FINAL
Revised Evaluation of Existing Interim Remedial Measures and Work Plan for Implementation of Future Interim Remedial Measures
Sherwin-Williams Facility
Emeryville, California

August 7, 1998
6215.00-015

Prepared for
The Sherwin-Williams Company
101 Prospect Avenue, N.W.
Cleveland, Ohio 44115

Levine·Fricke·Recon
ENGINEERS, HYDROGEOLOGISTS & APPLIED SCIENTISTS

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August 7, 1998

6215.00-015

Mr. Mark Johnson
California Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, California 94612

Subject: Final Report of Revised Evaluation of Existing Interim Remedial Measures and Work Plan for Implementation of Future Interim Remedial Measures, Sherwin-Williams Facility, Emeryville, California

Dear Mr. Johnson:

Enclosed is the subject final report. Levine·Fricke·Recon Inc. (LFR) has prepared this Revised Evaluation of Existing Interim Remedial Measures (IRMs) and Work Plan for Implementation of Future Interim Remedial Measures at the Sherwin-Williams Facility in Emeryville, California, on behalf of The Sherwin-Williams Company ("Sherwin-Williams") in accordance with Site Cleanup Requirements Order 98-009 adopted by the Regional Water Quality Control Board (RWQCB) on February 19, 1998. A summary of the responses to all comments submitted in writing by the RWQCB and the Consultative Work Group (CWG) is provided in Appendix A. The thoughts and comments received in the CWG meetings have been considered in preparing this revised report.

The subject report presents an evaluation of the effectiveness of existing IRMs at the Site in meeting remedial objectives. These IRMs and remedial objectives were first described in the "Evaluation of Interim Remedial Measures" submitted to the RWQCB on December 20, 1991 (EIRM). The subject report is limited to the IRMs previously implemented on site for Sherwin-Williams as described in the EIRM.

If you have any questions, please call Larry Mencin of The Sherwin-Williams Company at (216) 566-1768 or Mark Knox or Mike Marsden of LFR at (510) 652-4500.

Sincerely,

Mark D. Knox

Mark D. Knox, P.E.
Principal Engineer

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All information, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a Levine·Fricke·Recon California Professional Engineer.

8/7/98
Date

Mark D. Knox
Principal Engineer
California Professional Engineer (33194)

Sherwin-Williams has also implemented four additional remedial actions at the Site and in the site vicinity:

- a "hot-spot" excavation and disposal of metals- and VOC-affected soil in 1990 from the former solvent tank storage area
- the excavation and removal in 1994 of the underground storage tanks (USTs) historically owned by Southern Pacific railroad (SPRR) near the western Site property boundary (performed by both Sherwin-Williams and SPRR)
- the excavation and disposal of arsenic- and lead-affected soil from the Horton Street area in 1997
- the installation of the multipoint collection system during the 1997-1998 rainy season to isolate the storm-water collection system from infiltration of groundwater

Evaluation of Effectiveness

In this report, the effectiveness of the IRMs to meet the above objectives is evaluated collectively, rather than an individual evaluation of each IRM. This approach is appropriate because the IRMs have been designed to work together as an overall system and the effectiveness of one IRM impacts the effectiveness of other IRMs.

To date, the IRMs have not fully achieved their overall objectives, primarily because the IRMs have not adequately controlled groundwater elevations inside the slurry wall area on a continuous basis. Increased groundwater elevations inside the slurry wall area resulted in: (1) the infiltration of chemically affected groundwater into the storm-water collection system and then into Temescal Creek, and (2) the potential for groundwater to flow through the slurry wall, from inside to outside, due to an outward hydraulic gradient across the slurry wall.

Inhibiting Off-Site Migration of Chemically Affected Groundwater

The effectiveness of the IRMs in meeting the objective of inhibiting the migration of affected groundwater from the Site to off-site areas was evaluated by analyzing the following parameters: water balance inside the slurry wall area, groundwater elevations and flow directions inside and outside the slurry wall area, and chemical concentrations in groundwater inside and outside the slurry wall area.

Based on available data, the IRMs have been moderately effective in inhibiting off-site migration of chemically affected groundwater. Exceptions to this conclusion include:

- the period when chemically affected groundwater infiltrated into the storm-water collection system and then entered Temescal Creek
- uncertainty regarding the cause(s) of the statistically significant increasing trend in arsenic concentration at monitoring well MW-5, located in the vicinity of a known arsenic source area outside the slurry wall area

Although the IRMs have not consistently performed as designed to maintain an inward hydraulic gradient across the slurry wall, groundwater quality conditions have not generally deteriorated outside the slurry wall area, as evidenced by the absence of a statistically significant increasing trend in chemical concentrations in most wells outside the slurry wall. Nevertheless, because the potential for off-site migration of chemicals has existed frequently in the past, the IRMs will be improved as discussed in the Work Plan section (Section 4) of this report.

Removing Chemical Mass in Groundwater

The effectiveness of the IRMs in meeting the objective of removing chemical mass in groundwater inside the slurry wall area has been limited by frequent down-time of the GWTS and GWES. Due to recent improvements to the GWTS and increased operating time of the GWES, the chemical mass removal rate in the first half of 1998 has substantially increased. The GWES expansion proposed herein is expected to increase the chemical mass removal rate.

Since startup of the GWES and GWTS in October 1995, approximately 585 pounds of arsenic, 56 pounds of volatile organic compounds (VOCs), 87 pounds of total petroleum hydrocarbons as gasoline (TPHg), and 13 pounds of TPH as diesel (TPHd) have been extracted from the groundwater by the GWES.

Reducing the Potential for Exposure to Chemically Affected Soil and Groundwater

The potential exposure to chemically affected soil has been reduced by the installation of the asphalt and concrete cap and the soil remedial actions performed at the Site. The effectiveness of the IRMs in reducing the potential exposure to chemically affected soil and groundwater has varied since the IRMs were implemented. The cap, slurry wall, GWES, and storm-water collection system became less effective in reducing the potential for exposure to chemically affected groundwater by off-site receptors (Temescal Creek) when groundwater elevations inside the slurry wall area continued to increase in 1997.

The installation of the multipoint system in November 1997 was effective in isolating the storm-water collection system from infiltration of and off-site transport of contaminated groundwater to Temescal Creek. The increased performance of the GWES in the first half of 1998 and drier weather in May and June 1998 have resulted in groundwater elevations being lower than the inverts of the storm-water collection system and the development of an inward hydraulic gradient at numerous locations across the slurry wall. Thus, the potential for exposure to chemically affected groundwater was recently reduced and implementation of IRM improvements (as discussed below) should continue to reduce potential exposure to affected groundwater.

Work Plan for Implementation of Future Interim Remedial Measures

To improve the performance of the IRMs, a work plan was developed that identifies several tasks to enhance existing IRMs. The GWES will be expanded to increase the groundwater extraction rate within the slurry wall area, which will result in lower groundwater elevations within the slurry wall area and ensure the continuance of an inward hydraulic gradient. The GWES will be expanded by the addition of seven new on-site extraction wells. The effectiveness of the expanded GWES in achieving the IRM objectives will be monitored through monthly and quarterly monitoring of existing piezometers and monitoring wells.

The recommended future actions with respect to the cap and storm-water collection system are to prevent infiltration around the railroad tracks, to continue performing periodic maintenance of the cap, and to continue performing quarterly groundwater elevation measurements. A railroad design engineer will develop a solution to eliminate infiltration of surface rainwater along the railroad tracks. The long-term solution to prevent chemically affected groundwater from entering the storm-water collection system is to lower the groundwater table below the storm-water collection system piping through the GWES and GWTS expansion as discussed herein. Since the groundwater elevations have been recently lowered to below the inverts of the storm-drain lines, the storm-water collection system will effectively convey surface storm water to Temescal Creek and requires no further action. A check valve will be installed at the outfall to the creek to prevent water in Temescal Creek from flowing into the storm-water collection system during high tide events.

LFR has evaluated the performance and capacity of the existing GWTS. Upgrading of the GWTS is necessary to accommodate the projected increased flows from the expanded GWES. In addition, future expansion of the extraction system outside the slurry wall is proposed at the former Rifkin property and may be necessary elsewhere. The number of additional wells required in the future will be determined through the Site Remedial Investigation/Feasibility Study to be conducted in 1998 and 1999.

Due to concerns that the Andco technology would not consistently meet the National Pollutant Discharge Elimination System (NPDES) limit for arsenic at the higher projected flow rates, LFR has performed an evaluation of numerous arsenic-removal technologies as alternatives to the Andco system. Based on positive results of pilot-scale demonstrations conducted between January and May 1998, Sherwin-Williams has contracted MSE Technology Applications, Inc., to design and build a 30-gallon per minute (gpm) GWTS, using its proprietary reductive precipitation technology. Once operational, the MSE system will replace the existing Andco system.

1.0 INTRODUCTION

Levine·Fricke·Recon Inc. (LFR) has prepared this report on behalf of The Sherwin-Williams Company ("Sherwin-Williams") to comply with Task B.4. of the Regional Water Quality Control Board's (RWQCB) Site Cleanup Requirements Order 98-009, issued on February 19, 1998 ("the SCR Order"). This report describes existing interim remedial measures (IRMs) implemented at the Sherwin-Williams Facility in Emeryville, California ("the Site"; Figure 1-1), evaluates the effectiveness of the IRMs in meeting remedial objectives, and proposes modifications to the IRMs to improve their effectiveness.

This report incorporates comments from the RWQCB and the Consultative Work Group (CWG) on the previous draft final report entitled, "Draft Final Evaluation of Existing Interim Remedial Measures and Work Plan for Implementation of Future Interim Remedial Measures, Sherwin-Williams Facility, Emeryville, California," dated May 20, 1998 (LFR 1998a). Responses to comments submitted in writing by the RWQCB and the CWG on the May 1998 report are included in Appendix A of this report.

The IRMs were implemented in order to address immediate environmental concerns from known source areas at the Site. The IRMs were not designed to address chemically affected soil and groundwater that existed in off-site areas prior to implementation of the IRMs, such as the arsenic source area located on the adjacent former Rifkin property.

The objectives for each individual IRM were initially presented to the RWQCB in the LFR report entitled, "Evaluation of Interim Remedial Measures at the Sherwin-Williams Facility, Emeryville, California," dated December 20, 1991 ("EIRM Report"; LFR 1991). The objectives presented in the EIRM report were repeated in the LFR report entitled, "Interim Remedial Measures Completion Report, Sherwin-Williams Facility, Emeryville, California," dated April 19, 1996 ("IRM Completion Report"; LFR 1996). The primary overall objectives of the IRMs include the following:

- inhibiting off-site migration of chemically affected groundwater
- removing chemical mass in groundwater (although this objective was not explicitly defined in LFR 1991 or LFR 1996, it is included here because it was implied and it is another objective)
- reducing the potential for exposure to chemically affected soil and groundwater (including controlling source areas to prevent or minimize further groundwater impacts on site)

In this report, the effectiveness of the IRMs to meet these objectives is evaluated collectively, rather than an individual evaluation of each IRM. This approach is

1.3.2 Soil and Groundwater-Quality Conditions

Results of soil and groundwater sampling conducted at the Site and its vicinity (former Rifkin property and Horton Street; Figure 1-2) are summarized in Table 1-1. This table provides ranges of concentrations of the primary chemicals of concern detected in soil and groundwater, which include metals (arsenic and lead), benzene, toluene, ethylbenzene, and xylene (BTEX), volatile organic compounds (VOCs) – other than BTEX, total petroleum hydrocarbons (TPH) as gasoline (TPHg), and TPH as diesel (TPHd).

As explained in Section 3.1.3 of this report, arsenic is used as an indicator for evaluating the impacts of the IRMs on groundwater quality conditions in the vicinity of the Site. Therefore, the distribution of arsenic in groundwater during the most recent sampling event (April 1998) is provided in Figure 1-3 for reference in this report.

As shown in Figure 1-3, arsenic-affected A-zone groundwater at the Site and the site vicinity occurs primarily inside the slurry wall (Figure 1-3). Arsenic was detected at a concentration of 147 milligrams per liter (mg/l) in this area (well LF-22). A portion of this area of arsenic-affected groundwater extends onto the southwest portion of the former Rifkin property (downgradient from the Site), and approximately 200 feet to the north of the slurry wall along the western former Rifkin property/Site property boundary (downgradient from the Site). In this area, arsenic was detected at a concentration of 208 mg/l (well MW-5). Arsenic-affected groundwater also extends west of the Site.

As shown in Figure 1-4, arsenic was detected in two of four B-zone groundwater monitoring wells in April 1998 (LF-B5 and LF-B6, both located inside the slurry wall). The arsenic concentrations were 0.0067 mg/l at well LF-B6 and 0.13 mg/l at well LF-B5. Concentrations of chemicals in LF-B5 may not be representative of B-zone groundwater quality because well LF-B5 is screened within the A/B aquitard. Arsenic was not detected above analytical detection limits at well LF-B3, located inside the slurry wall, and at well LF-B4, located on Horton Street. Arsenic was not detected above analytical detection limits in grab groundwater samples collected by others from three locations on Horton Street in July 1993 (LFR 1998b).

1.4 Development of IRM Alternatives

In 1990, Sherwin-Williams retained LFR to develop and evaluate IRM alternatives that would address potential impacts from affected soil and groundwater encountered during investigation activities. The IRMs were implemented in order to address immediate environmental concerns. The objectives of the IRM alternatives were to reduce or eliminate potential human exposure to chemically affected soil and groundwater, to inhibit the migration of chemically affected groundwater from the Site to off-site areas, and to mitigate the impacts of the chemical source areas at the Site. Various IRMs were evaluated for the Site, using National Contingency Plan guidelines for interim actions. The IRM alternatives were evaluated based on their feasibility, effectiveness, and ability to be implemented. Based on the results of these evaluations, Sherwin-Williams proactively proposed several IRMs for the Site to meet these goals.

The proposed IRMs for the Site were presented in the EIRM Report (LFR 1991). The RWQCB approved the proposed IRMs in a letter signed by the Executive Officer, Steve Ritchie, dated March 10, 1992 (RWQCB 1992).

1.5 Implementation of IRMs and Additional Remedial Actions

Sherwin-Williams has implemented the following IRMs (Figure 1-2):

- a slurry wall to contain chemically affected areas and to inhibit the migration of chemically affected groundwater at the Site to off-site areas, and a GWES to remove the chemically affected groundwater inside the slurry wall and to create an inward hydraulic gradient inside the slurry wall
- a cap and storm-water collection system to prevent infiltration of storm-water runoff into chemically affected soils
- a GWTS to treat the extracted, chemically affected groundwater

Sherwin-Williams has also implemented several additional remedial actions (Figure 1-2), including:

- a "hot-spot" excavation and disposal of affected soil from the former solvent tank storage area (LFR 1991)
- the excavation and removal of the SPRR-owned USTs near the western property boundary (performed by both Sherwin-Williams and SPRR)
- the excavation and disposal of soil primarily affected with arsenic and lead from Horton Street
- the installation of the multipoint collection system during the 1997-1998 rainy season to isolate the storm-water collection system from infiltration of groundwater

Design of the IRMs was initiated after receiving approval from the RWQCB. The bidding of the construction of the IRMs was conducted and IRM implementation began in July 1993 with the start of construction of the slurry wall. The slurry wall was completed in November 1994, after delays in obtaining a lot line adjustment for property purchased from SPRR. The GWES and GWTS were installed between June and September 1995 and began operation in October 1995. Construction of the cap and storm-water collection system took place between March 1995 and September 1995.

The first additional remedial action was implemented in 1990 when chemically affected soil in the northwestern portion of the Site (i.e., "hot-spot") was excavated and disposed of at an off-site landfill. The second additional remedial action was implemented in 1994, when the SPRR-owned USTs encountered on the western property boundary were removed in 1994 by SPRR. The third additional remedial action was implemented in 1997, when primarily arsenic- and lead-affected soil was excavated from Horton Street and disposed off site at a landfill. The fourth additional remedial action occurred during the winter of 1997-1998, when the multipoint collection system was installed.

The descriptions and objectives of the IRMs are presented in greater detail in Section 2.

2.0 INTERIM REMEDIAL MEASURES AND ADDITIONAL REMEDIAL ACTIONS

The following sections describe and present the objectives of the IRMs and additional remedial actions performed at the Site.

2.1 Descriptions of the IRMs and Additional Remedial Actions

The IRMs were designed to work in conjunction with each other; that is, the overall effectiveness of an IRM is dependent on the interaction between one another. The slurry wall, the asphalt and concrete cap, and the storm-water collection system are passive IRMs and do not require frequent monitoring to maintain their effectiveness. The GWES and the GWTS are active IRMs that require periodic maintenance and monitoring to operate effectively in achieving their remedial goals and to maintain compliance. The locations of the existing IRMs are shown in Figure 1-2. Descriptions of each IRM and each additional remedial action follow.

2.1.1 Slurry Wall and Groundwater Extraction System

The slurry wall and GWES are discussed together because the effectiveness of each is dependent upon the other. The slurry wall is most effective when an inward hydraulic gradient exists across the slurry wall. The slurry wall works in conjunction with the GWES to contain and capture affected groundwater for treatment.

Slurry Wall

The slurry wall implementation involved excavating a slurry wall trench (keyed into the underlying, low-permeability Bay Mud), then backfilling the trench with a soil-bentonite (S-B) or cement-bentonite (C-B) slurry to create a relatively impermeable hydraulic barrier around affected areas of the Site (Figure 1-2). The slurry wall was not intended to be a completely impermeable hydraulic barrier or enclose 100 percent of the chemically affected soil. The intent of the slurry wall is to inhibit groundwater flow through the wall and to function together with the groundwater extraction wells to contain and capture affected groundwater for treatment. A detailed description of all aspects of the slurry-wall installation is included in the IRM Completion Report (LFR 1996).

The width of the slurry wall trench is approximately 3 feet and the trench was excavated to depths between approximately 20 and 30 feet bgs. The bottom of the slurry wall trench was excavated into a minimum 3-foot thickness of the Bay Mud interval, thus keying the wall into this very low permeability interval. The water/bentonite slurry mixture was maintained in the open trench to prevent the collapse of the trench walls during excavation activities (LFR 1996).

Most of the slurry wall (approximately 2,000 linear feet) was constructed of S-B backfill (Figure 1-2), which had a design hydraulic conductivity of 1×10^{-7} centimeters per second (cm/sec). All S-B samples tested for hydraulic conductivity met or exceeded the design specification (LFR 1996).

A shorter portion of the slurry wall (approximately 210 linear feet) adjacent to the former Rifkin property was constructed of C-B backfill (Figure 1-2). The design specification for the hydraulic conductivity of this material was 1×10^{-6} cm/sec. The C-B slurry was used in constructing this portion of the slurry wall because the slurry wall was located adjacent to an existing building on the former Rifkin property. Therefore, material with greater compressive strength was required for structural reasons (LFR 1996). During the installation of this portion of the slurry wall, two sets of samples were taken to measure the hydraulic conductivity of the C-B wall. One set of samples had a measured hydraulic conductivity (9.9×10^{-7} cm/sec) that exceeded the design specifications. The second set had a measured hydraulic conductivity (2×10^{-6} cm/sec) that was slightly below the design specifications. In other terms, the difference between the design specification (0.000001 cm/sec) and the measured hydraulic conductivity at this location (0.000002 cm/sec) was 0.000001 cm/sec or one one-millionth of a cm/sec. The measured hydraulic conductivity at this location is significantly lower than the adjacent soils. Based on aquifer testing results, the hydraulic conductivity of A-zone sandy silts and gravels ranges between approximately 6×10^{-4} (0.0006) cm/sec to 6×10^{-2} (0.06) cm/sec (LFR 1998b). Therefore, the much lower hydraulic conductivity of the slurry wall relative to the adjacent soils impedes the flow of groundwater across the slurry wall.

During construction of the slurry wall, subsurface piping was encountered at four locations (Figure 2-1):

1) a 24-inch storm-water line located near the north Site boundary

2) an 8-inch line located east of Building 35 that is used to discharge the treatment system effluent to the storm-water collection system

3) an abandoned storm-drain lateral extending from the truck loading area beneath the northern portion of Building 35

4) an abandoned storm-water lateral extending from the truck loading area to the northeastern corner of Building 35.

Other underground pipes encountered during excavation were abandoned in place (most were out of service, if not broken). If the pipes were broken during construction activities, they were removed to the extent necessary to complete the work and plugged with grout (LFR 1996).

The soil surrounding the 24-inch storm-water line was excavated and soil-bentonite slurry was pumped into the excavation to surround the pipe and prevent collapse of the trench. After the slurry was allowed to cure, the portion surrounding the storm-water line was excavated using hand shovels. Concrete was then placed in the excavation surrounding the storm-water line. The concrete collar was installed at this location because the storm-water line had been slightly damaged during the excavation of soil for the slurry wall trench. Figure 2-1 illustrates how the storm-water line passes through and is sealed on the outside by the bentonite slurry wall and the concrete collar.

At the three other locations where the storm-water lines were encountered during the slurry wall construction, the soil was excavated and the soil-bentonite slurry was pumped into the excavation to form a seal around the lines. Figure 2-1 illustrates how the storm-water pipe passes through and is sealed on the outside by the soil-bentonite slurry wall at the three locations identified above. Other abandoned underground lines and pipes were excavated at the point of slurry-wall installation and sealed off by the soil-bentonite slurry.

Groundwater Extraction System

The GWES consists of three shallow groundwater extraction wells, piping to convey the groundwater to the GWTS, compressed air lines, and appurtenances. The locations of the three extraction wells and the conveyance piping are shown on Figure 1-2. A detailed description of the installation of this IRM is included in the IRM Completion Report (LFR 1996).

Extraction wells EX-1, EX-2, and EX-3 are located in the area inside the slurry wall. Each extraction well was installed to an approximate depth of 20 feet bgs, and each well was constructed with a 15-foot-long screened interval. The pumps in the wells are pneumatic, using compressed air that originates from the plant air compressor. A pulse counter installed at each wellhead measures the approximate totalized flow. Totalizers were also added for each well at the GWTS. The pumps in the wells are designed to only operate when groundwater is present in the well and when the water level in the influent tank at the GWTS is below a maximum level (LFR 1996). Depending on water levels in each well, extraction wells EX-1 and EX-3 produce between 0.5 to 1.5 gallons per minute (gpm) and extraction well EX-2 produces between 2 and 8 gpm.

As shown in Figure 1-2, the conveyance piping between EX-1 and EX-2, and south to the approximate location of the loading platform, was installed underground. The remainder of the conveyance piping was installed aboveground.

2.1.2 Cap and Storm-Water Collection System

The cap and storm-water collection system implementation involved grading the Site for storm-water collection, constructing a storm-water collection system (consisting of drains, catch basins, conveyance piping, and appurtenances), and capping the Site with concrete or asphalt (Figure 1-2). A detailed description of the installation of this IRM is presented in the IRM Completion Report (LFR 1996).

