-dimethylphenol (ranging from less than the

detection limit up to 11 ppm), and some tentatively identified longer chain hydrocarbon compounds (ranging from less than the detection limit up to 2,000 ppm). With the exception of the results for lead from one soil boring (SW-1), the concentrations of metals in the former oils tank farm area do not appear to be elevated above background levels as determined from data collected from two off-site upgradient locations.

Apparent Arsenic Source Area - Analysis of soil samples collected during the drilling of two monitoring wells in the apparent arsenic source area reported primarily arsenic, with concentrations ranging from 5.6 ppm up to 480 ppm. Arsenic concentrations in this area appear to decrease significantly with depth (Figure 5).

B: SUMMARY OF GROUND-WATER QUALITY

Shallow-Zone Ground-Water Quality - Results from shallow-zone ground-water samples indicate a range of volatile and semi-volatile organic compounds and some metals (notably, arsenic and, to a lesser degree, cadmium). Quantified organic compounds with significant concentrations detected in more than one well included acetone, ethylbenzene, methyl ethyl ketone, total xylenes, and toluene. A major component of the detected volatile and semi-volatile organic compounds include several groups of tentatively identified compounds (TICs) that had semi-quantified estimates of concentrations. These TICs include straight chain hydrocarbons, alcohols, ketones, esters, organic acids, alkyl benzene isomers, and molecular sulfur. The TICs have semi-quantified estimates of concentrations because laboratory standards were not available for quantification reference.

The results of the laboratory analyses for volatile organic compounds detected in shallow-zone ground water are indicated on Figure 6. The results for semi-volatile organic compounds are indicated on Figure 7. Semi-quantified results are summarized on Figure 8 and metals results are indicated on Figure 9.

The results for wells LF-5 and LF-6 show that the former solvent tank farm area has elevated concentrations of acetone (51 to 64 ppm), ethylbenzene (less than 1 to 5 ppm), methyl ethyl ketone (320 ppm), total xylenes (less than 1 to 17 ppm), toluene (59 to 310 ppm), naphthalene (0.025 to 0.060 ppm), 2-methylphenol (0.160 to 0.280 ppm), 4-methylphenol (0.790 to 1.000 ppm), 2,2-dimethylphenol (less than 0.100 to 0.039 ppm), arsenic (less than 0.026 to 16 ppm), and cadmium (less than 0.04 to 0.06). The results for these compounds generally decrease significantly in the perimeter wells LF-4, LF-8, LF-9, and LF-10.

The results for wells LF-2 and LF-3 show that the former oils tank farm area has elevated concentrations of acetone (less than 5 to 0.350 ppm), ethylbenzene (less than 0.020 to 6.3 ppm), total xylenes (0.840 to 32 ppm), toluene (0.029 to 77 ppm), naphthalene (0.140 to 0.320 ppm), 2-methylphenol (less than 0.050 to 0.070 ppm), 4-methylphenol (less than 0.100 to 0.450 ppm), and arsenic (17 to 30 ppm). Semi-quantified results for tentatively identified compounds indicate total estimated concentrations for these downgradient wells that range from 0.160 ppm for LF-10 to 5.520 ppm for LF-11 (for semi-volatile organic compound results).

The results for LF-1 show high concentrations of arsenic (190 ppm) with some evidence of total xylenes (0.040 ppm) and C3 alkyl benzene (0.010 ppm).

The results for two upgradient off-site wells LF-12 and LF-13 show background levels of toluene (0.002 to 0.005 ppm), 1,1,1-trichloroethane (1,1,1-TCA; 0.029 ppm), and arsenic (less than 0.002 to 0.005 ppm).

Four downgradient wells located on the northern and western margins of the Site reported results that were generally below the laboratory detection limits for quantified volatile and semi-volatile organic compounds except for toluene (LF-8 and LF-9 at 0.003 ppm), naphthalene (LF-10 at 0.140 ppm), and arsenic (LF-10 at 0.650 ppm).

B-Zone Ground-Water Quality - The results for the B-zone wells (LF-B1, LF-B2, LF-B3) were generally below the laboratory limits of detection except for total xylenes (less than 0.001 to 0.013 ppm), 1,2-DCA (1,2-dichloroethane; 0.007 to 0.100 ppm), 2-hexanone (less than 0.001 to 0.001 ppm), vinyl acetate (less than 0.001 to 0.001 ppm), styrene (less than 0.001 to 0.001 ppm), methyl isobutyl ketone (less than 0.001 to 0.001 ppm), 2,4-dimethylphenol (less than 0.005 to 0.029 ppm), and zinc (less than 0.01 to 0.020 ppm). The B-zone results also included semi-quantified estimates for tentatively identified compounds propylether (up to 0.070 ppm) and C3 benzene (0.010 ppm). This suite of chemicals is notably different from the group of chemicals reported for the shallow-zone results. It should be noted that these are all low concentrations, indicating that the B-zone is relatively unaffected.