The asphalt and concrete cap was designed to accommodate the projected parking and vehicle traffic at the Site. For areas that typically receive parking and light vehicle (i.e., passenger cars) traffic, a light-duty pavement cap was installed (Figure 1-2). The light-duty asphalt cap comprises 2 1/2 inches of asphalt pavement that is underlain by 6 inches of aggregate base with a compacted native soil sub-grade. The light-duty asphalt cap was installed in the employee parking lot area and the area east of the SPRR spur extending through the Site. For areas that typically receive heavier traffic loading from trucks and heavy equipment, a heavy-duty asphalt pavement or concrete pavement cap was installed. The heavy-duty asphalt cap was installed in the truck parking area 250 feet north of Building 35 and in the corridor between the SPRR spur and the eastern side of Building 35 (Figure 1-2). The heavy-duty asphalt cap comprises 4 inches of asphalt pavement underlain by 12 inches of aggregate base with a compacted native soil sub-grade. After installation, the asphalt pavement was sealed with an emulsion-based slurry (LFR 1996).

The concrete pavement cap comprises 6 to 9 inches of reinforced concrete underlain by 6 to 7 inches of aggregate base and then by compacted sub-grade. The concrete pavement cap was installed in the truck loading area located immediately to the north of Building 35 and the truck loading and tank area located near Building 34 (Figure 1-2).

In September 1997, LFR performed a surficial inspection of the concrete and asphaltic concrete cap at the Site. The field observations noted indicate some minor maintenance items for the cap that can be addressed when the cap is periodically resealed as part of the routine maintenance for the Site. Overall, the results of the inspection verified that the cap is in good to excellent condition. The field observations of the September 1997 inspection are noted in Figure 2-2.

Prefabricated trench drains were installed in concrete on both sides of the railroad tracks east and south of the loading platform in order to effectively collect storm water in these areas. These trench drains are connected to the underground storm-water collection system. The western portion of the storm-water collection system consists of approximately 650 feet of 15-inch clay pipe that was installed after 1957. The eastern portion of the storm-water collection system consists of approximately 1,100 feet of 18- to 24-inch corrugated polypropylene pipe. The eastern portion of the storm-water collection system was installed adjacent to the SPRR line and completed in 1995 as part of the IRM installation. Double-gasketed pipe couplers joined the pipe joints of the storm-water lines. This allowed the system to be pressurized, reducing the leakage potential. During construction, the storm-water line segments were discretely pressure tested between the catch basins and manholes. Pressure tests were observed to meet or exceed the manufacturer's recommendations (LFR 1996).

The Site was graded to promote efficient drainage and so that surface runoff in discrete areas drained to catch basins. The concrete catch basins were installed and connected to the underground storm-drain conveyance piping. A gate valve was installed in the storm-water collection system pipe immediately upstream from the discharge point to Temescal Creek. The gate valve is normally open; however, it can be closed to prevent off-site discharge in the event that there is a surface release of bulk material offloading substances from plant operations.

2.1.3 Groundwater Treatment System

The original GWTS, completed by October 1995, consisted of an electrochemical co-precipitation system to remove metals ("the Andco system") and a biological system to remove organic compounds ("Tri-Bio system"). The original GWTS was designed in 1993 to treat groundwater at a flow rate of 12 gpm, however, the GWTS actually operates on average between 5 and 7 gpm.

The Tri-Bio system was taken off line in April 1997 and replaced with three 200-pound aqueous-phase carbon drums connected in series. The Tri-Bio system was replaced with aqueous-phase carbon drums because the concentrations of organics entering the Tri-Bio system dropped after the initial period of groundwater pumping. The carbon system has since been modified and consists of nine 200-pound aqueous-phase carbon drums arranged in three parallel series of three drums each. The two additional parallel sets of three drums were installed to compensate for pressure drop restrictions that limited the flow rate from the Andco system. Because regenerated bituminous granular-activated carbon can be a source of arsenic and other heavy metals, virgin coconut-shell carbon is used to eliminate that potential source.

The pneumatic extraction pumps installed in the three extraction wells remove groundwater, which is conveyed through piping to the Andco system, and then to the aqueous-phase granular-activated carbon ("the carbon system"). Treated water from the final three carbon drums in the series flows into a 500-gallon holding tank, from which it normally discharges into the storm-water collection system that flows to Temescal Creek. Water is discharged under National Pollution Discharge Elimination System (NPDES) permit No. CAG912003. Due to installation of the multipoint system installed in November 1997 (Section 2.1.7), a temporary GWTS effluent hose system was installed so that discharge of treated effluent went directly from the effluent pumping tank at the GWTS to Temescal Creek, thus bypassing the storm-water collection system (LFR 1998c). Figure 2-3 presents a schematic of the existing treatment system.

GWTS Discharge Limitations

In the EIRM Report (LFR 1991), LFR determined that discharge of the treated groundwater to the East Bay Municipal Utilities District (EBMUD) sanitary sewer was preferred over discharge to Temescal Creek. At the time that the EIRM was prepared, the arsenic discharge limit into the sanitary sewer was 2,000 parts per billion (ppb). After submission of the 1991 report to the RWQCB, EBMUD revised its arsenic discharge limit from 2,000 ppb to a technically unfeasible level of 2 ppb (although the general industrial discharge requirement remains at 2,000 ppb). EBMUD also indicated that one of the reasons for such a low discharge limit was to discourage the discharge of groundwater to the sanitary sewer. As a result of this EBMUD policy change, Sherwin-Williams instead elected to obtain an NPDES permit authorizing direct discharge of treated groundwater to Temescal Creek.

The GWTS currently operating at the Site was designed in 1993 to meet a discharge limit for arsenic of 25 ppb. This design objective was based on the United States Environmental Protection Agency (U.S. EPA) drinking water standard for arsenic of 50 ppb and the San Francisco Basin Plan ("the Basin Plan") shallow marine environment NPDES discharge limit of 36 ppb arsenic. These standards were in effect during the period the GWTS was being designed. The 25 ppb basis for design was selected because it was 50 percent of the drinking water standard, and below the shallow marine discharge limit by approximately 30 percent.

The RWQCB subsequently established a 10 ppb general NPDES discharge limit for arsenic on July 20, 1994, based on the Basin Plan. At the time this general NPDES discharge limit for arsenic was established, the existing GWTS had been purchased from Andco. On March 15, 1995, the RWQCB issued an NPDES discharge permit to Sherwin-Williams with a discharge limit for arsenic of 10 ppb. However, the NPDES permit allowed for a 25-ppb discharge limit, provided that the requirements described in Provision E.4 of the General Waste Discharge Requirements, Order No. 94-087, NPDES No. CAG912003 were followed. The requirements of Provision E.4 were fulfilled by the March 1997 cost and feasibility study report prepared by LFR and discussed in more detail in Appendix D.

In a letter to EBMUD, dated November 21, 1997, Sherwin-Williams resubmitted an application for discharge of treated groundwater to the EBMUD Publicly Owned Treatment Works (POTW). This application was resubmitted in order for Sherwin-Williams to increase the amount of water pumped from the existing and planned GWES to lower groundwater elevations inside the slurry wall area.

EBMUD's revised Ordinance No. 311 allows for exceptions to EBMUD's general policy of prohibiting groundwater discharge to the sanitary sewer. Specifically, Title I, Section 6 of Ordinance No. 311 allows for groundwater discharge exceptions where "unusual conditions compel special terms and conditions." As part of the permit application, Sherwin-Williams requested a discharge limit of 200 ppb for arsenic and a revised request for a 20-gpm flow rate. For reference, the 200-ppb discharge limit for

- prefabricated steel slip liners installed in each catch basin to form a solid barrier between water entering the catch basin via surface runoff and groundwater entering the catch basin past plugs or other indefinite pathways
- submersible pumps with automatic controls installed in each slip liner
- surface discharge hoses from each pump manifolded together for discharge of surface water to Temescal Creek

A detailed summary of the storm-drain emergency response activities and corrective actions was submitted to the RWQCB in the Storm Drain Report (LFR 1998c).

2.2 Remedial Objectives of the IRM Components and Additional Remedial Actions

As discussed in Section 1, the effectiveness of the IRM components will be evaluated in Section 3 of this report collectively, rather than as individual IRMs, because the effectiveness of each IRM is dependent, to some degree, on the effectiveness of the other IRMs. The remedial objectives for the IRM components and the additional remedial actions are stated below, as presented in previous reports (LFR 1991, LFR 1996, and LFR 1998c).

2.2.1 Slurry Wall and Groundwater Extraction System

The remedial objectives of the slurry wall and GWES are to contain on-site affected groundwater and inhibit migration of affected groundwater from the Site to off-site areas. This is achieved by providing a zone of lower hydraulic potential inside the boundaries of the slurry wall and creating an inward hydraulic gradient across the slurry wall (Figure 2-4). In addition, the slurry wall is intended to reduce the amount of groundwater requiring extraction and subsequent treatment by significantly inhibiting flow into or out of the area contained by the slurry wall, which addresses regulatory guidelines focused on reducing the unnecessary pumping of groundwater. The GWES removes chemically affected groundwater and conveys it to the GWTS for treatment.

2.2.2 Cap and Storm-Water Collection System

The objective of the cap portion of this IRM is to reduce the potential for vertical leaching of chemicals into groundwater from rainwater infiltration, while providing a direct barrier to wind or water erosion. The cap also eliminates potential human exposure pathways to affected soil. The objective of the storm-water collection system is to transport storm-water runoff to Temescal Creek and reduce the recharge of groundwater.

2.2.3 Groundwater Treatment System

The objective of the GWTS is to remove chemicals from the extracted groundwater and to discharge the treated groundwater at concentrations below acceptable discharge limits. As stated in Section 2.1.3, the original GWTS was designed in 1993 to treat groundwater at a flow rate of 12 gpm.

2.2.4 "Hot-Spot" Removal

The objective of this remedial action was to reduce the potential for vertical leaching of chemicals into groundwater from rainwater infiltration, and to eliminate potential human exposure pathways by removing "hot-spot" VOC-, lead-, and zinc-affected soil for off-site disposal at a Class I landfill in advance of the August 8, 1991 Land Disposal Restrictions. This was accomplished by excavating and disposing of primarily VOC-, lead-, and zinc-affected soil from the former solvent tank storage area.

2.2.5 Underground Storage Tank Removals by Southern Pacific Railroad

The objective of this remedial action was to reduce potential sources of petroleum hydrocarbons to soil and groundwater by excavating and removing USTs (owned by SPRR) identified during installation of the cap and slurry wall.

2.2.6 Horton Street Excavation

The objectivesof the Horton Street investigation and remediation were as follows:

- define the extent of arsenic and lead contamination in shallow soil surrounding the Sherwin-Williams property beneath Horton Street, 45th Street, and Sherwin Avenue and determine the extent of soil removal
- remediate shallow soils through excavation and off-site disposal as identified by the area investigations, as determined to be necessary based on risk assessments, and as required by the RWQCB

2.2.7 Multipoint System

The objective of this remedial action was to prevent the release of contaminated water to Temescal Creek from groundwater infiltrating into the storm-water collection system and mixing with storm water during rain events in the winter of 1997-1998.

3.0 EVALUATION OF EXISTING INTERIM REMEDIAL MEASURES

As discussed in Section 2, the IRM components at the Site (the slurry wall, the cap and storm-water collection system, the GWES, and the GWTS) were designed to work together to achieve specific objectives. This section evaluates the collective effectiveness of the IRMs in meeting the objectives of:

- inhibiting off-site migration of chemically affected groundwater (Section 3.1)
- removing chemical mass in groundwater (Section 3.2)
- reducing the potential for exposure to chemically affected soil and groundwater (Section 3.3)

3.1 Effectiveness of IRMs in Inhibiting Off-Site Migration of Chemically Affected Groundwater

A primary objective of the IRMs is to minimize the migration of chemicals of concern in groundwater by inhibiting the flow of groundwater from the Site to off-site areas. The IRMs were designed to meet this objective by the strategic placement of remedial measures to alter the ambient groundwater flow conditions at the Site.

The effectiveness of the IRMs in inhibiting the migration of affected groundwater from the Site to off-site areas was evaluated by analyzing the following parameters:

- water balance inside the slurry wall area (Section 3.1.1)
- groundwater elevations and flow directions inside and outside the slurry wall area (Section 3.1.2)
- chemical concentrations in groundwater inside and outside the slurry wall area (Section 3.1.3)

3.1.1 Impacts to the Water Balance Inside the Slurry Wall Area

The objective of the slurry wall and GWES is to depress groundwater levels within the slurry wall. Depressed groundwater levels within the slurry wall will result in inward hydraulic gradients, which will eliminate the potential for migration of affected groundwater out of the slurry wall area. The water balance within the slurry wall must be understood in order to evaluate the effectiveness of the IRMs in inhibiting the migration of chemically affected groundwater. A water balance analysis evaluates all of the water inputs (sources) to a system and all of the water outputs (sinks) from the system. If the inputs are greater than the outputs, there is a net gain in storage within the system, resulting in an increase in groundwater levels measured within the slurry wall area at the Site. If the inputs are less than the outputs, there is a net loss in storage within the system, resulting in a decrease in water levels measured within the slurry wall area at the Site.

There are several potential sources and sinks of water within the slurry wall area. A schematic diagram indicating the various sources and sinks is shown in Figure 3-1. Potential sources of water include water leakage from utility lines (sanitary sewer and water), water leakage from the storm-water collection system (when groundwater levels within the slurry wall are below the level of the storm-water collection system inverts and when water treated by the GWTS is discharged to the storm-water collection system), rainfall recharge, flow through the slurry wall (when there is an inward gradient), and flow into the A-zone aquifer from the B-zone aquifer (when there is an upward hydraulic gradient). Potential sinks include pumping of groundwater extraction wells, groundwater infiltration into the storm-water collection system (when groundwater levels within the slurry wall are above the level of the storm-water collection system inverts), flow out of the slurry wall (when there is an outward gradient), and flow out of the A-zone aquifer into the B-zone aquifer (when there is a downward hydraulic gradient). Each of the potential sources and sinks is discussed below.

Groundwater Extraction Through Pumping

Groundwater extracted by the GWES results in a loss (sink) of water within the area of the slurry wall. There are currently three groundwater extraction wells within the slurry wall, pumping at a total average rate of approximately 4 gpm, or 5,760 gallons per day (gpd) during the first half of 1998. The quantity of water extracted by these wells is measured at the GWTS using totalizers.

Utility Leakage

Water leaking from utilities, such as sanitary sewers or potable water pipes, may contribute water to groundwater within the slurry wall. In 1997-1998, LFR conducted several investigations to evaluate the potential significance of leaking utility water into the slurry wall area. These investigations included the following tasks:

- conducting a study of the oxygen isotope composition
- conducting a review of historical facility drawings
- analyzing fecal coliform count and surfactants in groundwater samples collected from Site piezometers and wells
- conducting a geophysical survey to evaluate the presence of water, sanitary sewer or drain lines within the slurry wall area
- evaluating potential water contributions from an abandoned fire line within the slurry wall area
- performing general mineral analyses of groundwater

Results of this investigation indicated that groundwater in a small area within the slurry wall had a similar isotopic composition to treated drinking water from EBMUD, the local water purveyor, suggesting that there may be an undiscovered source of leaking utility water to the slurry wall area. The results of the isotope study focused the remaining investigations on the area around LF-22 and EX-3. Review of the facility drawings indicated that a sewer line and high-pressure fire line may be present in the subsurface in this area. The geophysical survey to locate utility lines was inconclusive because of the presence of rebar in the concrete at the Site. Analysis of fecal coliform indicated that concentrations were all below reporting limits, and surfactant sampling indicated that this constituent was present at various locations in the groundwater in the slurry wall area at concentrations at or slightly above reporting limits, not indicative of a release. Excavation of the fire line indicated that the fire line was not under pressure, had been properly abandoned at its termination point, and was likely not a source of water to the slurry wall area. Therefore, the source of the water with an isotopic composition similar to treated drinking water is currently unknown.

Rainfall Recharge

Direct recharge of groundwater by infiltrating precipitation occurs at unpaved areas, within cracks in impervious surfaces, and along the railroad tracks at the Site. Rainfall recharge is inhibited over most of the Site due to the presence of the asphalt and concrete cap and other impervious surfaces (e.g., buildings). The most significant quantity of recharge is likely to occur along the unpaved areas along the rails and switchgear of the railroad tracks. Trench drains along the railroad tracks at the southern part of the Site were designed to collect and divert surface water away from the railroad tracks and direct it to the storm-water collection system piping. During the emergency response activities initiated during the winter of 1997/1998, the storm-water collection system was isolated and replaced by the temporary multipoint system (Section 2.1.7). As a consequence, surface water that normally flowed into the trench drains infiltrated into other unpaved areas along the tracks, such as the switchgear. Therefore, a greater volume of surface water infiltrated into sediments beneath this portion of the railroad tracks during this period. Based upon the Site grades and observations of rainfall runoff during the winter of 1997/1998, the railroad tracks may drain up to approximately 72,000 square feet (ft^2) of the Site.

Rainfall recharge is typically estimated as a percentage of total rainfall. Based on observations during rain events, as much as 60 percent of the rainfall/runoff reaching the railroad tracks infiltrates to groundwater, and assuming a rainfall intensity of 45 inches per year (approximately last year's total, the second wettest year on record), the total volume of water that would infiltrate along the railroad tracks inside the slurry wall would be approximately 1,000,000 gallons. Assuming a rainy season of six months, the total flux of water into the slurry wall area would be approximately 6,600 gpd, or 4.6 gpm over a six-month period. Based upon this estimate, it appears that during the rainy season, rainfall infiltration may be a significant source of water to the area inside the slurry wall. To ensure that the number of potential sources of water to the slurry wall area are reduced, measures are currently being evaluated to eliminate significant recharge along the railroad tracks within the slurry wall area (see Section 4.2).

Groundwater Discharge Into or Out of Storm-Water Collection System

As discussed in the first part of Section 3.1.1, the storm-water collection system can act as either a sink (high groundwater levels) or a source (low groundwater levels) to groundwater within the slurry wall. When groundwater elevations rise above the bottom of the inverts to the storm-water collection system, groundwater flows into the storm-water collection system and discharges to Temescal Creek. As much as 3,000 gpd (approximately 2.1 gpm) of groundwater may have infiltrated along the 1,500 feet of subsurface storm-water collection system piping at the Site based on field observations of water accumulation in the subsurface storm-water collection system piping during October 1997. These observations were made when the storm-water collection system outfall at Temescal Creek was plugged during a period of dry weather and high groundwater elevations. To prevent further discharge of groundwater to surface water, the multipoint system emergency action was implemented (see Section 2.1.7).

At present, the subsurface storm-water collection system piping does not appear to be either a source or a sink of groundwater within the area of the slurry wall (Figure 3-2). In the future, groundwater levels will be managed to prevent groundwater infiltration into the storm-drain system. When the multipoint system is decommissioned and the storm-water collection system is returned to service, some water leakage out of the subsurface piping and recharge to groundwater from storm water-runoff may occur. However, this recharge would be intermittent and occur only over short periods of time, when rain events occur. In addition, when water treated at the GWTS is discharged to the storm-water collection system, there is the potential for some water leakage out of the storm-water system. Because the hydrostatic pressure inside the piping causing leakage out of the piping is relatively low compared to the hydrostatic pressure of the groundwater surface (which caused infiltration into the piping), it is expected that overall leakage out of the piping would be much less than the observed maximum rate of infiltration of approximately 3,000 gpd.

Flow Into or Out of the Slurry Wall

At locations where groundwater elevations inside the slurry wall are lower than outside the slurry wall, the potential exists for groundwater to flow from outside the wall to inside the wall (inward hydraulic gradient). At locations where groundwater elevations inside the slurry wall are higher than outside the slurry wall, the potential exists for groundwater to flow from inside the wall to outside the wall (outward hydraulic gradient).

Historically, groundwater elevations inside the wall have not consistently been lower than groundwater elevations outside the wall, posing a potential for outward groundwater flow through the slurry wall. This groundwater elevations condition persisted due to a combination of problems with the GWTS, extreme wet weather during the winter of 1997-1998, and disabled storm drains. More recently, July 1998 groundwater elevations have receded due to increased pumping by the GWES and drier weather. At present, groundwater elevations are generally lower inside the wall than outside the wall, resulting in a potential inward hydraulic gradient (see Section 3.1.2).

Although the rate of groundwater discharge through the wall is not directly measurable, it can be estimated using the following equation (Darcy's Law):

$$Q = K*i*A$$

Where: Q = total flow across the wall ($Length^3/Time$)
K = hydraulic conductivity of the slurry wall (Length/Time)
i = hydraulic gradient across the wall (Length/Length)
A = cross-sectional area of the slurry wall below the water table ($Length^2$)

The most sensitive parameter in this equation is the hydraulic conductivity of the wall. The slurry wall was designed to have a hydraulic conductivity that is much lower than the native soils, which reduces the rates of groundwater and contaminant discharge through the wall. Additionally, there are effectively two sections of the wall, one constructed of an S-B slurry, and one constructed of a C-B slurry. Each of these sections has a different hydraulic conductivity and a different length. The hydraulic conductivity for each of these sections of the wall was originally measured when the slurry wall was installed in 1993 and 1994 (see Section 2.1.1). The following table provides a summary of the different parameters input into the Darcy equation in order to develop an estimate of flow through the slurry wall.

Parameter	Value for S-B	Value for C-B
K = hydraulic conductivity (field measurement)	10^{-7} cm/sec	2 x 10^{-6} cm/sec
I = hydraulic gradient	1 ft/ft	1 ft/ft
A = cross-sectional area	50,000 ft^2	5,250 ft^2
Flow Through the Slurry Wall	0.0132 gpm	0.003 gpm

The values for area were developed using lengths of 2,000 feet for the S-B section of the wall, and 210 feet for the C-B section of the wall, and a height of 25 feet. The value for hydraulic gradient was developed assuming a wall thickness of 3 feet, and a conservative head difference across the wall of 3 feet. Based upon these assumptions, the total calculated flow across the entire length of the slurry wall would be 0.0162 gpm, or 23.3 gpd. As indicated above, the most sensitive parameter in the equation is the hydraulic conductivity of the slurry wall. The values used in this calculation were the measured parameters for the slurry wall collected when the slurry wall was installed. Even if the slurry wall hypothetically has hydraulic conductivities ten times higher than the design hydraulic conductivities, flow through the wall would be ten times higher, or 0.162 gpm (233 gpd). This value is relatively low, compared with current groundwater extraction rates of approximately 4 gpm (5,760 gpd). Therefore, even at hydraulic conductivities ten times higher than the measured values, flow through the slurry wall does not appear to be a significant source of groundwater to the area outside the slurry wall.

LFR has also performed calculations to evaluate potential flow through joints in the slurry wall, if the joints did not seal properly. While there is no evidence that the slurry wall joints did not seal properly, these calculations were performed to address questions raised by other parties who have expressed concern with potential gaps in the wall or questions as to the integrity of the wall in the event of an earthquake.

Assuming there are 16 slurry wall joints, which have a gap of 6 inches at the joints, and these gaps extend the entire heigth of the slurry wall (25 feet), the cross-sectional area for flow through the gaps in the joints is 200 ft^2. Assuming the same gradient used for the flux through the slurry wall calculations (1 foot per foot [ft/ft]) and a hydraulic conductivity of the native material (which would fill in the gaps at the joints) of 1 x 10^{-5} cm/sec, the total flow through these gaps would be 0.0295 gpm, or approximately 42.4 gpd. These calculations suggest that even if significant gaps do exist in the joints of the slurry wall (and there is no evidence that such gaps do exist), groundwater flux through these gaps does not appear to be a significant source of groundwater to the area outside of the slurry wall.

Flow Into or Out of the B-Zone

There is a potential for A-zone groundwater inside the slurry wall to flow downward through the A-zone/B-zone aquitard to the B-zone at locations where the groundwater elevation in the A-zone is higher than the groundwater elevation in the B-zone. Conversely, there is a potential for B-zone groundwater to flow upward through the A/B aquitard to the A-zone at locations where the groundwater elevation in the B-zone is higher than the groundwater elevation in the A-zone.

During the period from January to May 1998, A-zone groundwater elevations inside the slurry wall were generally the same or slightly higher than groundwater elevations in the B-zone below the wall, creating a slight potential for downward groundwater flow. In June and July 1998, A-zone groundwater elevations have receded due to increased operation of the GWES and drier weather. At present, groundwater elevations are generally lower in the A-zone than in the B-zone, posing a potential for upward groundwater flow, and minimizing contaminant transport away from the region contained by the slurry wall (see Section 3.1.2).

Although the rate of groundwater discharge through the A/B-zone aquitard material beneath the A-zone is not directly measurable, it can be estimated using the same equation (Darcy's Law) used for the estimate of flow through the slurry wall. For purposes of this calculation, the hydraulic conductivity of the A-zone/B-zone aquitard was estimated using the value for a marine clay from Freeze and Cherry (1979), and the gradient was estimated assuming a seven-foot-thick aquitard and a one-foot difference in groundwater elevations between the A- and B-zone aquifers. (Since the completion of the slurry wall in November 1995, the difference in groundwater elevations between the A- and B-zone aquifers has ranged between 0 and approximately 3.5 feet. However, after the installation of the IRMS, the periods in which differences in groundwater elevations exceeded one foot have generally been short.) The following table summarizes the different values used as inputs into the Darcy equation, to estimate leakage across the A/B aquitard.

Parameter	Value for A/B Aquitard
K = hydraulic conductivity	10^{-7} cm/sec
I = hydraulic gradient	0.143 ft/ft
A = cross-sectional area	156,000 ft^2
Flow Across A/B Aquitard	0.03 gpm

Based on these conservative assumptions, flow across the A/B aquitard does not appear to be a significant source or sink of groundwater to the area outside the slurry wall. As noted in the report entitled, "Work Plan for Site Investigation, The Sherwin-Williams Facility," dated June 2, 1997 (LFR 1997), it is anticipated that a further B-zone investigation will be conducted, which should provide additional information regarding the potential for upward or downward contaminant migration.

Results of Water Balance Analysis

Each of the sources and sinks discussed above contribute to the overall water balance at the Site. The accuracy of groundwater recharge and discharge estimates attributable to each source and sink varies considerably. Table 3-1 summarizes the estimated relative importance of each term under two hydraulic scenarios: a generally inward hydraulic gradient and a generally outward hydraulic gradient.

Estimating the entire mass flux for the slurry-wall system under outward gradient conditions is uncertain, because the calculations could be subject to compensating overestimates and underestimates. However, as shown in Table 3-1, the primary sources of water under these conditions are rainfall recharge, likely through the railroad track area, and potentially utility leakage, although leaking utilities have not yet been positively identified within the slurry wall area. Additionally, during April, May, June, and July 1998, when there was almost no rainfall, water levels across the Site declined substantially (between 1- to 2.5-feet over the three-month period). While this decline may be attributed to increased pumping from the GWES, the absence of an ongoing source of water (such as rainfall infiltration) suggests that utility leakage is not a significant source of water to the slurry wall area.

Under inward gradient conditions, there is only one sink for groundwater, and that is continued operation of the GWES. Under declining or steady groundwater elevations, the quantity of groundwater being extracted is greater than or equal to the sum of all the sources of groundwater within the slurry wall. This condition will be enhanced by the expansion of the extraction system inside the slurry wall. Once this is achieved and maintained, improved estimates of the various water balance terms can be evaluated.

A more detailed discussion of observed groundwater elevations and flow conditions follows.

3.1.2 Groundwater Elevations and Flow Directions Inside and Outside the Slurry Wall Area

This section evaluates the effectiveness of the IRMs in inhibiting the flow of chemically affected groundwater from the Site to off-site areas (including the potential for downward migration of chemicals in groundwater to the B-zone) by evaluating groundwater elevations and flow directions inside, outside, and beneath the slurry wall. Results of this analysis, described in detail below, indicate that the IRMs have not consistently eliminated the potential for chemically affected groundwater to flow to off-site areas. Although the potential has existed for chemicals in groundwater to migrate off site, the available data suggest that any potential flows away from the Site would be relatively low. Also, the IRMs have recently reduced the potential for off-site migration of chemically affected groundwater at most locations along the slurry wall because an inward hydraulic gradient has been achieved.

The influence of the IRMs on groundwater flow at the Site is evident by comparing A-zone groundwater elevation contour maps created before and after IRMs were initiated. Prior to installation of the slurry wall and the GWES, the general direction of A-zone groundwater flow was to the northwest, toward Temescal Creek (Figure 3-3). After installation of the slurry wall in 1994 and the GWES in 1995, A-zone groundwater flow was significantly changed. As shown in Figure 3-4, groundwater inside the slurry wall generally flowed toward extraction wells EX-1, EX-2, and EX-3, and groundwater outside the slurry wall generally flowed to the north and northwest toward Temescal Creek. Recent A-zone groundwater elevation contour maps from January 24, 1998 (Figure 3-5) and February 24, 1998 (Figure 3-6) indicate that the GWES had limited influence on the groundwater flow inside the slurry wall. This is because the GWES was off-line during the period from October 1997 to February 1998 as a result of the storm-drain emergency response actions (LFR 1998). Groundwater flow inside the slurry wall continued to deviate from groundwater flow outside the slurry wall due to the low permeability of the wall, relative to adjacent soils.

As described in Section 3.1.1, the IRMs were designed to inhibit migration of affected groundwater from the Site to off-site areas by creating an inward hydraulic gradient across the slurry wall. If there is an inward hydraulic gradient, the potential for groundwater to flow from inside the slurry wall, through the slurry wall, to outside the slurry wall does not exist. If there is an outward hydraulic gradient, there is the potential for groundwater to flow from inside the slurry wall to outside the wall. In either case, the potential rate of groundwater flow across the slurry wall is estimated to be only on the order of 23 gpd, based on calculations provided in Section 3.1.1.

To assess the effectiveness of the IRMs in maintaining an inward hydraulic gradient across the slurry wall, groundwater elevations in monitoring well/piezometer pairs in which one well/piezometer is located immediately inside the slurry wall and the other is located immediately outside of the slurry wall are measured. Table 3-2 presents historical groundwater elevation data for well/piezometer pairs. Additional historical groundwater elevation data are provided in the Current Conditions Report (LFR 1998b) Groundwater elevation hydrographs for well pairs across the slurry wall are presented in Appendix B. As shown in these hydrographs and as indicated in Table 3-2, the IRMs have not consistently achieved the objective of establishing an inward gradient across the entire slurry wall throughout the duration of the IRMs. Consequently, the potential has existed for chemicals in groundwater to migrate from inside the slurry wall to outside the slurry wall. However, the most recent water-level data collected on July 2, 1998 indicate that the IRMs have recently achieved an inward hydraulic gradient at most locations across the slurry wall due to improved operation of the GWES and drier weather.

As discussed in Section 3.1.1, there is a potential for A-zone groundwater inside the slurry wall to flow downward through the A/B-zone aquitard to the B-zone at locations where the groundwater elevation in the A-zone is higher than the groundwater elevation in the B-zone. Groundwater elevation hydrographs for well pairs in which one well is screened in the A-zone and one well is screened in the B-zone are presented in Appendix B. As shown on these hydrographs, historically there has been a potential for both upward and downward flow at various locations at the Site. The most recent groundwater elevation data from the Site (July 1998) generally indicate there is the potential for groundwater to flow upward from the B-zone to the A-zone. In either case, as discussed in Section 3.1.1, potential flow across the A/B-zone aquitard is estimated to be relatively low (on the order of 0.03 gpm or 43 gpd).

3.1.3 Chemical Concentrations in Groundwater Inside and Outside the Slurry Wall Area

This section evaluates the effectiveness of the IRMs in inhibiting migration of chemicals of concern in groundwater from the Site to off-site areas (including downward to the B-zone) by evaluating trends in chemical concentrations in groundwater collected from A-zone and B-zone wells located inside and outside the slurry wall. An increasing trend in chemical concentrations in groundwater from wells located outside (or beneath) the slurry wall could be indicative of migration of chemically affected groundwater through the slurry wall (or downward to the B-zone); however, other mechanisms with the same effect are plausible. Results of this analysis, described in detail below, indicate that with the exception of two A-zone wells (LF-11 and MW-5), there has not been a statistically significant increasing trend in chemical concentration in groundwater outside of the slurry wall. It is unlikely that the increasing trend in chemical concentration at well LF-11 is indicative of chemical migration through the slurry wall. The increasing trend at well LF-11 more likely resulted from migration of chemicals from outside the slurry wall. The increasing trend at well MW-5 may have similarly resulted from migration of chemicals from outside the slurry wall; however, the extent to which chemical migration through the slurry wall could have potentially contributed to the increasing trend at MW-5 is uncertain based on available data.

To evaluate chemical concentration trends in groundwater, graphs of arsenic concentration detected in groundwater samples collected from selected monitoring wells versus time were generated (Appendix C), and the data were analyzed using statistical methods. Arsenic is considered a good indicator for evaluating chemical migration in groundwater because it has been detected at the highest concentrations inside the slurry wall and it is generally more mobile than other chemicals of concern at the Site. Arsenic concentrations detected in groundwater at the Site and its vicinity are summarized in Table 3-3.

Arsenic concentration data from wells that are located relatively close to each other and the slurry wall, and that are on opposite sides of the wall, are plotted on the same graph for comparative purposes. Data for the remainder of the wells are plotted on individual graphs (Appendix C).

The arsenic concentration data were analyzed using the nonparametric Mann-Kendall test for trend (Mann 1945; Kendall 1975). This analysis yields one of four possible outcomes for each of the 36 monitoring wells that were analyzed. The data exhibit either:

- a statistically significant increasing trend
- a statistically significant decreasing trend
- no statistically significant trend
- insufficient data available to determine any statistically significant trend

Results of the trend analysis (Table 3-4) indicate that arsenic concentrations detected in two of the wells exhibit a statistically significant decreasing trend (LF-B6 and RP-1). Well LF-B6 is located inside the slurry wall and is screened in the B-zone. Well RP-1 is screened in the A-zone and is located outside the slurry wall on the former Rifkin property, near Horton Street (Figure 1-3). Based on the trend analysis results for well RP-1, there is no evidence of outward migration of arsenic through the slurry wall near this location. Similarly, based on the results for well LF-B6, there is no evidence of downward migration of arsenic through the A/B-zone aquitard at this location.

The arsenic concentration data from 26 wells of the 36 wells analyzed exhibit no statistically significant trend. These include six wells located inside the slurry wall (A-zone wells LF-4, LF-7, LF-8, and LF-10; and B-zone wells LF-B3 and LF-B5) and 19 wells outside the wall (A-zone wells LF-3, LF-12, LF-13, LF-18, LF-19, LF-20, LF-21, LF-23, LF-24, LF-25, LF-29, MW-1, MW-2, MW-3, MW-4, RP-2, RP-3, RP-4, and RP-5; and B-zone well LF-B4; (Figure 1-3). Based on these results, there is no evidence of outward migration of arsenic through the slurry wall or downward migration of arsenic through the A/B-zone aquitard.

There was an insufficient amount of data available to determine any statistically significant trend in arsenic concentrations by this method for six wells (LF-17, LF-22, LF-26, LF-27, LF-28, and LF-30). Consequently, based on these results, no conclusions can be made regarding the possibility of migration of arsenic at these locations.

Arsenic concentrations detected in two wells (LF-11 and MW-5) exhibit a statistically significant increasing trend. Both of these wells are screened in the A-zone and are located outside the slurry wall. Well LF-11 is located near the southwestern corner of the slurry wall on the Sherwin-Williams property and well MW-5 is located on the former Rifkin property. Arsenic concentrations detected at LF-11 have risen from 0.019 mg/l in January 1994 to 2.7 mg/l in March 1998. Arsenic concentrations detected at MW-5 increased from 41.5 mg/l in December 1994 to 190 mg/l in March 1998 (Appendix C; Figure 1-3).

In general, increases in arsenic concentrations outside of the slurry wall in wells LF-11 and MW-5 may have resulted from:

- migration of arsenic-affected groundwater through the slurry wall, from inside to outside, and/or
- migration of arsenic from other areas outside the slurry wall

Evaluation of the influence of these potential mechanisms on groundwater quality outside the slurry wall is complicated by:

- the presence of affected soil and groundwater outside the slurry wall prior to installation of the wall
- changes in groundwater flow directions after the slurry wall was installed, which likely redistributed chemicals in groundwater outside the wall
- fluctuations in groundwater elevations, such that groundwater moved vertically in and out of contact with chemically affected soil outside the wall

Given the location of well LF-11 relative to the slurry wall, and the direction of groundwater flow in the vicinity of this well, it is unlikely that the increase in arsenic concentration detected at this well resulted from migration of arsenic through the slurry wall. Although well LF-11 is located approximately 80 feet from the southwestern corner of the slurry wall, it is unlikely that groundwater would flow from this part of the slurry wall southward to LF-11. Interpretation of groundwater elevation contours suggests that groundwater generally flows from the area south of (outside) the southernmost portion of the slurry wall (near LF-PZ11), west-northwestward toward LF-11. The shortest distance from well LF-11 to a segment of the slurry wall that is approximately upgradient from LF-11 (i.e., near well LF-3) is approximately 240 feet (Figure 1-3). This relatively long distance, and the absence of an increasing trend in arsenic concentration at well LF-3, suggest that the increasing trend at well LF-11 is not a result of migration of arsenic through the slurry wall. The increases in arsenic concentrations detected at well LF-11 more likely resulted from migration of arsenic from areas outside the slurry wall. This may have resulted from changes in groundwater flowpaths outside the slurry wall due to diversion of groundwater flow around the outside of the slurry wall.

Well MW-5 is located in the vicinity of a known "arsenic source area" outside the slurry wall (Figure 1-2). Therefore, it is plausible that increases in arsenic concentration at this location may be due to migration of arsenic that originated outside the slurry wall. However, interpretation of groundwater elevation contours in the vicinity of this well suggests that groundwater generally flows from the vicinity of the slurry wall north-northwestward toward MW-5 (Figure 3-7). At times when the hydraulic gradient across the slurry wall has been outward in this general area, there has been the potential for groundwater to flow outward through the slurry wall. Consequently, the relative contribution of each of the potential mechanisms for increasing chemical concentrations at well MW-5 is uncertain based on available data.

3.2 Effectiveness in Removing Chemical Mass in Groundwater

The following section discusses the effectiveness of the IRMs in removing the amount of chemical mass in the area within the slurry wall. The amount of groundwater extracted and chemical mass removed from within the slurry wall area has been previously limited by frequent down-time of the GWTS and GWES. However, the chemical mass removed in the first half of 1998 has increased over previous time periods due to greater operating time of the GWES.

Since startup in October 1995, arsenic concentrations in the GWTS influent water (i.e., extracted groundwater) have ranged between 11,000 and 81,000 ppb and removal efficiency of arsenic through the GWTS has been in excess of 99.97 percent. Previous operating problems between 1995 and 1997 resulted in the extraction system operating approximately 60 percent of the time, which limited the effectiveness of chemical mass extraction.

As discussed in Section 2.1.3, several modifications have been made to increase the performance of the GWTS. Between February and July 1998, the extensive efforts to modify the GWTS, revise operation and maintenance procedures, and adjust treatment-system operation parameters have resulted in greater success for mass removal. The GWES was returned to service in mid February 1998, and between February and the end of June 1998, the GWES has been in operation approximately 85 percent of the time. Since extraction well EX-3 was placed back on line in early May 1998, influent arsenic concentrations to the GWTS have increased from 8,500 ppb to 38,500 ppb.

Due to the improvements made to the Andco system and the additional labor to operate the GWTS, the volume of groundwater extracted by the GWES and treated by the GWTS in the first half of 1998 has already met or exceeded yearly totals from 1995, 1996, and 1997 (Table 3-5). Using the monthly influent groundwater sample results and totalizer readings for the GWTS, the estimated mass of contaminants removed from within the slurry wall is presented in Table 3-5. Since startup of the GWES and GWTS in October 1995, approximately 585 pounds of arsenic, 56 pounds of VOCs, 87 pounds of TPHg, and 13 pounds of TPHd have been extracted from the groundwater by the GWES.

3.3 Effectiveness in Reducing Potential for Exposure to Chemically Affected Soil and Groundwater

The following section discusses the effectiveness of the IRMs in reducing potential exposure to chemically affected soil and groundwater. The potential exposure to chemically affected soil has been reduced by the installation of the asphalt and concrete cap and the remedial actions performed at the Site. The cap, slurry wall, GWES, and storm-water collection system became less effective in reducing the potential exposure to chemically affected groundwater by off-site receptors when groundwater levels rose above the inverts of the storm-water collection system and created an outward hydraulic gradient across the slurry wall. The installation of the multipoint system in November 1997 was effective in isolating the storm-water collection system from infiltration of and off-site transport of contaminated groundwater to Temescal Creek. The increased performance of the GWES in the first half of 1998 and drier weather in May and June 1998 have resulted in groundwater levels being lower than the inverts of the storm-water collection system and an inward hydraulic gradient has been achieved at numerous locations of the slurry wall.

The area of the Site covered by the asphalt and concrete cap has been protected from erosion by wind or rain. That has kept the underlying soil from migrating to locations where off-site exposure to chemicals could occur. The cap has also been an effective barrier against direct human exposure to soils on the Site.

Other measures that have prevented or reduced exposure to chemically affected soil include the removal actions taken at the Site. The "hot-spot" removal action in the vicinity of the former solvent tank farm removed approximately 450 cy of soil that contained lead and zinc at concentrations up to 3,200 mg/kg and 12,000 mg/kg, respectively. The Horton Street area excavation and removal reduced the potential for exposure to chemically affected soil through the removal of 3,800 cy of soil containing arsenic and lead at concentrations up to 86,000 mg/kg and 49,000 mg/kg, respectively. The contaminated soils near the ground surface have been replaced with clean backfill and the potential for human exposure to contaminants in the Horton Street area has been significantly reduced. The "hot-spot" removal and Horton Street area excavation reduced the potential for future leaching of contaminants in soil to groundwater and subsequent exposure to contaminants in groundwater. The discovery and subsequent removal of four buried railroad tank cars and two small torpedo tanks near the SPRR boundary reduced the potential for future leakage from the tanks in soil and groundwater and subsequent exposure to contaminants in soil and groundwater.

The IRMs were also designed to reduce potential exposure of contaminants in groundwater to the environment. The cap and storm-water collection system were designed to collect and transport surface-water runoff off site and reduce the recharge of groundwater. The combined effects of the slurry wall, the GWES, and the storm-water collection system were intended to minimize the off-site transport of and potential exposure to chemically affected groundwater. The GWTS was designed to reduce the contaminant concentrations in the extracted groundwater to concentrations suitable for discharge under an NPDES permit.

Several factors have reduced the effectiveness of the cap and storm-water collection system in achieving the objective of reducing potential exposure by off-site receptors to chemically affected groundwater. First, the infiltration of surface water through the cap at locations along the railroad tracks and switch gear inside the slurry wall, in addition to experiencing the second wettest rainy season on record, has contributed to higher groundwater elevations within the slurry wall during the 1997/1998 rainy season. Secondly, the GWTS has experienced operational difficulties, which has led to excessive down-time and lower volumes of groundwater extracted. The storm-water collection system became less effective in achieving its objectives when groundwater levels rose above the invert depths of the storm-drain system, thus allowing for infiltration of chemically affected groundwater and transport off site to Temescal Creek. The installation of the multipoint system in late November 1997 was an effective temporary solution in isolating the existing storm-water collection system from infiltration of and potential exposure to contaminated groundwater. However, a permanent solution to lower groundwater elevations below the storm-water collection system inverts needs to be implemented.

The objectives of the slurry wall, GWES, and cap in reducing the potential exposure to contaminants by off-site receptors by creating an inward hydraulic gradient have not been consistently achieved. However, the water balance calculations provided in Section 3.1.1 illustrate that the slurry wall has been partially effective in reducing the off-site migration of chemically affected groundwater. Even with the elevated groundwater levels within the area of the slurry wall between November 1996 and June 1998, estimates of the volume of groundwater flow off site through the entire length of the slurry wall is estimated to be 23 gpd. In addition, the statistical trend for arsenic concentrations outside the slurry wall do not indicate that contaminants are migrating through the slurry wall (with the possible exception of uncertainty near well MW-5).

Groundwater elevations measured on July 2, 1998 indicate that an inward hydraulic gradient has been recently achieved at numerous locations along the slurry wall and that groundwater elevations are below the inverts of the storm-water collection system (Figure 3-2). The lower groundwater levels inside the slurry wall are a result of recent dry periods in May and June 1998 and the increased operating efficiency of the GWES in the first half of 1998. Once an inward hydraulic gradient has been consistently achieved along the slurry wall, it is anticipated that the IRMs will be fully effective in inhibiting off-site migration of chemicals.

3.4 Summary of Evaluation of Existing IRMs and Remedial Actions

The following summarizes the evaluation of existing IRMs and remedial actions implemented by Sherwin-Williams in achieving the remedial objectives. These objectives, as previously stated, are as follows:

- inhibit off-site migration of chemically affected groundwater
- removing chemical mass in groundwater
- reduce the potential exposure to chemically affected soil and groundwater

3.4.1 Effectiveness in Inhibiting Off-Site Migration of Chemically Affected Groundwater

Based on available data, the IRMs have been moderately effective in inhibiting off-site migration of chemically affected groundwater. Exceptions to this conclusion include:

- the period when chemically affected groundwater infiltrated into the storm-water collection system and then entered Temescal Creek (as discussed in Section 3.3)
- uncertainty regarding the cause(s) of the statistically significant increasing trend in arsenic concentration at well MW-5 outside the slurry wall (as discussed in Section 3.1.1)

Although the IRMs have not consistently performed as designed to maintain an inward hydraulic gradient across the slurry wall, groundwater quality conditions have not generally deteriorated outside the slurry wall, as evidenced by the absence of a statistically significant increasing trend in chemical concentrations in most wells outside the slurry wall. Nevertheless, because the potential for off-site migration of chemicals has existed frequently in the past, the IRMs will be improved as discussed in Section 4.

3.4.2 Removing Chemical Mass in Groundwater

The amount of groundwater extracted and chemical mass removed within the slurry wall area has been previously limited by frequent down-time of the GWTS and GWES. However, the chemical mass removed in the first half of 1998 has increased due to greater operating time of the GWES.

Since startup of the GWES and GWTS in October 1995, approximately 585 pounds of arsenic, 56 pounds of VOCs, 87 pounds of TPHg, and 13 pounds of TPHd have been extracted from the groundwater by the GWES.

3.4.3 Reducing Potential Exposure to Chemically Affected Soil and Groundwater

The potential exposure to chemically affected soil has been reduced by the installation of the asphalt and concrete cap and the soil remedial actions performed at the Site. The cap, slurry wall, GWES, and storm-water collection system became less effective in reducing the potential for exposure to chemically affected groundwater by off-site receptors (Temescal Creek) when groundwater levels rose above the inverts of the storm-water collection system and created an outward hydraulic gradient across the slurry wall. The installation of the multipoint system in November 1997 was effective in isolating the storm-water collection system from infiltration of and off-site transport of contaminated groundwater to Temescal Creek. The increased performance of the GWES in the first half of 1998 and drier weather in May and June 1998 have resulted in: 1) groundwater levels being lower than the inverts of the storm-water collection system and 2) an inward hydraulic gradient has been achieved at the majority of locations along the slurry wall. Thus, the potential for exposure to chemically affected groundwater is reduced.

4.0 WORK PLAN FOR IMPLEMENTATION OF FUTURE INTERIM REMEDIAL MEASURES

The following sections summarize the tasks that will be implemented to enhance the performance of the IRMs that have been implemented at the Site. Where applicable, performance evaluation criteria and monitoring requirements are described and contingency measures are developed to address potential future problems. A schedule for all these tasks is presented in Figure 4-1.

4.1 Slurry Wall and Groundwater Extraction System

The slurry wall and GWES have not met all of the IRM objectives and the GWES will be expanded to increase the groundwater extraction rate. As discussed in Section 3.1, the effectiveness of the slurry wall and GWES can be monitored through groundwater level differences measured across the slurry wall and the differences in groundwater contaminant concentration and flow direction inside and outside of the slurry wall. Based on historical groundwater level measurements and the water balance evaluation described in Section 3.1.1, the slurry wall and GWES have not consistently achieved the objective of establishing an inward hydraulic gradient along the entire length of the slurry wall. It is expected that consistent inward hydraulic gradients will be established through the proposed expansion of the existing GWES as described below. The additional extraction wells proposed under this task will lower groundwater levels within the slurry wall area and create the necessary groundwater sink to establish an inward hydraulic gradient.

Figure 4-2 shows the preliminary design for location and layout of the proposed expanded GWES. The plan for design and installation of the expanded extraction system comprises the following items:

- strategically placing seven additional on-site extraction wells at selected locations to enhance groundwater extraction, which will result in lowering groundwater elevations below the inverts of the storm-drain system and achieving an inward hydraulic gradient
- design of conveyance hose (air supply to pneumatic pumps and groundwater extraction) within secondary containment pipe and associated trench work connecting the seven additional wells to the GWTS
- design and selection of the down-well pneumatic pumps to accommodate the anticipated extraction rates for each well

As shown in Figure 4-2, new extraction wells EX-4, EX-5, and EX-6 are located next to the existing storm-water collection system. Extraction of groundwater from these new wells will contribute to achieving an inward hydraulic gradient within the slurry wall area as well as lowering the groundwater table below the storm-drain system. Extraction wells EX-7 through EX-10 will also lower groundwater levels and assist in maintaining an inward gradient within the slurry wall area at the Site. Installation and operation of the seven new extraction wells are expected to increase the overall yield of the GWES to between 10 and 15 gpm during initial startup.

Piping to the new extraction wells will match the existing piping network, consisting of 1-inch nylon fluid discharge hose and ½-inch nylon air supply hose contained within an outer 4-inch-diameter, Schedule 80 PVC casing which serves as secondary containment. The air supply hose operates the down-well pneumatic pumps, while the fluid discharge hose serves to transport extracted groundwater to the treatment system. Figure 4-2 shows the location of the subsurface trenches with hosing and secondary containment piping. Aboveground piping to the GWTS will be secured to the existing facility buildings. The new extraction well vaults and wellheads will be redesigned with better access for maintenance technicians to monitor the operation of the wells. The proposed down-well pneumatic pumps (pneumatic short-version total fluids pumps) are rated, as a whole, to exceed the potential overall groundwater extraction rate, which is limited by the capacity yield of the A-zone within the slurry wall area. LFR has prepared plans and specifications for construction of the expanded GWES. The plans and specifications have been submitted to several contractors for bidding and a contractor has been selected to complete the work.

Continued monitoring of the slurry wall and GWES performances will occur through monthly monitoring from existing monitoring wells and piezometers during the first three months after the GWES is expanded and during the first rainy season. Thereafter, groundwater elevation measurements will be collected on a quarterly basis. Groundwater elevation contour maps will be updated and evaluated as a measure of effectiveness. Should improvements not be observed, contingency measures including an evaluation of the need for additional extraction wells and the identification of additional sources of potential groundwater recharge will be implemented. The schedule for completing the GWES design, bidding, and construction is shown in Figure 4-1.

4.2 Cap and Storm-Water Collection System

The cap and storm-water collection system have substantially met their IRM objectives of eliminating human exposure pathways and preventing water infiltration. As discussed in Section 2.1.2, the cap was inspected by LFR in September 1997 and found to be in good to excellent condition. Annual inspections of the cap will be performed and maintenance of the concrete and asphalt will be performed as required.

Surface-water sources contributing to groundwater recharge within the containment area have been investigated including storm-water infiltration through the existing railroad tracks and associated switch gear. LFR has identified a qualified railroad design engineer to evaluate alternatives to prevent surface water from infiltrating the cap underneath the railroad track and switch gear. One such alternative being evaluated includes a subsurface geocomposite drainage system with concrete manholes serving as collection and pumping points. Specific recommendations for preventing infiltration around the railroad tracks will be submitted to the RWQCB upon completion of an engineering analysis by the railroad design engineer and LFR.

LFR evaluated several long-term solutions to prevent affected groundwater from entering the storm-water collection system, including lining the storm-drain pipes, installing surface trench drains, and lowering groundwater levels within the slurry wall. As discussed in Section 4.1, the selected alternative is to lower the groundwater table below the storm-water collection system piping and catch basins through expansion of the GWES. Increasing the GWES capacity, resulting in a lowered groundwater table, will prevent the chemically affected groundwater from infiltrating into the storm-water collection system piping. The effectiveness of this alternative will be evaluated through groundwater level measurements described in Section 4.1. Since the groundwater elevations have been recently lowered to below the inverts of the storm-drain lines, the storm-water collection system will effectively convey surface storm water to Temescal Creek and requires no further modifications. A check valve will be installed at the outfall to the creek to prevent water in Temescal Creek from flowing into the storm-water collection system during high tide events.

4.3 Groundwater Treatment System

LFR has evaluated the performance and capacity of the existing GWTS. Upgrading of the existing GWTS to accommodate increased flows is necessary because of the need for additional extraction wells on site to lower the groundwater table. A conservative estimated flow rate of 6.5 gpm will be required to maintain lower groundwater elevations during rainy periods. In addition, future expansion of the extraction system on the former Rifkin property as well as potential wells outside the slurry wall area may be necessary, depending on results of the site remedial investigation/feasibility study to be conducted in 1998 and 1999. As a result, the overall expansion of the treatment system will be designed for 30 gpm, which, based on engineering judgement, should accommodate wells that may be installed in the future.

LFR identified several equipment limitations (e.g., filter press, clarifier, and hydrogen peroxide controller unit) in the existing Andco system. The current GWTS was designed in 1993 to treat groundwater at a flow rate of 12 gpm; however, the GWTS actually operates on average between 5 and 7 gpm. The Andco GWTS system has difficulty in consistently meeting the NPDES discharge requirements of 25 ppb when operating at higher flow rates of 7 to 9 gpm. Additionally, a significant capital expenditure would be required to upgrade the existing Andco system to handle a flow rate of 30 gpm, and it is questionable whether sustained flow rates can be achieved.

Due to concerns that the Andco technology would not meet the NPDES limit for arsenic at the higher projected flowrates, LFR performed an evaluation of numerous arsenic-removal technologies as alternatives to the Andco system. The alternative arsenic-removal technologies evaluated include: ion exchange, reverse osmosis, hydroxide precipitation with lime, sulfide precipitation, silica-matrix precipitation, mineral-like precipitation, catalyzed cementation, and reductive precipitation. Appendix D presents a detailed description of each of the alternative arsenic-removal technologies evaluated by LFR.

Between January and May 1998, MSE Technology Applications, Inc. (MSE) performed three pilot-scale demonstrations at the Sherwin-Williams facility. MSE has developed three proprietary arsenic removal technologies (mineral-like precipitation, catalyzed cementation, and reductive precipitation) in conjunction with the University of Montana at Butte ("Montana Tech"), with funding from the U.S. EPA Mine Waste Technology Program. The objectives of the three pilot-scale demonstrations were as follows:

- evaluate which of the three technologies could treat the contaminated groundwater on a pilot-scale level to concentrations less than the NPDES limit of 25 ppb of arsenic
- generate adequate volumes of sludge in order to characterize the solid waste stream as non-hazardous, California hazardous, or Resource Conservation and Recovery Act (RCRA) hazardous waste
- provide data to optimize the quantities of chemicals used in the three technologies
- provide information for estimating capital and annual operations and maintenance (O&M) costs for operating a treatment system at 30 gpm

The overall objective of treating contaminated groundwater to concentrations less than the NPDES limit of 25 ppb for arsenic was achieved for the catalyzed cementation and the reductive precipitation technologies (Appendix D). The mineral-like precipitation was unable to treat the groundwater to concentrations less than 25 ppb for arsenic.

Following completion of a preliminary engineering design, it was determined by MSE that several steps in the catalyzed cementation process could potentially be difficult to design for a full-scale 30 gpm system. MSE completed a preliminary design for a 30 gpm system using the reductive precipitation technology.

Based on the positive results of the third MSE pilot-scale demonstration, Sherwin-Williams decided to contract with MSE to design and build a 30-gpm GWTS, using the proprietary reductive precipitation technology, to replace the existing Andco co-precipitation process.

The proprietary reductive precipitation process offers numerous advantages over the current Andco GWTS, including:

- the equipment needed for the process will be easier to operate and maintain, resulting in less projected down time and reduced labor costs
- smaller sludge volumes are produced and sludge will dewater more readily
- the chemistry of the reductive precipitation process will be easily controlled at flow rates of 30 gpm
- a 30-gpm system using the reductive precipitation technology is expected to cost less (based on a present worth analysis) than expanding the Andco system

The following tasks will be implemented for expanding the GWTS:

- develop contract and licensing agreement between Sherwin-Williams and MSE
- design the groundwater treatment system
- procure parts and equipment
- install process tanks, pumps, piping, valves, electrical and controls on site
- perform start up of MSE system

A preliminary flow diagram of the proprietary reductive precipitation process is shown in Figure 4-3. This flow diagram may be subject to change based on the final design to be implemented. A schedule for designing and constructing the GWTS is shown in Figure 4-1.

4.4 Summary of Work Plan for Implementation of Future IRMs

The slurry wall and GWES have not met all of the IRM objectives; therefore, the GWES will be expanded to increase the groundwater extraction rate within the slurry wall area. To achieve lower groundwater elevations within the slurry wall and achieve an inward hydraulic gradient, the GWES will be expanded by the addition of seven new on-site extraction wells. The effectiveness of the expanded GWES in achieving the IRM objectives will be monitored through monthly and quarterly monitoring of existing piezometers and monitoring wells.

The recommended future actions with respect to the cap and storm-water collection system are to prevent infiltration around the railroad tracks, to continue performing periodic maintenance of the cap, and to continue to perform quarterly groundwater level measurements. The long-term solution to prevent chemically affected groundwater from entering the storm-water collection system is to lower the groundwater table below the storm-water collection system piping. This will be achieved by the addition of the seven new on-site groundwater extraction wells as discussed above. The storm-water collection system requires no further modifications and will effectively convey surface storm water to Temescal Creek after the groundwater elevations have been lowered to below the inverts of the storm-water collection system.

LFR has evaluated the performance and capacity of the existing GWTS. Upgrading of the GWTS is necessary to accommodate the projected increased flows from the expanded GWES. In addition, future expansion of the extraction system on the former Rifkin property is planned as well as potential wells outside the slurry wall area may be necessary. The number of additional wells required in the future will be determined through the Site RI/FS to be conducted in 1998 and 1999.

Due to concerns that the Andco technology would not meet the NPDES limit for arsenic at the higher projected flowrates, LFR has performed an evaluation of numerous arsenic-removal technologies as alternatives to the Andco system. Based on

Table 1-1
Summary of Contaminant Concentrations Detected in Soil and Groundwater
Prior to Implementation of the IRMs and Remedial Actions
Sherwin-Williams Company, Emeryville, California

Area	Soil	Groundwater (A-zone)
Sherwin-Williams Property (Inside Slurry Wall Area)	Metals: [As (0 - 2 ft bgs): 13 – 1,100 mg/kg] [Pb (0 - 2 ft bgs): 12 – 2,900 mg/kg] [As (2 - 6 ft bgs): 2 – 110,000 mg/kg] [Pb (2 - 6 ft bgs): 4 – 62,000 mg/kg]	Metals: [As (<0.002 – 820[d])] [Pb (<0.002 – 0.015 mg/l)]
	Total BTEX[a]: (0 - 2 ft bgs: <0.1 – 506 mg/kg) (2 - 6 ft bgs: <0.005 – 14,301 mg/kg)	Total BTEX[a]: (<0.005 – 310 mg/l)
	Total VOCs[b]: (0 - 2 ft bgs: <0.1 mg/kg) (2 - 6 ft bgs): <0.005 – 1,800 mg/kg)	Total VOCs[b]:(<0.005 – 4,120[d] mg/l)
	TPH: [TPH-g (0 - 2 ft bgs): NS [c]] [TPH-d (0 – 2 ft bgs): <0.5 – 71 mg/kg] [TPH-g (2 – 6 ft bgs): <1 – 2,000 mg/kg] [TPH-d (2 - 6 ft bgs): <0.5 – 3,300 mg/kg]	TPH: [TPH-g (<0.05 – 430[d])] [TPH-d (<0.05 - 21[d])]
Former Rifkin Property	Metals: [As (0 – 2 ft bgs): 920 – 1,900 mg/kg] [Pb (0 – 2 ft bgs): 380 – 2,300 mg/kg] [As (2 - 6 ft bgs): 1 – 30,000 mg/kg] [Pb (2 - 6 ft bgs): <5 –120,000 mg/kg]	Metals: [As (<0.002 – 430[d] mg/l)] [Pb (<0.005 – 0.15 mg/l)]
	Total BTEX[a]: (0 - 2 ft bgs: NS [c]) (2 - 6 ft bgs: <0.005 – 67.3 mg/kg)	Total BTEX[a]: (<0.0005 – 354.6 mg/l)
	Total VOCs[b]: (0 – 2 ft bgs): NS [c]) (2 - 6 ft bgs): <0.1 – 123 mg/kg)	Total VOCs[b]:(<0.001 – 3,000.13 mg/l)
	TPH: [TPH-g (0 – 2 ft bgs): NS [c]] [TPH-d (0 – 2 ft bgs): NS [c]] [TPH-g (2 - 6 ft bgs): <0.2 – 43 mg/kg] [TPH-d (2 - 6 ft bgs): <0.05 – 17 mg/kg]	TPH: [TPH-g (<0.05 – 660 mg/l)] [TPH-d (<0.05 - 320[d] mg/l)]

Table 1-1 (continued)
Summary of Contaminant Concentrations Detected in Soil and Groundwater
Prior to Implementation of the IRMs and Remedial Actions
Sherwin-Williams Facility, Emeryville, California

Area	Soil		Groundwater (A-zone)	
Horton Street	Metals:	[As (0 – 2 ft bgs): <1 – 86,000 mg/kg] [Pb (0 – 2 ft bgs): < 1 – 49,000 mg/kg] [As (2 – 6 ft bgs): <1 – 460 mg/kg] [Pb (2 - 6 ft bgs): 2.2 – 910 mg/kg]	Metals:	[As (<0.005 – 0.66 mg/l)] [Pb (<0.005 – 0.0557 mg/l)]
	Total BTEX[a]:	(0 - 2 ft bgs: <0.1 mg/kg) (2 - 6 ft bgs: <0.1 – 32 mg/kg)	Total BTEX[a]:	(<0.0005 – 0.262 mg/l)
	Total VOCs[b]:	(0 – 2 ft bgs): <0.1 mg/kg) (> 2 ft bgs): <0.1 - 0.2 mg/kg)	Total VOCs[b]:	(<0.001 – 2.24 mg/l)
	TPH:	[TPH-g (0 – 2 ft bgs): NS[c]] [TPH-d (0 – 2 ft bgs): NS[c]] [TPH-g (2 – 6 ft bgs): <1 – 128 mg/kg] [TPH-d (2 - 6 ft bgs): <1 mg/kg]	TPH:	[TPH-g (<0.05 – 7.41 mg/l)] [TPH-d (<0.05 – 77 mg/l)]

Notes:

As arsenic
BTEX benzene, toluene, ethylbenzene, and xylene
mg/kg milligrams per kilogram
mg/l milligrams per liter
Pb lead
TPH total petroleum hydrocarbons
VOCs volatile organic compounds

Concentration ranges taken from the LFR report "Current Conditions Report for the Sherwin-Williams Facility, California," dated June 19, 1998

a Includes sum of BTEX concentrations
b Includes sum of VOC (other than BTEX) concentrations (TCE; PCE; 1,1,1-TCA; cis-1,2-DCE; trans-1,2-DCE; 1,2-DCA; 1,1-DCE; 1,2-DCP; vinyl chloride; acetone; 2-butanone; and 4-methyl-2-pentanone)
c not sampled for this constituent
d grab groundwater sample

Table 3-1
Relative Comparison of Water Balance Terms
Sherwin-Williams Company
Emeryville, California

Water Balance Term	Inward Gradient: Source or Sink	Inward Gradient: Estimated Magnitude	Outward Gradient: Source or Sink	Outward Gradient: Estimated Magnitude
Pumping	Sink	Large	Sink	Large
Utility Leakage	Source	Small to Moderate	Source	Small to Moderate
Rainfall Recharge	Source	Moderate	Source	Moderate
Groundwater Discharge into (outward gradient) or out of (inward gradient) Stormwater Drains[1]	Source	Small	Sink	Moderate
Flow into (inward gradient) or out of (outward gradient) the Slurry Wall	Source	Small	Sink	Small
Flow into (outward gradient) or out of (inward gradient) B-Zone[2]	Source	Small	Sink	Small

Notes:

[1] Assumes that if there is an inward hydraulic gradient across the slurry wall, groundwater elevations will be below the storm-water collection system piping and, therefore, will not flow into the storm-water collection system piping. Assumes that if there is an outward hydraulic gradient, groundwater elevations will be above the storm-water collection system piping and, therefore, groundwater will potentially flow into the storm-water collection system piping.

[2] Assumes that if there is inward hydraulic gradient, A-zone groundwater elevations inside the slurry wall would be lower than B-zone groundwater elevations and, therefore, there would be the potential for flow from the B-zone to the A-zone. Assumes that if there is an outward hydraulic gradient, A-zone groundwater elevations inside the slurry wall would be higher than B-zone groundwater elevations and, therefore, there would be the potential for flow from the A-zone to the B-zone.

Table 3-2
Historical Water Levels for Wells and Piezometer Pairs, Post Slurry-Wall Construction
Sherwin Williams Company
Emeryville, California

(all measurements are in feet above mean sea level [msl])

Date	LF-7 (a)	LF-19 (b)	GWE Diff.	LF-8 (a)	LF-18 (b)	GWE Diff.	LF-26 (a)	LF-20 (b)	GWE Diff.	LF-10 (a)	LF-21 (b)	GWE Diff.	LF-PZ13 (a)	LF-PZ12 (b)	GWE Diff.	LF-17 (a)	LF-3 (b)	GWE Diff.
04/24/96	5.79	6.26	+0.47	5.77	4.84	-0.93	5.00	4.22	-0.78	5.89	6.72	+0.83	nm	nm	nc	7.18	7.13	-0.05
07/29/96	4.74	6.42	+1.68	4.70	4.40	-0.30	4.82	3.86	-0.96	nm	5.76	nc	nm	nm	nc	6.43	6.43	0.00
12/13/96	7.45	9.33	+1.88	7.79	6.61	-1.18	6.15	4.06	-2.09	7.31	5.31	-2.00	nm	nm	nc	9.94	7.11	-2.83
04/15/97	6.23	6.82	+0.59	5.70	4.55	-1.15	5.69	3.92	-1.77	6.32	4.79	-1.53	nm	nm	nc	8.49	6.22	-2.27
09/19/97	6.22	6.49	+0.27	5.66	4.74	-0.92	5.29	3.86	-1.43	6.34	4.95	-1.39	nm	nm	nc	8.53	6.29	-2.24
12/03/97	7.02	7.38	+0.36	7.26	5.73	-1.53	3.94	4.19	+0.25	6.94	5.05	-1.89	nm	nm	nc	7.98	6.82	-1.16
12/15/97	8.49	6.32	-2.17	8.35	6.03	-2.32	5.79	4.24	-1.55	8.18	5.10	-3.08	8.15	6.63	-1.52	8.74	7.39	-1.35
01/13/98	9.55	nm	nc	9.40	7.16	-2.24	8.85	4.47	-4.38	9.22	5.34	-3.88	9.15	7.34	-1.81	10.08	8.38	-1.70
01/30/98	9.42	8.17	-1.25	9.28	6.73	-2.55	9.05	4.35	-4.70	9.04	5.33	-3.71	8.88	6.97	-1.91	9.73	7.82	-1.91
02/24/98	9.22	8.90	-0.32	9.23	6.71	-2.52	9.01	4.34	-4.67	8.86	5.54	-3.32	8.92	7.33	-1.59	10.13	8.35	-1.78
04/06/98	6.92	7.67	+0.75	7.00	5.56	-1.44	6.99	4.16	-2.83	6.63	5.37	-1.26	nm	nm	nc	8.40	6.95	-1.45
04/07/98	nm	nm	nc	nm	nm	nc	nm	nm	nc	nm	nm	nc	6.90	6.40	-0.50	nm	nm	nc
07/02/98	4.70	7.01	+2.31	4.94	4.54	-0.40	4.78	3.96	-0.82	4.83	5.02	+0.19	5.17	5.80	+0.63	6.32	6.15	-0.17
07/13/98	4.59	6.86	+2.27	4.73	4.66	-0.07	4.94	3.91	-1.03	4.73	5.00	+0.27	5.06	5.78	+0.72	6.13	6.11	-0.02

Notes:

Piezometers were installed in late November and early December of 1997

(a) The first well in each pair shown is located INSIDE the slurry-wall

(b) The second well in each pair shown is located OUTSIDE the slurry-wall

GWE differences for each pair are calculated by GWE (b) - GWE (a)

Positive (+) values indicate an INWARD gradient, negative (-) values indicate an OUTWARD gradient

nm = no measurement, nc = no calculation

Table 3-2 (continued)
Historical Water Levels for Wells and Piezometer Pairs, Post Slurry-Wall Construction
Sherwin Williams Company
Emeryville, California

(all measurements are in feet above mean sea level [msl])

Date	LF-PZ9 (a)	LF-PZ11 (b)	GWE Diff.	LF-22 (a)	LF-12 (b)	GWE Diff.	LF-PZ3 (a)	LF-PZ2 (b)	GWE Diff.	LF-PZ5 (a)	LF-PZ4 (b)	GWE Diff.
04/24/96	nm	nm	nc	7.61	8.38	+0.77	nm	nm	nc	nm	nm	nc
07/29/96	nm	nm	nc	6.94	7.66	+0.72	nm	nm	nc	nm	nm	nc
12/13/96	nm	nm	nc	10.09	9.26	-0.83	nm	nm	nc	nm	nm	nc
04/15/97	nm	nm	nc	9.02	8.01	-1.01	nm	nm	nc	nm	nm	nc
09/19/97	nm	nm	nc	9.15	7.95	-1.20	nm	nm	nc	nm	nm	nc
12/03/97	nm	nm	nc	8.44	8.83	+0.39	nm	nm	nc	nm	nm	nc
12/15/97	8.85	6.87	-1.98	8.76	8.84	+0.08	8.55	8.72	+0.17	8.47	8.01	-0.46
01/13/98	10.10	9.02	-1.08	9.59	9.42	-0.17	9.69	7.93	-1.76	8.71	8.42	-0.29
01/30/98	9.67	8.38	-1.29	9.56	9.10	-0.46	9.54	8.61	-0.93	9.31	8.49	-0.82
02/24/98	10.12	8.75	-1.37	10.08	9.38	-0.70	10.19	9.28	-0.91	10.03	8.94	-1.09
04/06/98	8.35	7.64	-0.71	8.42	8.68	+0.26	8.05	8.25	+0.20	8.30	8.05	-0.25
04/07/98	nm	nm	nc	nm	nm	nc	nm	nm	nc	nm	nm	nc
07/02/98	6.42	6.94	+0.52	6.82	8.00	+1.18	6.71	7.49	+0.78	7.25	7.34	+0.09
07/13/98	6.30	6.91	+0.61	6.58	7.94	+1.36	6.67	7.38	+0.71	7.15	7.25	+0.10

Notes:

Piezometers were installed in late November and early December of 1997

(a) The first well in each pair shown is located INSIDE the slurry-wall

(b) The second well in each pair shown is located OUTSIDE the slurry-wall

GWE differences for each pair are calculated by GWE (b) - GWE (a)

Positive (+) values indicate an INWARD gradient, negative (-) values indicate an OUTWARD gradient

nm = no measurement, nc = no calculation

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-1		01-Jun-89	200	na	na	<0.04	<0.3	na	na	na	na	na	0.59
LF-1		07-Dec-89	190	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-1		20-Jul-90	120	0.06	na	<0.05	<0.2	na	na	na	na	na	0.26
LF-1		20-Jun-91	58	na	na	<0.005	<0.004	na	na	na	na	na	0.236
LF-1		09-Jul-92	53.2	<0.1	na	0.058	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-1		09-Jun-93	39.8	<0.1	na	<0.03	0.0039	<0.01	<0.0002	<0.05	<0.01	na	na
LF-1		Destroyed under permit											
LF-2		02-Jun-89	2.6	na	na	<0.04	<0.3	na	na	na	na	na	0.01
LF-2		07-Dec-89	17	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-2		20-Jul-90	110	0.45	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-2		Destroyed or lost during slurry wall and cap construction activities											
LF-3		02-Jun-89	27	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-3		07-Dec-89	30	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-3		20-Jul-90	21	0.42	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-3		20-Jun-91	60.4	na	na	<0.005	<0.004	na	na	na	na	na	0.028
LF-3		09-Jul-92	70.8	0.473	na	0.0205	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
DUP		09-Jul-92	66.6	0.452	na	0.0361	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-3		09-Jun-93	142	0.625	na	<0.1	<0.003	<0.01	<0.0002	<0.05	<0.01	na	na
DUP		09-Jun-93	141	0.635	na	<0.1	<0.003	<0.01	<0.0002	<0.05	<0.01	na	na
LF-3		16-Apr-96	58	na	na	na	<0.002	na	na	na	na	na	na
LF-3		31-Jul-96	72	na	na	na	na	na	na	na	na	na	na
LF-3		20-Nov-96	72	na	na	na	na	na	na	na	na	na	na
LF-3		19-Mar-97	110	na	na	na	na	na	na	na	na	na	na
LF-3		12-Jun-97	180	na	na	na	na	na	na	na	na	na	na
LF-3		19-Aug-97	120	na	na	na	na	na	na	na	na	na	na
LF-3		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.04
LF-3		17-Dec-97	60	na	na	na	na	na	na	na	na	na	na
DUP		17-Dec-97	67	na	na	na	na	na	na	na	na	na	na
LF-3		02-Mar-98	65	na	na	na	na	na	na	na	na	na	na
LF-3		10-Apr-98	25.7	na	na	na	na	na	na	na	na	na	na
LF-4		02-Jun-89	0.53	na	na	<0.04	<0.3	na	na	na	na	na	<0.01

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
DUP		02-Jun-89	0.58	na	na	<0.04	<0.3	na	na	na	na	na	7
LF-4		06-Dec-89	0.420	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
DUP		06-Dec-89	0.550	na	na	<0.04	<0.3	na	na	na	na	na	0.010
LF-4		20-Jul-90	0.19	0.16	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-4		20-Jun-91	0.51	na	na	<0.005	0.015	na	na	na	na	na	0.071
DUP		20-Jun-91	0.493	na	na	<0.005	0.01	na	na	na	na	na	0.109
LF-4		09-Jul-92	0.367	0.119	na	<0.005	<0.04	<0.01	<0.00027	<0.025	<0.01	na	na
LF-4		09-Jun-93	1.520	0.250	na	<0.015	<0.003	<0.01	<0.0002	<0.025	<0.01	na	na
LF-4		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.05
LF-4		02-Mar-98	0.34	na	na	na	na	na	na	na	na	na	na
LF-4		09-Apr-98	0.73	na	na	na	na	na	na	na	na	na	na
LF-5		01-Jun-89	0.017	na	na	<0.04	<0.3	na	na	na	na	na	0.04
LF-5		06-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-5		20-Jul-90	0.020	0.17	na	<0.05	<0.2	na	na	na	na	na	0.05
LF-5		20-Jun-91	0.038	na	na	<0.005	0.003	na	na	na	na	na	<0.02
LF-5		09-Jul-92	<0.01	0.111	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-5		09-Jun-93	0.0283	0.257	na	<0.005	<0.003	<0.01	<0.00027	<0.005	<0.01	na	na
LF-5		Destroyed or lost during slurry wall and cap construction activities											
LF-6		01-Jun-89	13	na	na	0.09	<0.3	na	na	na	na	na	0.12
LF-6		05-Dec-89	16	na	na	0.06	<0.3	na	na	na	na	na	<0.01
LF-6		20-Jul-90	14	0.21	na	<0.05	<0.2	na	na	na	na	na	0.06
LF-6		Sealed August 2, 1990											
LF-7		01-Jun-89	0.008	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-7		06-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-7		19-Jul-90	<0.002	0.06	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-7		20-Jun-91	0.012	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-7		09-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
DUP		09-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-7		09-Jun-93	<0.01	0.191	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
DUP		09-Jun-93	<0.01	0.201	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-7		06-Jan-94	<0.002	0.07	na	<0.001	0.001	<0.002	<0.0002	<0.004	<0.001	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-7		01-Aug-96	na	na	na	na	na	na	na	na	na	na	26
LF-7		22-Nov-96	na	na	na	na	na	na	na	na	na	na	0.12
LF-7		25-Nov-97	na	na	na	na	na	na	na	na	na	na	0.49
LF-7		27-Feb-98	0.020	na	na	na	na	na	na	na	na	na	na
DUP		27-Feb-98	0.020	na	na	na	na	na	na	na	na	na	na
LF-8		05-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-8		19-Jul-90	<0.002	0.12	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-8		21-Dec-90	0.02	0.59	na	0.0015	<0.2	na	na	na	na	na	0.25
LF-8		20-Jun-91	0.021	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-8		09-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-8		30-Dec-92	0.029	0.177	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-8		09-Jun-93	0.0384	0.121	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-8		06-Jan-94	0.055	0.1	na	<0.001	<0.001	<0.002	<0.0002	0.005	<0.001	na	na
LF-8		25-Nov-97	na	na	na	na	na	na	na	na	na	na	0.01
LF-8		27-Feb-98	0.022	na	na	na	na	na	na	na	na	na	na
LF-8		08-Apr-98	0.026	na	na	na	na	na	na	na	na	na	na
LF-9		05-Dec-89	0.067	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-9		19-Jul-90	0.008	0.11	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-9		21-Dec-90	0.12	0.27	na	0.0029	<0.2	na	na	na	na	na	0.73
LF-9		20-Jun-91	0.075	na	na	<0.005	0.012	na	na	na	na	na	0.1
LF-9		06-Aug-91	0.131	na	na	na	na	na	na	na	na	na	na
LF-9		09-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-9		30-Dec-92	0.106	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-9		09-Jun-93	0.158	0.169	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-9		Destroyed or lost during slurry wall and cap construction activities											
LF-10		07-Dec-89	0.650	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-10		19-Jul-90	0.012	0.11	na	<0.05	<0.2	na	na	na	na	na	<0.05
DUP		19-Jul-90	0.008	0.14	na	<0.05	<0.3	na	na	na	na	na	0.07
LF-10		21-Dec-90	1	0.33	na	0.0009	<0.2	na	na	na	na	na	<0.05
DUP		21-Dec-90	1.1	0.35	na	0.0007	<0.3	na	na	na	na	na	0.07

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-10		20-Jun-91	0.657	na	na	<0.005	0.013	na	na	na	na	na	0.064
LF-10		06-Aug-91	1.09	na	na	na	na	na	na	na	na	na	na
LF-10		09-Jul-92	0.328	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.025	<0.01	na	na
LF-10		31-Dec-92	0.550	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
DUP		31-Dec-92	0.552	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-10		09-Jun-93	0.958	0.249	na	<0.005	<0.003	<0.01	<0.0002	<0.05	<0.01	na	na
LF-10		06-Jan-94	0.94	0.19	na	<0.001	<0.001	<0.002	<0.0002	<0.004	0.002	na	na
DUP		06-Jan-94	0.82	0.18	na	<0.001	0.001	<0.002	<0.0002	<0.004	0.002	na	na
LF-10		01-Aug-96	na	na	na	na	na	na	na	na	na	na	2.3
LF-10		20-Nov-96	na	na	na	na	na	na	na	na	na	na	0.13
LF-10		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.02
LF-10		27-Feb-98	0.77	na	na	na	na	na	na	na	na	na	na
LF-11		05-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-11		19-Jul-90	0.007	0.12	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-11		21-Dec-90	0.011	0.18	na	0.0006	<0.2	na	na	na	na	na	<0.05
LF-11		21-Jun-91	0.023	na	na	<0.005	0.007	na	na	na	na	na	<0.02
DUP		21-Jun-91	0.024	na	na	<0.005	0.006	na	na	na	na	na	<0.02
LF-11		06-Aug-91	0.021	na	na	na	na	na	na	na	na	na	na
LF-11		09-Jul-92	<0.01	0.169	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-11		31-Dec-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-11		09-Jun-93	0.0116	0.152	na	<0.005	<0.003	<0.01	<0.0002	<0.05	<0.01	na	na
LF-11		05-Jan-94	0.019	0.13	na	<0.001	<0.001	<0.002	<0.0002	<0.004	0.001	na	na
LF-11		16-Apr-96	0.048	na	na	na	<0.002	na	na	na	na	na	na
LF-11		31-Jul-96	0.11	na	na	na	na	na	na	na	na	na	na
LF-11		20-Nov-96	0.45	na	na	na	na	na	na	na	na	na	na
LF-11		18-Mar-97	1.2	na	na	na	na	na	na	na	na	na	na
DUP		18-Mar-97	1.2	na	na	na	na	na	na	na	na	na	na
LF-11		11-Jun-97	0.62	na	na	na	na	na	na	na	na	na	na
LF-11		19-Aug-97	1.3	na	na	na	na	na	na	na	na	na	na
DUP		19-Aug-97	1.1	na	na	na	na	na	na	na	na	na	na
LF-11		17-Dec-97	2.1	na	na	na	na	na	na	na	na	na	na
LF-11		02-Mar-98	2.7	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-11		10-Apr-98	2.9	na	na	na	na	na	na	na	na	na	na
DUP		10-Apr-98	2.5	na	na	na	na	na	na	na	na	na	na
LF-12		06-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-12		18-Jul-90	0.004	0.06	na	<0.05	<0.3	na	na	na	na	na	<0.2
LF-12		19-Jun-91	<0.01	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-12		08-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-12		30-Dec-92	0.014	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-12		08-Jun-93	0.0152	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.05	<0.01	na	na
LF-12		06-Jan-94	0.013	0.06	na	<0.001	<0.001	0.006	<0.0002	0.005	<0.001	na	na
LF-12		16-Apr-96	0.043	na	na	na	<0.002	na	na	na	na	na	na
LF-12		30-Jul-96	0.006	na	na	na	na	na	na	na	na	na	0.81
LF-12		20-Nov-96	0.022	na	na	na	na	na	na	na	na	na	0.1
LF-12		17-Mar-97	0.014	na	na	na	na	na	na	na	na	na	na
LF-12		01-Jul-97	0.014	na	na	na	na	na	na	na	na	na	na
DUP		01-Jul-97	0.014	na	na	na	na	na	na	na	na	na	na
LF-12		20-Aug-97	0.018	na	na	na	na	na	na	na	na	na	na
LF-12		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.03
LF-12		18-Dec-97	0.013	na	na	na	na	na	na	na	na	na	na
LF-12		26-Feb-98	0.014	na	na	na	na	na	na	na	na	na	na
LF-12		08-Apr-98	0.014	na	na	na	na	na	na	na	na	na	na
LF-13		06-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-13		18-Jul-90	<0.002	<0.05	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-13		19-Dec-90	<0.002	0.1	na	<0.0005	<0.2	na	na	na	na	na	<0.05
LF-13		19-Jun-91	<0.01	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-13		09-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-13		30-Dec-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-13		08-Jun-93	<0.01	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.05	<0.01	na	na
LF-13		05-Jan-94	0.003	0.04	na	<0.005	<0.001	<0.002	<0.0002	<0.004	<0.001	na	na
LF-13		16-Apr-96	<0.002	na	na	na	<0.002	na	na	na	na	na	na
LF-13		30-Jul-96	<0.002	na	na	na	na	na	na	na	na	na	na
DUP		30-Jul-96	<0.002	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-13		20-Nov-96	<0.002	na	na	na	na	na	na	na	na	na	na
LF-13		17-Mar-97	<0.002	na	na	na	na	na	na	na	na	na	na
DUP		17-Mar-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-13		12-Jun-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-13		19-Aug-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-13		18-Dec-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-13		25-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
LF-13		07-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
DUP		07-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-14		04-Sep-90	0.092	0.06	na	<0.0005	0.007	na	na	na	na	na	<0.05
LF-14		02-Oct-90	0.077	na	na	na	na	na	na	na	na	na	na
LF-14		20-Dec-90	0.15	0.47	na	0.0036	<0.2	na	na	na	na	na	0.41
LF-14		20-Jun-91	0.095	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-14		31-Dec-92	0.121	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-14		09-Jun-93	0.102	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-14		Destroyed during railway expansion activities											
LF-15		04-Sep-90	0.002	0.06	na	<0.0005	0.043	na	na	na	na	na	<0.05
LF-15		20-Dec-90	0.007	0.23	na	0.0007	<0.2	na	na	na	na	na	0.1
LF-15		20-Jun-91	<0.01	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-15		08-Jul-92	<0.01	0.105	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-15		30-Dec-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-15		09-Jun-93	<0.01	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-15		Destroyed during railway expansion activities											
LF-16		04-Sep-90	0.003	0.06	na	<0.0005	<0.002	na	na	na	na	na	<0.05
LF-16		20-Dec-90	0.003	0.17	na	0.0007	<0.2	na	na	na	na	na	0.07
LF-16		20-Jun-91	0.01	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-16		09-Jul-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-16		30-Dec-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-16		09-Jun-93	<0.01	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-16		Destroyed under permit											
LF-17		24-Nov-97	na	na	na	na	na	na	na	na	na	na	<0.01

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-17		02-Mar-98	65	na	na	na	na	na	na	na	na	na	na
LF-17		10-Apr-98	80.9	na	na	na	na	na	na	na	na	na	na
LF-18		11-Apr-96	0.012	na	na	na	<0.002	na	na	na	na	na	na
LF-18		30-Jul-96	0.037	na	na	na	na	na	na	na	na	na	na
LF-18		20-Nov-96	0.043	na	na	na	na	na	na	na	na	na	na
LF-18		19-Mar-97	0.023	na	na	na	na	na	na	na	na	na	na
LF-18		11-Jun-97	0.026	na	na	na	na	na	na	na	na	na	na
DUP		11-Jun-97	0.032	na	na	na	na	na	na	na	na	na	na
LF-18		19-Aug-97	0.048	na	na	na	na	na	na	na	na	na	na
LF-18		25-Nov-97	na	na	na	na	na	na	na	na	na	na	<0.01
LF-18		17-Dec-97	0.008	na	na	na	na	na	na	na	na	na	na
LF-18		27-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
LF-18		08-Apr-98	0.0066	na	na	na	na	na	na	na	na	na	na
LF-19		13-Jun-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-19		19-Aug-97	0.007	na	na	na	na	na	na	na	na	na	na
LF-19		01-Dec-97	na	na	na	na	na	na	na	na	na	na	0.19
LF-19		27-Feb-98	0.007	na	na	na	na	na	na	na	na	na	na
LF-19		08-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-20		11-Apr-96	<0.002	na	na	na	<0.002	na	na	na	na	na	na
LF-20		30-Jul-96	0.085	na	na	na	na	na	na	na	na	na	na
LF-20		21-Nov-96	0.12	na	na	na	na	na	na	na	na	na	na
LF-20		18-Mar-97	0.11	na	na	na	na	na	na	na	na	na	na
LF-20		11-Jun-97	0.18	na	na	na	na	na	na	na	na	na	na
LF-20		19-Aug-97	0.18	na	na	na	na	na	na	na	na	na	na
LF-20		01-Dec-97	na	na	na	na	na	na	na	na	na	na	0.01
LF-20		18-Dec-97	0.15	na	na	na	na	na	na	na	na	na	na
LF-20		27-Feb-98	0.13	na	na	na	na	na	na	na	na	na	na
LF-20		09-Apr-98	0.075	na	na	na	na	na	na	na	na	na	na
DUP		09-Apr-98	0.093	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-21		10-Apr-96	<0.002	na	na	na	<0.002	na	na	na	na	na	na
LF-21		31-Jul-96	0.43	na	na	na	na	na	na	na	na	na	na
LF-21		21-Nov-96	0.38	na	na	na	na	na	na	na	na	na	na
LF-21		18-Mar-97	0.4	na	na	na	na	na	na	na	na	na	na
LF-21		11-Jun-97	0.43	na	na	na	na	na	na	na	na	na	na
LF-21		19-Aug-97	0.53	na	na	na	na	na	na	na	na	na	na
LF-21		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.02
LF-21		17-Dec-97	0.48	na	na	na	na	na	na	na	na	na	na
LF-21		02-Mar-98	0.35	na	na	na	na	na	na	na	na	na	na
DUP		02-Mar-98	0.41	na	na	na	na	na	na	na	na	na	na
LF-21		09-Apr-98	0.36	na	na	na	na	na	na	na	na	na	na
LF-22		01-Aug-96	na	na	na	na	na	na	na	na	na	na	4.1
LF-22		20-Nov-96	na	na	na	na	na	na	na	na	na	na	0.19
LF-22		24-Nov-97	na	na	na	na	na	na	na	na	na	na	<0.01
LF-22		02-Mar-98	160	na	na	na	na	na	na	na	na	na	na
LF-22		10-Apr-98	147	na	na	na	na	na	na	na	na	na	na
LF-23		10-Apr-96	<0.002	na	na	na	<0.002	na	na	na	na	na	na
DUP		10-Apr-96	0.004	na	na	na	<0.002	na	na	na	na	na	na
LF-23		02-Aug-96	<0.009 U5	na	na	na	na	na	na	na	na	na	na
LF-23		21-Nov-96	0.027	na	na	na	na	na	na	na	na	na	na
LF-23		18-Mar-97	0.01	na	na	na	na	na	na	na	na	na	na
LF-23		11-Jun-97	0.009	na	na	na	na	na	na	na	na	na	na
LF-23		20-Aug-97	0.009	na	na	na	na	na	na	na	na	na	na
LF-23		18-Dec-97	0.006	na	na	na	na	na	na	na	na	na	na
LF-23		26-Feb-98	0.008	na	na	na	na	na	na	na	na	na	na
LF-23		08-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-24		11-Apr-96	0.005	na	na	na	<0.002	na	na	na	na	na	na
LF-24		02-Aug-96	<0.01 U5	na	na	na	na	na	na	na	na	na	na

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Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-24		21-Nov-96	0.01	na	na	na	na	na	na	na	na	na	na
LF-24		18-Mar-97	0.006	na	na	na	na	na	na	na	na	na	na
LF-24		11-Jun-97	0.005	na	na	na	na	na	na	na	na	na	na
LF-24		20-Aug-97	0.008	na	na	na	na	na	na	na	na	na	na
LF-24		18-Dec-97	0.004	na	na	na	na	na	na	na	na	na	na
LF-24		26-Feb-98	0.007	na	na	na	na	na	na	na	na	na	na
LF-24		08-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-25		11-Apr-96	<0.002	na	na	na	<0.002	na	na	na	na	na	na
LF-25		02-Aug-96	0.07	na	na	na	na	na	na	na	na	na	na
LF-25		21-Nov-96	0.14	na	na	na	na	na	na	na	na	na	na
LF-25		18-Mar-97	0.13	na	na	na	na	na	na	na	na	na	na
LF-25		11-Jun-97	0.16	na	na	na	na	na	na	na	na	na	na
LF-25		20-Aug-97	0.16	na	na	na	na	na	na	na	na	na	na
LF-25		18-Dec-97	0.12	na	na	na	na	na	na	na	na	na	na
LF-25		26-Feb-98	0.094	na	na	na	na	na	na	na	na	na	na
LF-25		08-Apr-98	0.055	na	na	na	na	na	na	na	na	na	na
LF-26		01-Dec-97	na	na	na	na	na	na	na	na	na	na	<0.01
LF-26		27-Feb-98	0.070	na	na	na	na	na	na	na	na	na	na
LF-26		09-Apr-98	0.037	na	na	na	na	na	na	na	na	na	na
LF-27		29-Dec-97	0.011	na	na	na	na	na	na	na	na	na	na
LF-27		26-Feb-98	0.007	na	na	na	na	na	na	na	na	na	na
LF-27		08-Apr-98	0.0097	na	na	na	na	na	na	na	na	na	na
LF-28		29-Dec-97	0.66	na	na	na	na	na	na	na	na	na	na
LF-28		26-Feb-98	0.51	na	na	na	na	na	na	na	na	na	na
LF-28		08-Apr-98	0.19	na	na	na	na	na	na	na	na	na	na
LF-29		29-Dec-97	0.006	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-29		25-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
LF-29		07-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-30		30-Dec-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-30		25-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
DUP		25-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
LF-30		07-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-B1	(a)	07-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	<0.01
LF-B1	(a)	18-Jul-90	0.007	0.08	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-B1	(a)	20-Dec-90	0.005	0.1	na	0.001	<0.2	na	na	na	na	na	<0.05
LF-B1	(a)	20-Jun-91	<0.01	na	na	<0.005	0.004	na	na	na	na	na	<0.02
LF-B1	(a)	09-Jul-92	<0.01	0.122	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-B1	(a)	30-Dec-92	<0.01	<0.1	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B1	(a)	08-Jun-93	<0.01	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B1		Destroyed under permit											
LF-B2		06-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	0.02
LF-B2		18-Jul-90	0.005	0.14	na	<0.05	<0.2	na	na	na	na	na	<0.05
DUP		18-Jul-90	0.004	0.15	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-B2		19-Dec-90	0.008	0.32	na	0.0026	<0.2	na	na	na	na	na	0.17
LF-B2		20-Jun-91	<0.01	na	na	<0.005	0.005	na	na	na	na	na	0.075
LF-B2		08-Jul-92	<0.01	0.245	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-B2		08-Jun-93	<0.01	0.233	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B2		Destroyed or lost during slurry wall and cap construction activities											
LF-B3		07-Dec-89	<0.07 U5,6	na	na	<0.04	<0.3	na	na	na	na	na	0.01
LF-B3		18-Jul-90	0.003	0.1	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-B3		20-Dec-90	0.002	0.16	na	<0.0005	<0.2	na	na	na	na	na	<0.05
LF-B3		19-Jun-91	<0.01	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-B3		08-Jul-92	<0.01	0.133	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-B3		30-Dec-92	<0.01	0.112	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B3		08-Jun-93	<0.01	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B3		05-Jan-94	0.004	0.11	na	0.006	<0.001	<0.002	<0.0002	<0.004	<0.001	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-B3		16-Apr-96	0.036	na	na	na	<0.002	na	na	na	na	na	na
LF-B3		01-Aug-96	0.004	na	na	na	na	na	na	na	na	na	2.2
LF-B3		21-Nov-96	0.006	na	na	na	na	na	na	na	na	na	0.05
DUP		21-Nov-96	0.004	na	na	na	na	na	na	na	na	na	na
LF-B3		17-Mar-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-B3		12-Jun-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-B3		20-Aug-97	0.005	na	na	na	na	na	na	na	na	na	na
LF-B3		17-Dec-97	0.017	na	na	na	na	na	na	na	na	na	na
LF-B3		27-Feb-98	0.009	na	na	na	na	na	na	na	na	na	na
LF-B3		08-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-B4		17-Jul-90	0.003	0.08	na	<0.05	<0.2	na	na	na	na	na	<0.05
LF-B4		19-Dec-90	<0.002	0.08	na	0.0014	<0.2	na	na	na	na	na	0.08
LF-B4		19-Jun-91	<0.01	na	na	<0.005	<0.004	na	na	na	na	na	<0.02
LF-B4		08-Jul-92	<0.01	0.140	na	<0.005	<0.04	<0.01	<0.00027	<0.005	<0.01	na	na
LF-B4		30-Dec-92	<0.01	0.110	na	<0.005	<0.04	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B4		08-Jun-93	<0.01	<0.1	na	<0.005	<0.003	<0.01	<0.0002	<0.005	<0.01	na	na
LF-B4		05-Jan-94	0.003	0.07	na	<0.001	0.001	<0.002	<0.0002	<0.004	<0.001	na	na
LF-B4		16-Apr-96	<0.002	na	na	na	<0.002	na	na	na	na	na	na
LF-B4		30-Jul-96	<0.002	na	na	na	na	na	na	na	na	na	0.08
LF-B4		22-Nov-96	<0.002	na	na	na	na	na	na	na	na	na	0.04
DUP		22-Nov-96	<0.002	na	na	na	na	na	na	na	na	na	na
LF-B4		17-Mar-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-B4		01-Jul-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-B4		20-Aug-97	0.005	na	na	na	na	na	na	na	na	na	na
LF-B4		18-Dec-97	<0.002	na	na	na	na	na	na	na	na	na	na
LF-B4		25-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
LF-B4		07-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
LF-B5	(b)	09-Apr-96	0.32	na	na	na	<0.002	na	na	na	na	na	na
LF-B5	(b)	01-Aug-96	0.097	na	na	na	na	na	na	na	na	na	0.15
LF-B5	(b)	22-Nov-96	0.11	na	na	na	na	na	na	na	na	na	0.03
LF-B5	(b)	17-Mar-97	0.11	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California
(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
LF-B5	(b)	12-Jun-97	0.18	na	na	na	na	na	na	na	na	na	na
LF-B5	(b)	20-Aug-97	0.14	na	na	na	na	na	na	na	na	na	na
LF-B5	(b)	17-Dec-97	0.20	na	na	na	na	na	na	na	na	na	na
LF-B5	(b)	27-Feb-98	0.22	na	na	na	na	na	na	na	na	na	na
LF-B5	(b)	09-Apr-98	0.13	na	na	na	na	na	na	na	na	na	na
LF-B6		09-Apr-96	0.08	na	na	na	<0.002	na	na	na	na	na	na
LF-B6		01-Aug-96	0.033	na	na	na	na	na	na	na	na	na	0.06
LF-B6		25-Nov-96	0.027	na	na	na	na	na	na	na	na	na	0.04
DUP		25-Nov-96	0.03	na	na	na	na	na	na	na	na	na	na
LF-B6		17-Mar-97	0.021	na	na	na	na	na	na	na	na	na	na
LF-B6		12-Jun-97	0.035	na	na	na	na	na	na	na	na	na	na
LF-B6		19-Aug-97	0.01	na	na	na	na	na	na	na	na	na	na
LF-B6		18-Dec-97	0.010	na	na	na	na	na	na	na	na	na	na
LF-B6		27-Feb-98	0.009	na	na	na	na	na	na	na	na	na	na
LF-B6		08-Apr-98	0.0067	na	na	na	na	na	na	na	na	na	na
EX-1		15-Sep-95	0.15	na	na	na	na	na	na	na	na	na	na
EX-1		18-Oct-95	15	na	na	na	na	na	na	na	na	na	na
EX-1		18-Apr-96	0.002	na	na	na	<0.002	na	na	na	na	na	na
EX-1		01-Aug-96	0.022	na	na	na	na	na	na	na	na	na	na
EX-1		18-Dec-96	0.015	na	na	na	na	na	na	na	na	na	na
EX-1		15-Apr-97	0.072	na	na	na	na	na	na	na	na	na	na
EX-1		01-Jul-97	0.013	na	na	na	na	na	na	na	na	na	na
EX-1		22-Sep-97	0.028	na	na	na	na	na	na	na	na	na	na
EX-1		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.04
EX-1		18-Dec-97	0.31	na	na	na	na	na	na	na	na	na	na
EX-1		27-Feb-98	0.24	na	na	na	na	na	na	na	na	na	na
EX-1		09-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
EX-2		15-Sep-95	8.6	na	na	na	na	na	na	na	na	na	na
EX-2		18-Oct-95	<0.002	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
EX-2		18-Apr-96	9.3	na	na	na	<0.002	na	na	na	na	na	na
EX-2		01-Aug-96	57	na	na	na	na	na	na	na	na	na	na
EX-2		18-Dec-96	34	na	na	na	na	na	na	na	na	na	na
EX-2		04-Feb-97	38	na	na	na	na	na	na	na	na	na	na
EX-2		15-Apr-97	44	na	na	na	na	na	na	na	na	na	na
EX-2		01-Jul-97	49	na	na	na	na	na	na	na	na	na	na
EX-2		22-Sep-97	42	na	na	na	na	na	na	na	na	na	na
EX-2		02-Dec-97	na	na	na	na	na	na	na	na	na	na	<0.01
EX-2		22-Dec-97	36	na	na	na	na	na	na	na	na	na	na
EX-2		02-Mar-98	18	na	na	na	na	na	na	na	na	na	na
EX-2		09-Apr-98	51.8	na	na	na	na	na	na	na	na	na	na
EX-3		15-Sep-95	180	na	na	na	na	na	na	na	na	na	na
EX-3		18-Oct-95	170	na	na	na	na	na	na	na	na	na	na
EX-3		18-Apr-96	200	na	na	na	<0.002	na	na	na	na	na	na
EX-3		01-Aug-96	170	na	na	na	na	na	na	na	na	na	na
EX-3		18-Dec-96	270	na	na	na	na	na	na	na	na	na	na
EX-3		15-Apr-97	220	na	na	na	na	na	na	na	na	na	na
EX-3		01-Jul-97	190	na	na	na	na	na	na	na	na	na	na
EX-3		22-Sep-97	150	na	na	na	na	na	na	na	na	na	na
EX-3		02-Dec-97	na	na	na	na	na	na	na	na	na	na	0.02
EX-3		19-Dec-97	180	na	na	na	na	na	na	na	na	na	na
EX-3		02-Mar-98	240	na	na	na	na	na	na	na	na	na	na
EX-3		09-Apr-98	141	na	na	na	na	na	na	na	na	na	na
RP-1		28-Jul-94	0.07	na	na	na	na	na	na	na	na	na	na
RP-1		08-Sep-94	0.08	na	na	na	na	na	na	na	na	na	na
RP-1		28-Feb-95	0.046	na	na	na	na	na	na	na	na	na	na
RP-1		29-Mar-95	0.035	0.04	<0.002	<0.005	<0.04	<0.01	<0.0002	<0.004	<0.005	<0.005	0.01
RP-1		10-May-95	0.095	na	na	na	na	na	na	na	na	na	na
RP-1		09-Aug-95	0.059	na	na	na	na	na	na	na	na	na	na
RP-1		17-Nov-95	0.086	na	na	na	na	na	na	na	na	na	na
RP-1		10-Jan-96	0.061	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
RP-4		19-Nov-96	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		25-Mar-97	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		10-Jun-97	0.011	na	na	na	na	na	na	na	na	na	na
DUP		10-Jun-97	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		18-Aug-97	0.014	na	na	na	na	na	na	na	na	na	na
RP-4		19-Dec-97	0.006	na	na	na	na	na	na	na	na	na	na
RP-4		25-Feb-98	0.011	na	na	na	na	na	na	na	na	na	na
RP-4		07-Apr-98	0.0061	na	na	na	na	na	na	na	na	na	na
RP-5		28-Jul-94	<0.01	na	na	na	na	na	na	na	na	na	na
DUP		28-Jul-94	<0.01	na	na	na	na	na	na	na	na	na	na
RP-5		08-Sep-94	0.003	na	na	na	na	na	na	na	na	na	na
RP-5		28-Feb-95	0.007	na	na	na	na	na	na	na	na	na	na
RP-5		29-Mar-95	0.006	0.04	<0.002	<0.005	<0.04	<0.01	<0.0002	<0.004	<0.005	<0.005	0.03
RP-5		10-May-95	0.018	na	na	na	na	na	na	na	na	na	na
RP-5		09-Aug-95	0.003	na	na	na	na	na	na	na	na	na	na
RP-5		17-Nov-95	0.008	na	na	na	na	na	na	na	na	na	na
RP-5		09-Jan-96	0.005	na	na	na	na	na	na	na	na	na	na
DUP		09-Jan-96	0.004	na	na	na	na	na	na	na	na	na	na
RP-5		17-Apr-96	0.008	na	na	na	na	na	na	na	na	na	na
RP-5		31-Jul-96	<0.002	na	na	na	na	na	na	na	na	na	na
RP-5		19-Nov-96	0.007	na	na	na	na	na	na	na	na	na	na
DUP		19-Nov-96	0.008	na	na	na	na	na	na	na	na	na	na
RP-5		25-Mar-97	0.006	na	na	na	na	na	na	na	na	na	na
DUP		25-Mar-97	0.004	na	na	na	na	na	na	na	na	na	na
RP-5		10-Jun-97	0.006	na	na	na	na	na	na	na	na	na	na
RP-5		18-Aug-97	0.011	na	na	na	na	na	na	na	na	na	na
RP-5		19-Dec-97	0.038	na	na	na	na	na	na	na	na	na	na
RP-5		26-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
RP-5		07-Apr-98	0.0058	na	na	na	na	na	na	na	na	na	na
MW-1		29-Mar-95	0.0786	0.548	ND	0.0068	0.0308	0.091	ND	ND	ND	na	0.462
MW-1		08-Jun-95	0.04	0.35	ND	ND	0.02	ND	ND	ND	ND	na	0.16

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
MW-1		09-Jan-96	0.022	na	na	na	na	na	na	na	na	na	na
MW-1		17-Apr-96	0.034	na	na	na	na	na	na	na	na	na	na
MW-1		31-Jul-96	0.037	na	na	na	na	na	na	na	na	na	na
MW-1		19-Nov-96	0.071	na	na	na	na	na	na	na	na	na	na
MW-1		25-Mar-97	0.042	na	na	na	na	na	na	na	na	na	na
MW-1		10-Jun-97	0.05	na	na	na	na	na	na	na	na	na	na
MW-1		18-Aug-97	0.077	na	na	na	na	na	na	na	na	na	na
MW-1		19-Dec-97	0.010	na	na	na	na	na	na	na	na	na	na
MW-1		26-Feb-98	0.028	na	na	na	na	na	na	na	na	na	na
MW-1		08-Apr-98	0.028	na	na	na	na	na	na	na	na	na	na
DUP		08-Apr-98	0.037	na	na	na	na	na	na	na	na	na	na
MW-2		29-Mar-95	0.0452	0.772	ND	ND	0.0557	0.188	ND	ND	ND	na	0.449
MW-2		08-Jun-95	ND	0.59	ND	0.01	0.03	ND	ND	ND	ND	na	0.24
MW-2		09-Jan-96	0.016	na	na	na	na	na	na	na	na	na	na
MW-2		17-Apr-96	0.028	na	na	na	na	na	na	na	na	na	na
MW-2		31-Jul-96	0.037	na	na	na	na	na	na	na	na	na	na
MW-2		19-Nov-96	0.041	na	na	na	na	na	na	na	na	na	na
MW-2		25-Mar-97	0.038	na	na	na	na	na	na	na	na	na	na
MW-2		10-Jun-97	0.039	na	na	na	na	na	na	na	na	na	na
MW-2		18-Aug-97	0.038	na	na	na	na	na	na	na	na	na	na
MW-2		19-Dec-97	0.050	na	na	na	na	na	na	na	na	na	na
MW-2		26-Feb-98	0.019	na	na	na	na	na	na	na	na	na	na
MW-2		08-Apr-98	0.022	na	na	na	na	na	na	na	na	na	na
MW-3		29-Mar-95	0.0276	0.102	ND	ND	0.007	0.0105	ND	ND	ND	na	0.19
MW-3		08-Jun-95	0.03	0.21	ND	ND	0.01	ND	ND	ND	ND	na	0.38
MW-3		09-Jan-96	0.015	na	na	na	na	na	na	na	na	na	na
MW-3		17-Apr-96	0.018	na	na	na	na	na	na	na	na	na	na
MW-3		31-Jul-96	0.059	na	na	na	na	na	na	na	na	na	na
MW-3		19-Nov-96	0.048	na	na	na	na	na	na	na	na	na	na
MW-3		25-Mar-97	0.019	na	na	na	na	na	na	na	na	na	na
MW-3		10-Jun-97	0.027	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-5
Estimate of Contaminants Removed From Within Bentonite Slurry Wall Between October 1995 and June 1998
Sherwin-Williams Company
Emeryville, California

Period	Volume of Groundwater Treated (Gallons)	Volume of Groundwater Treated (Liters)	Ave. As Conc. (ug/L)	Ave. VOC Conc. (ug/L)	Ave. TPH-g Conc. (ug/L)	Ave. TPH-d Conc. (ug/L)	As Mass Removed (lbs)	VOC Mass Removed (lbs)	TPH-g Mass Removed (lbs)	TPH-d Mass Removed (lbs)
7/1/97 - 7/31/97	62,417	236,248	30,000	6,794	8,400	410	15.6	3.54	4.37	0.21
8/1/97 - 8/31/97	77,225	292,297	47,000	960	1,300	480	30.3	0.62	0.84	0.31
9/1/97 - 9/19/97	12,240	46,328	56,000	3,630	1,300 (d)	290	5.7	0.37	0.13	0.03
9/20/97 - 12/31/97	0	0	0 (e)	0 (e)	0 (e)	0 (e)	0.0	0.00	0.00	0.00
1/1/98 - 2/19/98	0	0	0 (e)	0 (e)	0 (e)	0 (e)	0.0	0.00	0.00	0.00
2/20/98 - 2/28/98	36,928	139,772	11,000	4,477	6,900	570	3.4	1.38	2.13	0.18
3/1/98 - 3/31/98	209,228	791,928	13,000	4,551	6,100	620	22.7	7.95	10.65	1.08
4/1/98 - 4/30/98	127,737	483,485	8,500	1,180	3,800	1,500	9.1	1.26	4.05	1.60
5/1/98 - 5/31/98	159,273	602,848	38,500	1,666	5,300	900	51.2	2.21	7.04	1.20
6/1/98 - 6/30/98	162,218	613,995	61,800	345	1,000	1,200	83.7	0.47	1.35	1.62
1995 Totals	60,544	229,159	--	--	--	--	19.0	2.7	4.3	0.6
1996 Totals	702,838	2,660,242	--	--	--	--	222.9	22.8	35.8	4.7
1997 Totals	489,749	1,853,700	--	--	--	--	172.3	16.9	22.0	2.2
1998 Totals (1/98-6/98)	695,384	2,632,028	--	--	--	--	170.0	13.3	25.2	5.7
Totals	**1,948,515**	**7,375,129**	--	--	--	--	**584.2**	**55.6**	**87.2**	**13.2**

Notes:

(a) July and August 1996 samples were not analyzed for TPH-g and TPH-d; therefore, September 1996 concentrations used for calculations.

(b) November 1996 samples were not collected; therefore, December 1996 concentrations used for calculations.

(c) Influent samples not collected. Groundwater treatment system was in recirculation mode and no groundwater extracted during time period.

(d) September 1997 samples not analyzed for TPH-g; therefore, August 1997 concentration used for calculation.

(e) Influent samples not collected during this period. Groundwater treatment system used to treat storm water runnoff stored in Rain-for-Rent tanks.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
RP-3		28-Jul-94	<0.01	na	na	na	na	na	na	na	na	na	na
RP-3		08-Sep-94	0.004	na	na	na	na	na	na	na	na	na	na
RP-3		28-Feb-95	0.004	na	na	na	na	na	na	na	na	na	na
RP-3		29-Mar-95	0.004	0.18	<0.002	<0.005	<0.04	<0.01	<0.0002	<0.004	<0.005	0.015	0.01
RP-3		10-May-95	0.013	na	na	na	na	na	na	na	na	na	na
RP-3		09-Aug-95	0.003	na	na	na	na	na	na	na	na	na	na
RP-3		17-Nov-95	0.006	na	na	na	na	na	na	na	na	na	na
RP-3		10-Jan-96	0.014	na	na	na	na	na	na	na	na	na	na
RP-3		17-Apr-96	0.006	na	na	na	na	na	na	na	na	na	na
RP-3		31-Jul-96	0.009	na	na	na	na	na	na	na	na	na	na
RP-3		19-Nov-96	0.005	na	na	na	na	na	na	na	na	na	na
RP-3		25-Mar-97	0.004	na	na	na	na	na	na	na	na	na	na
RP-3		10-Jun-97	0.008	na	na	na	na	na	na	na	na	na	na
RP-3		18-Aug-97	0.008	na	na	na	na	na	na	na	na	na	na
RP-3		19-Dec-97	0.003	na	na	na	na	na	na	na	na	na	na
RP-3		25-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
RP-3		07-Apr-98	<0.0050	na	na	na	na	na	na	na	na	na	na
RP-4		28-Jul-94	<0.01	na	na	na	na	na	na	na	na	na	na
RP-4		08-Sep-94	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		28-Feb-95	0.007	na	na	na	na	na	na	na	na	na	na
DUP		28-Feb-95	0.006	na	na	na	na	na	na	na	na	na	na
RP-4		29-Mar-95	0.008	0.06	<0.002	<0.005	0.15	<0.01	<0.0002	<0.004	<0.005	<0.005	0.16
RP-4		10-May-95	0.013	na	na	na	na	na	na	na	na	na	na
DUP		10-May-95	0.011	na	na	na	na	na	na	na	na	na	na
RP-4		09-Aug-95	0.007	na	na	na	na	na	na	na	na	na	na
DUP		09-Aug-95	0.007	na	na	na	na	na	na	na	na	na	na
RP-4		17-Nov-95	0.011	na	na	na	na	na	na	na	na	na	na
DUP		17-Nov-95	0.011	na	na	na	na	na	na	na	na	na	na
RP-4		09-Jan-96	0.004	na	na	na	na	na	na	na	na	na	na
RP-4		17-Apr-96	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		31-Jul-96	0.005	na	na	na	na	na	na	na	na	na	na
DUP		31-Jul-96	0.003	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
RP-4		19-Nov-96	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		25-Mar-97	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		10-Jun-97	0.011	na	na	na	na	na	na	na	na	na	na
DUP		10-Jun-97	0.009	na	na	na	na	na	na	na	na	na	na
RP-4		18-Aug-97	0.014	na	na	na	na	na	na	na	na	na	na
RP-4		19-Dec-97	0.006	na	na	na	na	na	na	na	na	na	na
RP-4		25-Feb-98	0.011	na	na	na	na	na	na	na	na	na	na
RP-4		07-Apr-98	0.0061	na	na	na	na	na	na	na	na	na	na
RP-5		28-Jul-94	<0.01	na	na	na	na	na	na	na	na	na	na
DUP		28-Jul-94	<0.01	na	na	na	na	na	na	na	na	na	na
RP-5		08-Sep-94	0.003	na	na	na	na	na	na	na	na	na	na
RP-5		28-Feb-95	0.007	na	na	na	na	na	na	na	na	na	na
RP-5		29-Mar-95	0.006	0.04	<0.002	<0.005	<0.04	<0.01	<0.0002	<0.004	<0.005	<0.005	0.03
RP-5		10-May-95	0.018	na	na	na	na	na	na	na	na	na	na
RP-5		09-Aug-95	0.003	na	na	na	na	na	na	na	na	na	na
RP-5		17-Nov-95	0.008	na	na	na	na	na	na	na	na	na	na
RP-5		09-Jan-96	0.005	na	na	na	na	na	na	na	na	na	na
DUP		09-Jan-96	0.004	na	na	na	na	na	na	na	na	na	na
RP-5		17-Apr-96	0.008	na	na	na	na	na	na	na	na	na	na
RP-5		31-Jul-96	<0.002	na	na	na	na	na	na	na	na	na	na
RP-5		19-Nov-96	0.007	na	na	na	na	na	na	na	na	na	na
DUP		19-Nov-96	0.008	na	na	na	na	na	na	na	na	na	na
RP-5		25-Mar-97	0.006	na	na	na	na	na	na	na	na	na	na
DUP		25-Mar-97	0.004	na	na	na	na	na	na	na	na	na	na
RP-5		10-Jun-97	0.006	na	na	na	na	na	na	na	na	na	na
RP-5		18-Aug-97	0.011	na	na	na	na	na	na	na	na	na	na
RP-5		19-Dec-97	0.038	na	na	na	na	na	na	na	na	na	na
RP-5		26-Feb-98	<0.005	na	na	na	na	na	na	na	na	na	na
RP-5		07-Apr-98	0.0058	na	na	na	na	na	na	na	na	na	na
MW-1		29-Mar-95	0.0786	0.548	ND	0.0068	0.0308	0.091	ND	ND	ND	na	0.462
MW-1		08-Jun-95	0.04	0.35	ND	ND	0.02	ND	ND	ND	ND	na	0.16

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
MW-1		09-Jan-96	0.022	na	na	na	na	na	na	na	na	na	na
MW-1		17-Apr-96	0.034	na	na	na	na	na	na	na	na	na	na
MW-1		31-Jul-96	0.037	na	na	na	na	na	na	na	na	na	na
MW-1		19-Nov-96	0.071	na	na	na	na	na	na	na	na	na	na
MW-1		25-Mar-97	0.042	na	na	na	na	na	na	na	na	na	na
MW-1		10-Jun-97	0.05	na	na	na	na	na	na	na	na	na	na
MW-1		18-Aug-97	0.077	na	na	na	na	na	na	na	na	na	na
MW-1		19-Dec-97	0.010	na	na	na	na	na	na	na	na	na	na
MW-1		26-Feb-98	0.028	na	na	na	na	na	na	na	na	na	na
MW-1		08-Apr-98	0.028	na	na	na	na	na	na	na	na	na	na
DUP		08-Apr-98	0.037	na	na	na	na	na	na	na	na	na	na
MW-2		29-Mar-95	0.0452	0.772	ND	ND	0.0557	0.188	ND	ND	ND	na	0.449
MW-2		08-Jun-95	ND	0.59	ND	0.01	0.03	ND	ND	ND	ND	na	0.24
MW-2		09-Jan-96	0.016	na	na	na	na	na	na	na	na	na	na
MW-2		17-Apr-96	0.028	na	na	na	na	na	na	na	na	na	na
MW-2		31-Jul-96	0.037	na	na	na	na	na	na	na	na	na	na
MW-2		19-Nov-96	0.041	na	na	na	na	na	na	na	na	na	na
MW-2		25-Mar-97	0.038	na	na	na	na	na	na	na	na	na	na
MW-2		10-Jun-97	0.039	na	na	na	na	na	na	na	na	na	na
MW-2		18-Aug-97	0.038	na	na	na	na	na	na	na	na	na	na
MW-2		19-Dec-97	0.050	na	na	na	na	na	na	na	na	na	na
MW-2		26-Feb-98	0.019	na	na	na	na	na	na	na	na	na	na
MW-2		08-Apr-98	0.022	na	na	na	na	na	na	na	na	na	na
MW-3		29-Mar-95	0.0276	0.102	ND	ND	0.007	0.0105	ND	ND	ND	na	0.19
MW-3		08-Jun-95	0.03	0.21	ND	ND	0.01	ND	ND	ND	ND	na	0.38
MW-3		09-Jan-96	0.015	na	na	na	na	na	na	na	na	na	na
MW-3		17-Apr-96	0.018	na	na	na	na	na	na	na	na	na	na
MW-3		31-Jul-96	0.059	na	na	na	na	na	na	na	na	na	na
MW-3		19-Nov-96	0.048	na	na	na	na	na	na	na	na	na	na
MW-3		25-Mar-97	0.019	na	na	na	na	na	na	na	na	na	na
MW-3		10-Jun-97	0.027	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc
MW-3		18-Aug-97	0.027	na	na	na	na	na	na	na	na	na	na
MW-3		19-Dec-97	0.011	na	na	na	na	na	na	na	na	na	na
MW-3		26-Feb-98	0.007	na	na	na	na	na	na	na	na	na	na
MW-3		07-Apr-98	0.018	na	na	na	na	na	na	na	na	na	na
MW-4		16-Dec-94	8.87	0.163	ND	0.141	0.0304	0.0359	<0.0002	0.0275	0.0134	na	71
MW-4		29-Mar-95	22	0.333	ND	0.286	0.0636	0.031	ND	ND	ND	na	171
MW-4		08-Jun-95	46	0.56	0.01	0.42	0.06	ND	ND	ND	ND	na	97
MW-4		10-Jan-96	15	na	na	na	na	na	na	na	na	na	na
MW-4		19-Nov-96	3.1	na	na	na	<0.04	na	na	na	na	na	230
MW-4		18-Aug-97	120	na	na	na	na	na	na	na	na	na	na
MW-4		19-Dec-97	42	na	na	na	na	na	na	na	na	na	na
MW-4		02-Mar-98	18	na	na	na	na	na	na	na	na	na	na
MW-4		10-Apr-98	19.0	na	na	na	na	na	na	na	na	na	na
MW-5		16-Dec-94	41.5	0.236	ND	0.156	0.0317	0.056	0.00023	0.009	<0.01	na	11
MW-5		29-Mar-95	35.3	0.137	ND	ND	0.0317	0.0103	ND	ND	ND	na	4.67
MW-5		08-Jun-95	99	0.45	ND	0.03	0.05	ND	ND	ND	ND	na	13.8
MW-5		10-Jan-96	79	na	na	na	na	na	na	na	na	na	na
MW-5		19-Nov-96	192	na	na	na	0.07	na	na	na	na	na	21
MW-5		18-Aug-97	310	na	na	na	na	na	na	na	na	na	na
MW-5		19-Dec-97	380	na	na	na	na	na	na	na	na	na	na
MW-5		02-Mar-98	190	na	na	na	na	na	na	na	na	na	na
MW-5		10-Apr-98	208	na	na	na	na	na	na	na	na	na	na

Notes: All notes are listed at the end of this table - see last page.

Table 3-3
Summary of Historical Inorganic Compounds in Groundwater Monitoring Wells
The Sherwin-Williams Company
Emeryville, California

(Results reported in milligrams per liter [mg/L])

Well Number	Notes	Date Sampled	Arsenic	Barium	Beryllium	Cadmium	Lead	Total Chromium	Mercury	Selenium	Silver	Vanadium	Zinc

Data QA/QC performed by LXG.

Notes:

Analyses were done by EPA Method 200/6000/7000 Series for selected metals

< = Analyte was not detected at or greater than the detection limit reported

DUP = Duplicate sample (field duplicate)

ND = Not detected (no associated detection limit was reported)

na = Not analyzed

(a) Concentrations for LF-B1 may not represent the B-zone water quality because LF-B1 is screened in the aquitard between the A and B zones.

(b) Concentrations for LF-B5 may not represent the B-zone water quality because LF-B5 is screened in the aquitard between the A and B zones.

Data Qualifiers:

U5 = Qualified as non-detect (U) based on field blank contamination evaluation

U6 = Qualified as non-detect (U) based on trip blank contamination evaluation

U5,6 = For samples analyzed in December, 1989, data were qualified as non-detect (U) based on positive results of both the trip blank (0.014 mg/L) and the bailer rinsate blank (0.013 mg/L) of associated samples. The detection limit for arsenic for this sampling period was set at 0.070 (5 times the reported value of 0.014 mg/L detected in the trip blank sample).

Table 3-4
Results of Mann-Kendall Evaluation
Sherwin-Williams Company
Emeryville, California

Location	Number of Samples	Sum of Trend (S)	Conclusion
LF-3	15	30	No trend
LF-4	8	2	No trend
LF-7	8	-4	No trend
LF-8	10	15	No trend
LF-10	10	7	No trend
LF-11	18	106	Increasing
LF-12	16	20	No trend
LF-13	17	-37	No trend
LF-17	2	1	Insufficient Data
LF-18	9	-12	No trend
LF-19	4	1	No trend
LF-20	9	9	No trend
LF-21	9	4	No trend
LF-22	2	-1	Insufficient Data
LF-23	9	-6	No trend
LF-24	9	-3	No trend
LF-25	9	1	No trend
LF-26	2	-1	Insufficient Data
LF-27	3	-1	Insufficient Data
LF-28	3	-3	Insufficient Data
LF-29	3	-2	No trend
LF-30	3	2	Insufficient Data
LF-B3	17	-5	No trend
LF-B4	16	-25	No trend
LF-B5	9	9	No trend
LF-B6	9	-29	Decreasing
MW-1	12	-10	No trend
MW-2	12	9	No trend
MW-3	12	-22	No trend
MW-4	9	4	No trend
MW-5	9	22	Increasing
RP-1	17	-48	Decreasing
RP-2	17	-9	No trend
RP-3	17	-23	No trend
RP-4	17	20	No trend
RP-5	17	12	No trend

Table 3-5
Estimate of Contaminants Removed From Within Bentonite Slurry Wall Between October 1995 and June 1998
Sherwin-Williams Company
Emeryville, California

Period	Volume of Groundwater Treated (Gallons)	Volume of Groundwater Treated (Liters)	Ave. As Conc. (ug/L)	Ave. VOC Conc. (ug/L)	Ave. TPH-g Conc. (ug/L)	Ave. TPH-d Conc. (ug/L)	As Mass Removed (lbs)	VOC Mass Removed (lbs)	TPH-g Mass Removed (lbs)	TPH-d Mass Removed (lbs)
10/16/95 - 10/27/95	13,035	49,337	33,000	7,360	12,000	600	3.6	0.80	1.31	0.07
10/28/95 - 11/29/95	44,119	166,990	36,000	4,955	7,700	1,200	13.3	1.82	2.83	0.44
11/30/95 - 1/5/96	3,390	12,831	76,000	3,877	5,100	3,400	2.1	0.11	0.14	0.10
1/6/96 - 1/30/96	113,041	427,860	39,000	25	50	50	36.8	0.02	0.05	0.05
1/31/96 - 2/27/96	87,468	331,066	11,000	12,385	19,000	560	8.0	9.04	13.87	0.41
2/28/96 - 3/29/96	61,604	233,171	39,300	6,350	11,000	1,200	20.2	3.26	5.65	0.62
3/30/96 - 4/30/96	88,528	335,078	52,000	4,740	7,300	960	38.4	3.50	5.39	0.71
5/1/96 - 5/31/96	91,036	344,571	20,000	3,730	6,100	1,200	15.2	2.83	4.63	0.91
6/1/96 - 6/28/96	64,197	242,986	23,000	20	90	390	12.3	0.01	0.05	0.21
6/29/96 - 7/30/96	48,608	183,981	64,000	1,020	3,200 [a]	1,100 [a]	26.0	0.41	1.30	0.45
7/31/96 - 9/30/96	24,649	93,296	47,000	2,510	3,200	1,100	9.7	0.52	0.66	0.23
8/1/96 - 10/28/96	40,708	154,080	74,000	3,240	4,100	650	25.1	1.10	1.39	0.22
10/29/96 - 12/2/96	22,965	86,923	45,000	2,960 [b]	4,000 [b]	1,300 [b]	8.6	0.57	0.77	0.25
12/3/96 - 12/31/96	60,034	227,229	45,000	2,960	4,000	1,300	22.5	1.48	2.00	0.65
1/1/97 - 1/31/97	48,818	184,776	86,000	4,091	6,200	1,200	35.0	1.67	2.53	0.49
2/1/97 - 2/25/97	90,209	341,441	23,000	5,004	6,400	370	17.3	3.77	4.82	0.28
2/26/97 - 4/8/97	0	0	0 [c]	0 [c]	0 [c]	0 [c]	0.0	0.00	0.00	0.00
4/9/97 - 4/30/97	56,290	213,058	47,000	7,270	9,200	520	22.1	3.41	4.32	0.24
5/1/97 - 5/30/97	109,610	414,874	44,000	2,793	3,800	670	40.2	2.55	3.48	0.61
5/31/97 - 6/30/97	32,940	124,678	22,000	3,479	5,400	170	6.0	0.96	1.48	0.05

Table 3-5
Estimate of Contaminants Removed From Within Bentonite Slurry Wall Between October 1995 and June 1998
Sherwin-Williams Company
Emeryville, California

Period	Volume of Groundwater Treated (Gallons)	(Liters)	Ave. As Conc. (ug/L)	Ave. VOC Conc. (ug/L)	Ave. TPH-g Conc. (ug/L)	Ave. TPH-d Conc. (ug/L)	As Mass Removed (lbs)	VOC Mass Removed (lbs)	TPH-g Mass Removed (lbs)	TPH-d Mass Removed (lbs)
7/1/97 - 7/31/97	62,417	236,248	30,000	6,794	8,400	410	15.6	3.54	4.37	0.21
8/1/97 - 8/31/97	77,225	292,297	47,000	960	1,300	480	30.3	0.62	0.84	0.31
9/1/97 - 9/19/97	12,240	46,328	56,000	3,630	1,300 (d)	290	5.7	0.37	0.13	0.03
9/20/97 - 12/31/97	0	0	0 (e)	0 (e)	0 (e)	0 (e)	0.0	0.00	0.00	0.00
1/1/98 - 2/19/98	0	0	0 (e)	0 (e)	0 (e)	0 (e)	0.0	0.00	0.00	0.00
2/20/98 - 2/28/98	36,928	139,772	11,000	4,477	6,900	570	3.4	1.38	2.13	0.18
3/1/98 - 3/31/98	209,228	791,928	13,000	4,551	6,100	620	22.7	7.95	10.65	1.08
4/1/98 - 4/30/98	127,737	483,485	8,500	1,180	3,800	1,500	9.1	1.26	4.05	1.60
5/1/98 - 5/31/98	159,273	602,848	38,500	1,666	5,300	900	51.2	2.21	7.04	1.20
6/1/98 - 6/30/98	162,218	613,995	61,800	345	1,000	1,200	83.7	0.47	1.35	1.62
1995 Totals	60,544	229,159	--	--	--	--	19.0	2.7	4.3	0.6
1996 Totals	702,838	2,660,242	--	--	--	--	222.9	22.8	35.8	4.7
1997 Totals	489,749	1,853,700	--	--	--	--	172.3	16.9	22.0	2.2
1998 Totals (1/98-6/98)	695,384	2,632,028	--	--	--	--	170.0	13.3	25.2	5.7
Totals	**1,948,515**	**7,375,129**	--	--	--	--	**584.2**	**55.6**	**87.2**	**13.2**

Notes:

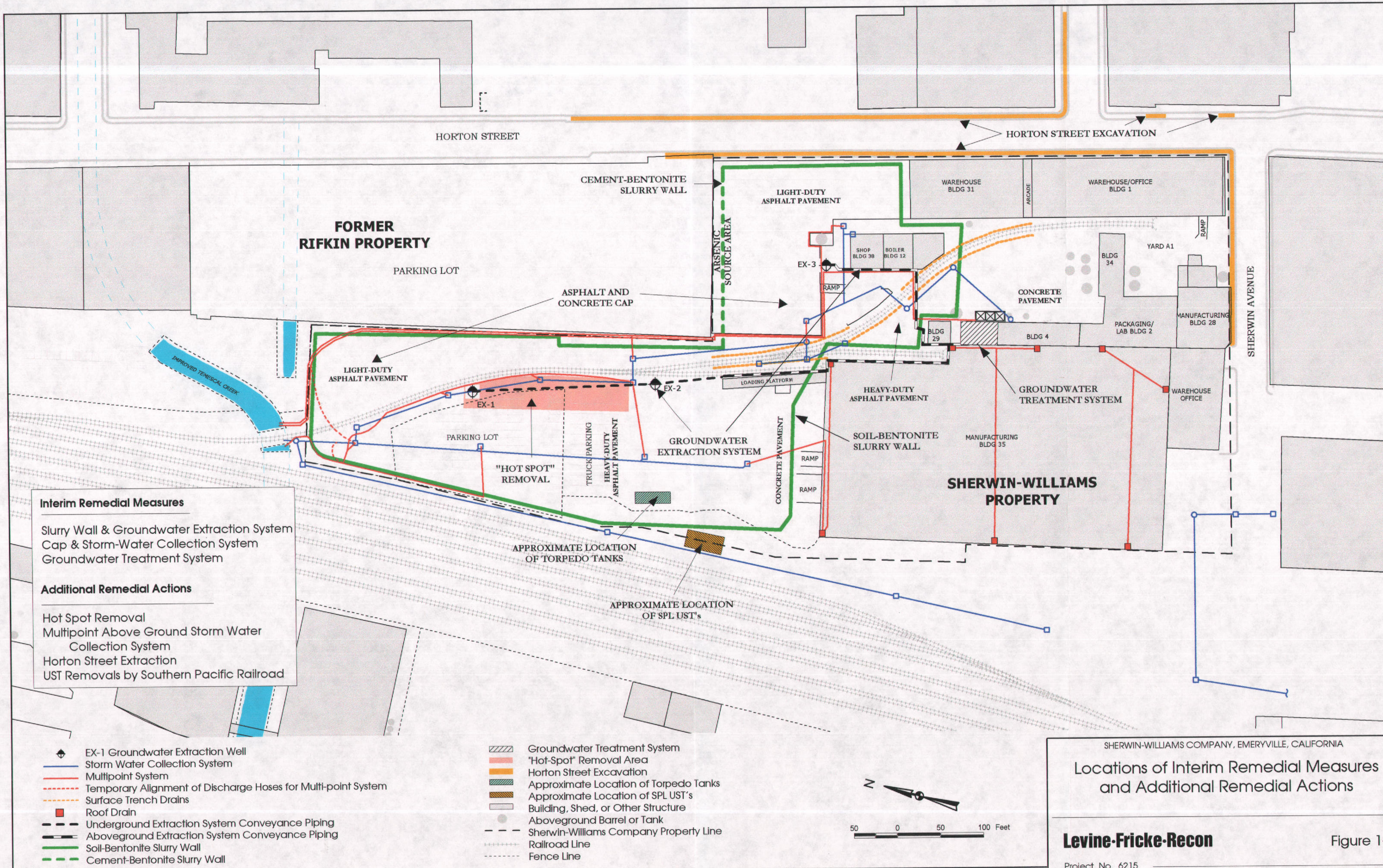
(a) July and August 1996 samples were not analyzed for TPH-g and TPH-d; therefore, September 1996 concentrations used for calculations.

(b) November 1996 samples were not collected; therefore, December 1996 concentrations used for calculations.

(c) Influent samples not collected. Groundwater treatment system was in recirculation mode and no groundwater extracted during time period.

(d) September 1997 samples not analyzed for TPH-g; therefore, August 1997 concentration used for calculation.

(e) Influent samples not collected during this period. Groundwater treatment system used to treat storm water runoff stored in Rain-for-Rent tanks.



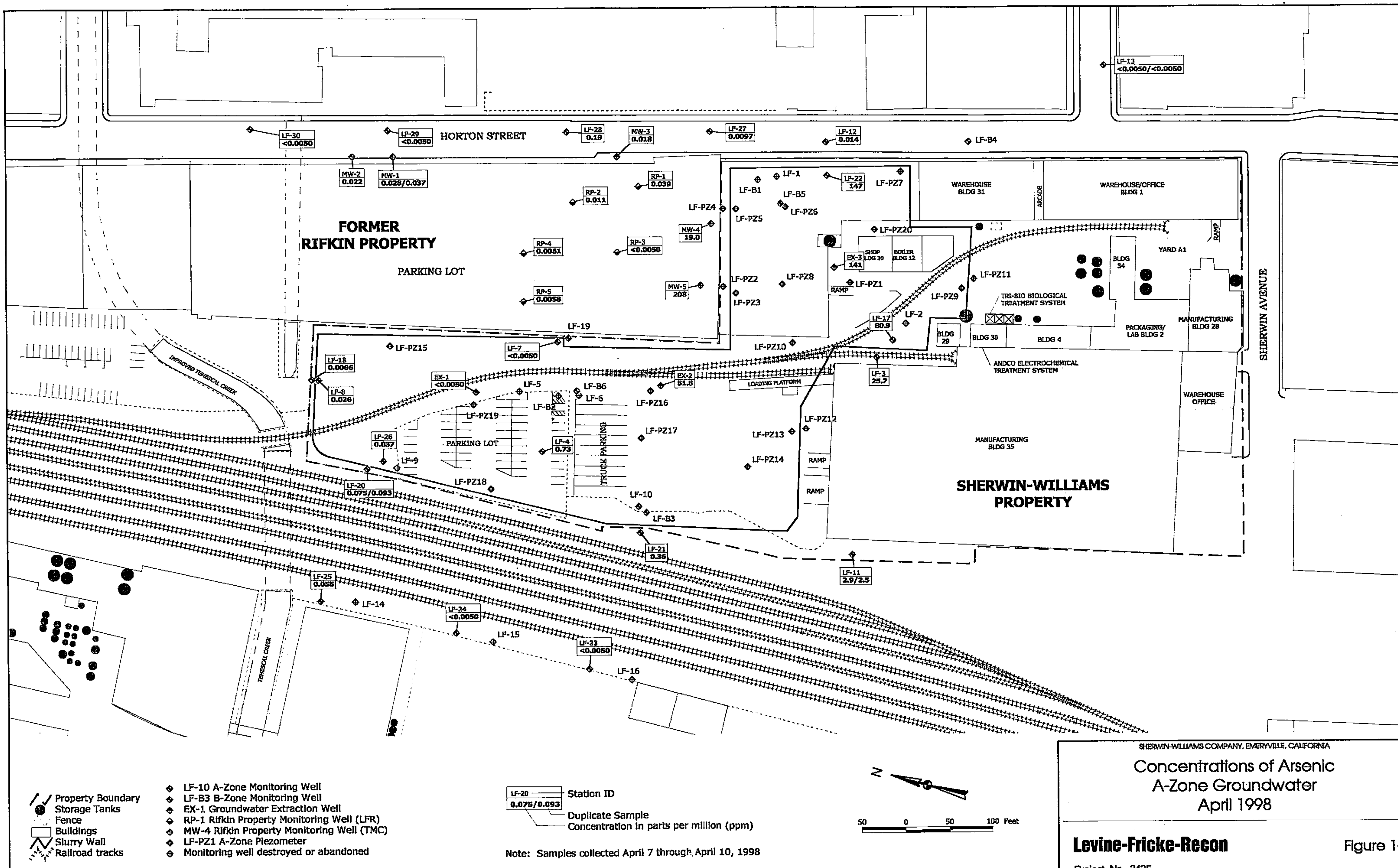
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

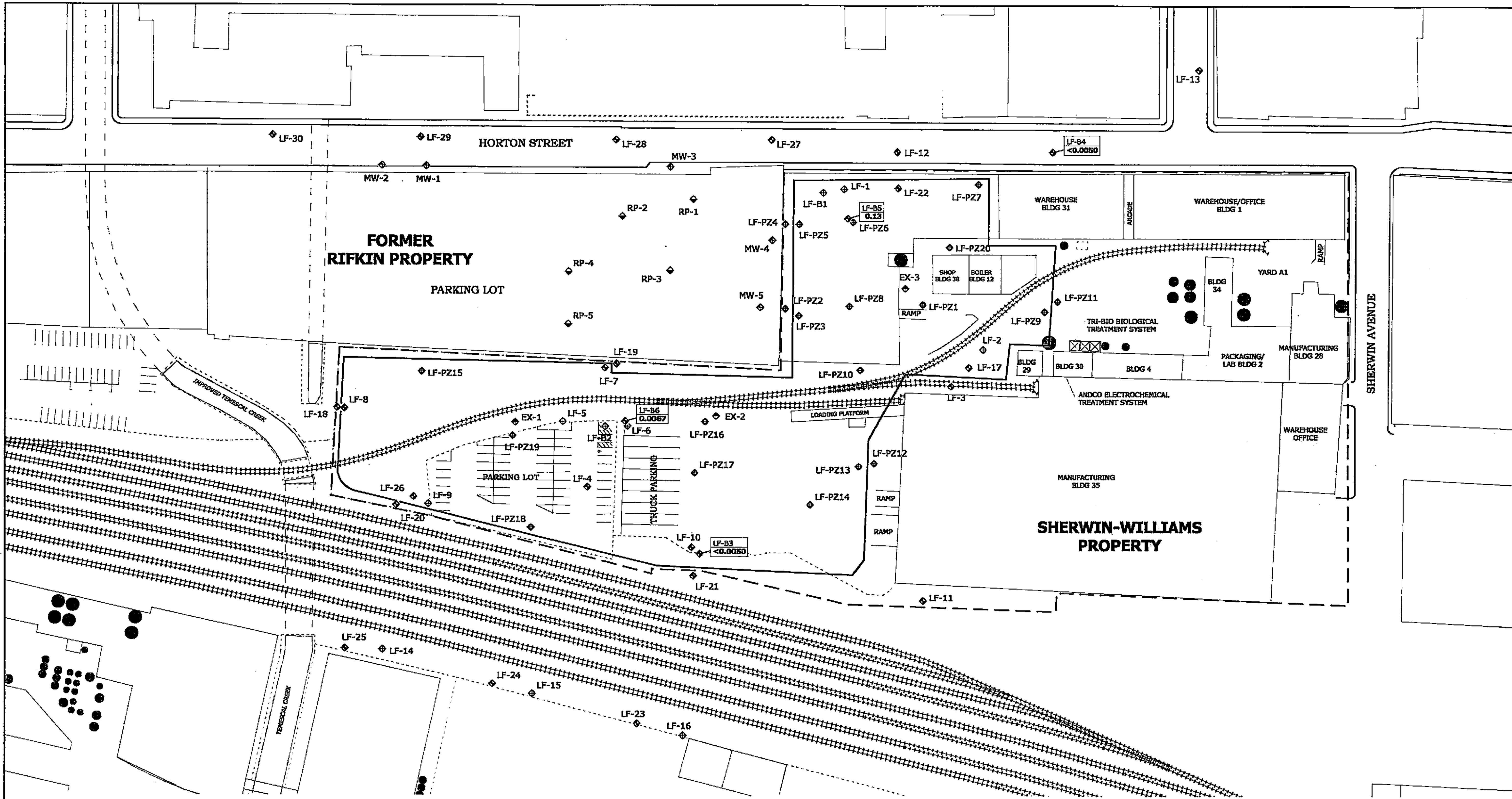
Locations of Interim Remedial Measures and Additional Remedial Actions

Levine·Fricke·Recon

Figure 1-2

Project No. 6215


HORTON STREET
SHERWIN AVENUE
FORMER RIFKIN PROPERTY
PARKING LOT
SHERWIN-WILLIAMS PROPERTY
LF-30 <0.0050
LF-29 <0.0050
LF-28 0.19
MW-3 0.018
LF-27 0.0097
LF-12 0.014
LF-B4
LF-13 <0.0050/<0.0050
MW-2 0.022
MW-1 0.028/0.037
RP-1 0.039
RP-2 0.011
RP-4 0.0081
RP-3 <0.0050
MW-4 19.0
RP-5 0.0058
MW-5 208
LF-1
LF-B1
LF-B5
LF-PZ6
LF-22 147
LF-PZ7
LF-PZ4
LF-PZ5
LF-PZ20
EX-3 141
LF-PZ2
LF-PZ8
LF-PZ1
LF-PZ3
LF-PZ11
LF-PZ9
LF-17 80.9
LF-2
LF-19
LF-PZ10
LF-PZ15
LF-7 <0.0050
LF-18 0.0066
LF-8 0.026
EX-1 <0.0050
EX-2 51.8
LF-3 25.7
LF-5
LF-B6
LF-6
LF-B2
LF-PZ16
LF-PZ19
LF-PZ17
LF-26 0.037
LF-4 0.73
LF-9
LF-PZ12
LF-PZ13
LF-PZ14
LF-PZ18
LF-20 0.075/0.093
LF-10
LF-B3
LF-21 0.36
LF-11 2.9/2.5
LF-25 0.055
LF-14
LF-24 <0.0050
LF-15
LF-23 <0.0050
LF-16
WAREHOUSE BLDG 31
ARCADE
WAREHOUSE/OFFICE BLDG 1
RAMP
YARD A1
BLDG 34
SHOP BLDG 38
BOILER BLDG 12
RAMP
TRI-BIO BIOLOGICAL TREATMENT SYSTEM
PACKAGING/ LAB BLDG 2
MANUFACTURING BLDG 28
BLDG 29
BLDG 30
BLDG 4
ANDCO ELECTROCHEMICAL TREATMENT SYSTEM
LOADING PLATFORM
WAREHOUSE OFFICE
MANUFACTURING BLDG 35
RAMP
RAMP
PARKING LOT
TRUCK PARKING
IMPROVED TEMESCAL CREEK
TEMESCAL CREEK
Property Boundary
Storage Tanks
Fence
Buildings
Slurry Wall
Railroad tracks
LF-10 A-Zone Monitoring Well
LF-B3 B-Zone Monitoring Well
EX-1 Groundwater Extraction Well
RP-1 Rifkin Property Monitoring Well (LFR)
MW-4 Rifkin Property Monitoring Well (TMC)
LF-PZ1 A-Zone Piezometer
Monitoring well destroyed or abandoned
LF-20 0.075/0.093
Station ID
Duplicate Sample
Concentration in parts per million (ppm)
Note: Samples collected April 7 through April 10, 1998
N
50 0 50 100 Feet
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA
Concentrations of Arsenic
A-Zone Groundwater
April 1998
Levine-Fricke-Recon
Figure 1-3
Project No. 3435



Property Boundary
Storage Tanks
Fence
Buildings
Slurry Wall
Railroad tracks

- LF-10 A-Zone Monitoring Well
- LF-B3 B-Zone Monitoring Well
- EX-1 Groundwater Extraction Well
- RP-1 Rifkin Property Monitoring Well (LFR)
- MW-4 Rifkin Property Monitoring Well (TMC)
- LF-PZ1 A-Zone Piezometer
- Monitoring well destroyed or abandoned

Note: Samples collected April 7 through April 10, 1998

LF-B3 — Station ID
<0.0050 — Concentration in parts per million (ppm)

Concentration of chemicals detected in LF-B5 may not be representative of B-zone groundwater quality since LF-B5 is only screened within the aquitard between the A-zone and B-zone.

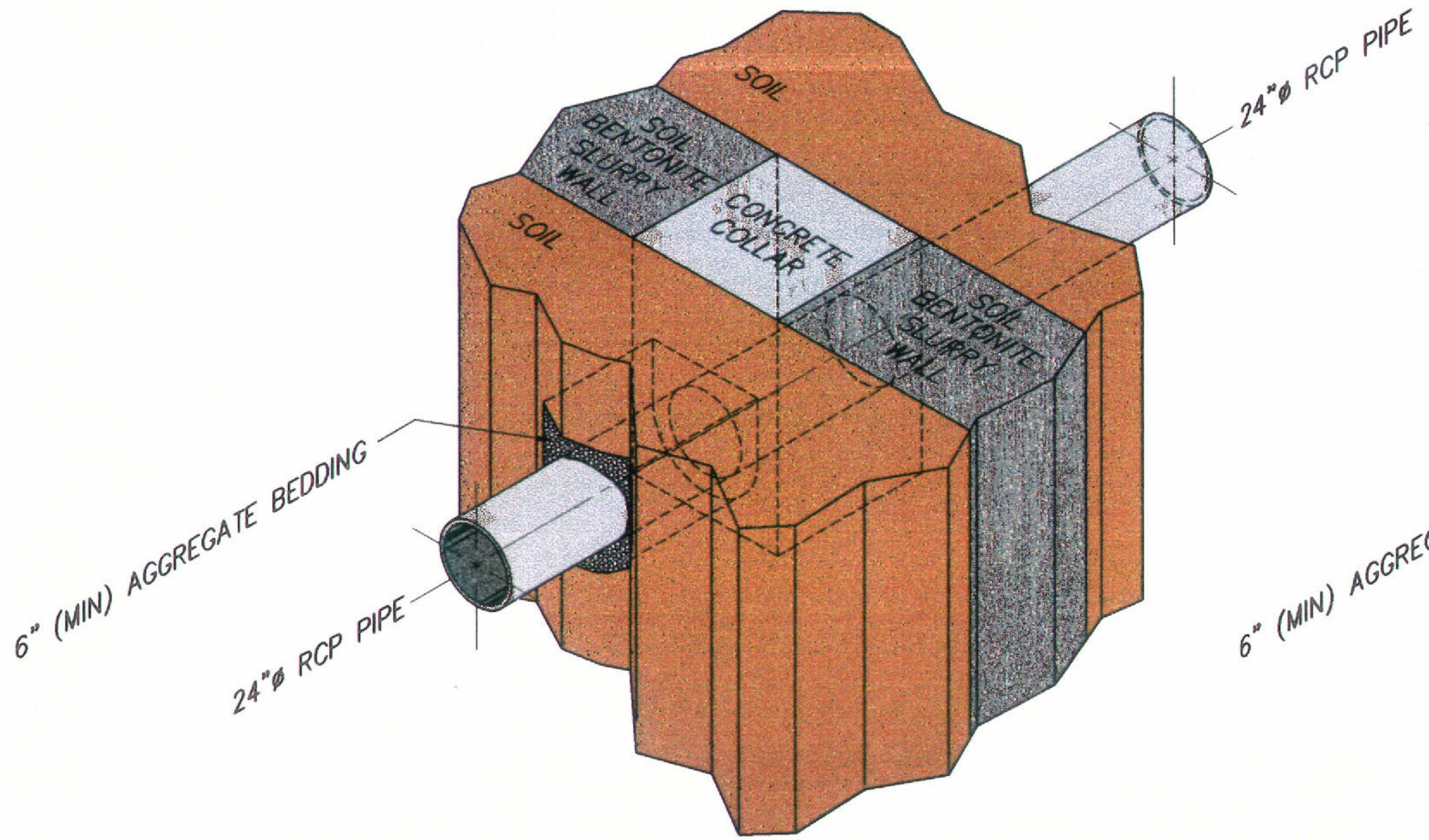
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Concentrations of Arsenic B-Zone Groundwater April 1998

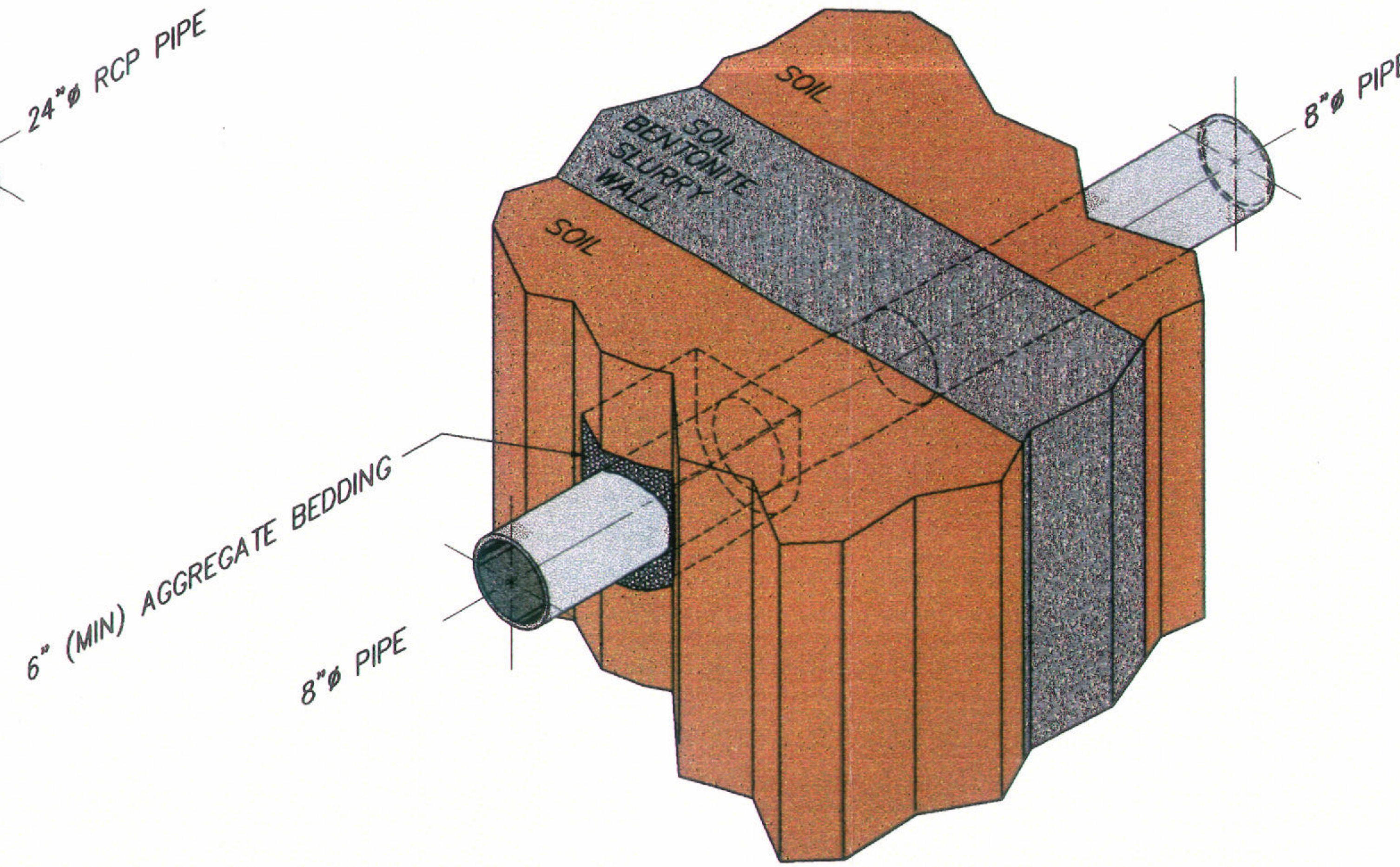
Levine-Fricke-Recon

Figure 1-4

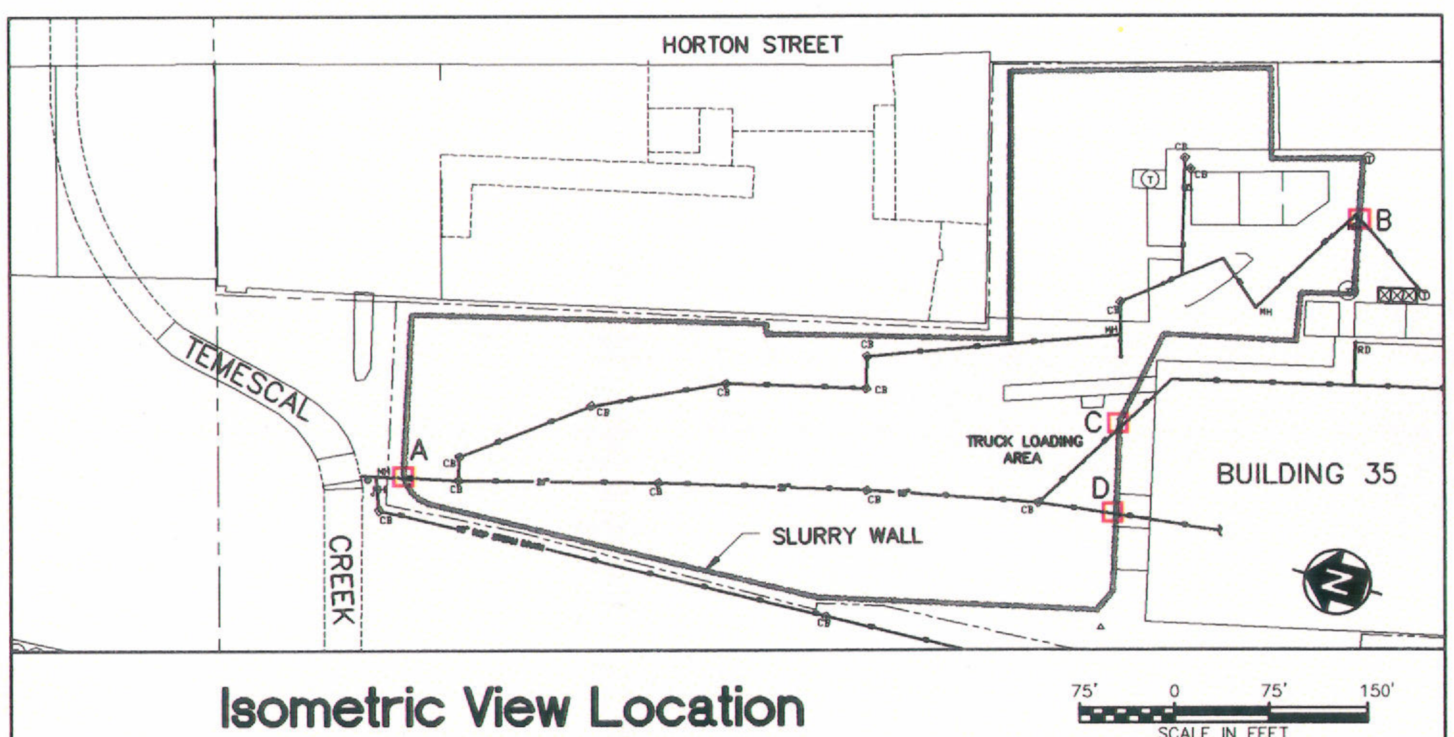
Project No. 3435



Isometric View Through Concrete Collar at Location "A"



Isometric View Through Slurry Wall at Locations "B", "C", and "D"



Isometric View Location

SHERWIN–WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

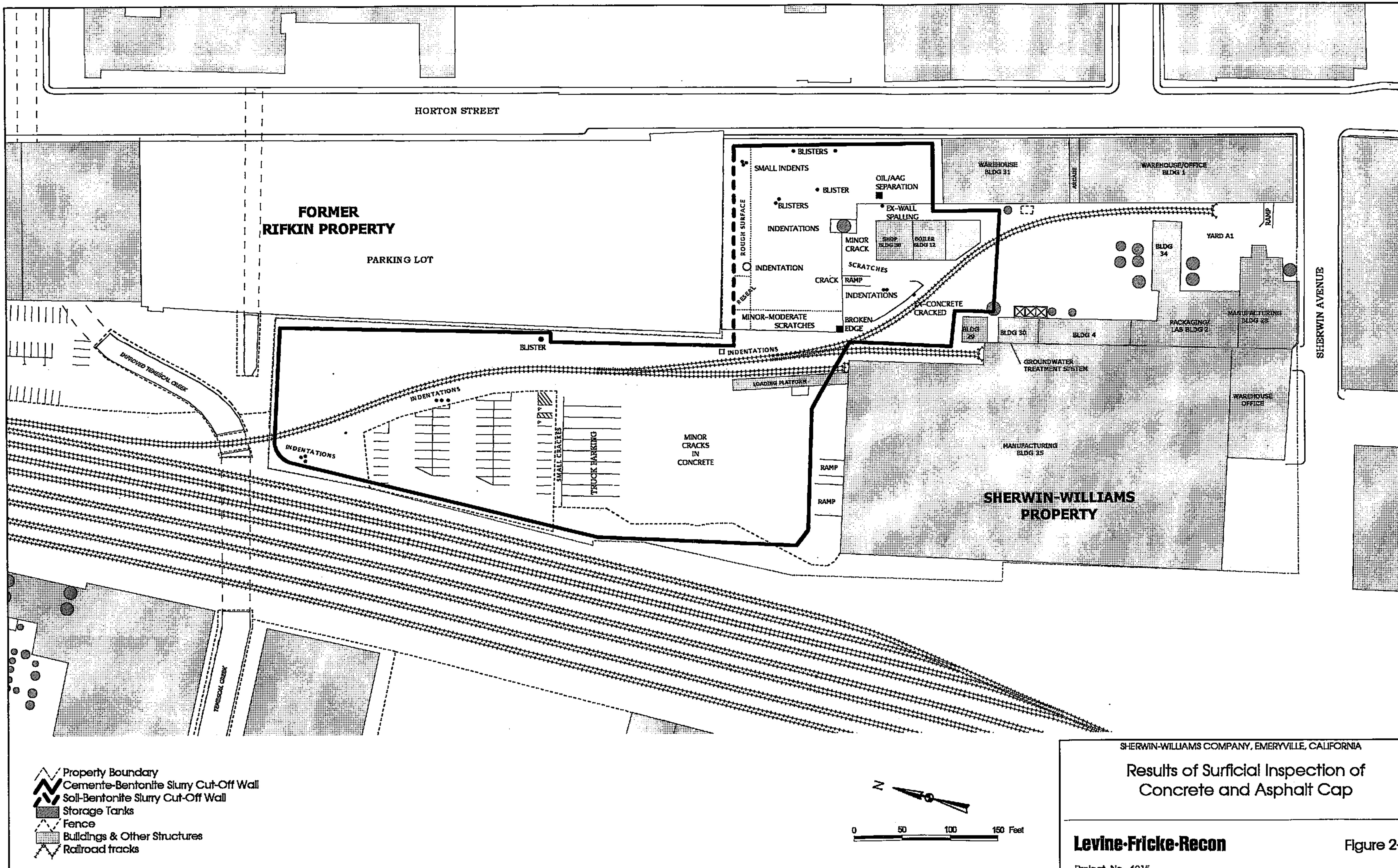
Isometric View of Storm–Drain Line Passing Through Slurry Wall

Levine•Fricke•Recon

Figure 2-1

Project No. 6215

7/16/1998 3:13 P.M. LTScale: 0.25 Drawing File(.DWG): J:\ENGCAD\SHERWIN\6215\STORMDRAIN-ISO.DWG



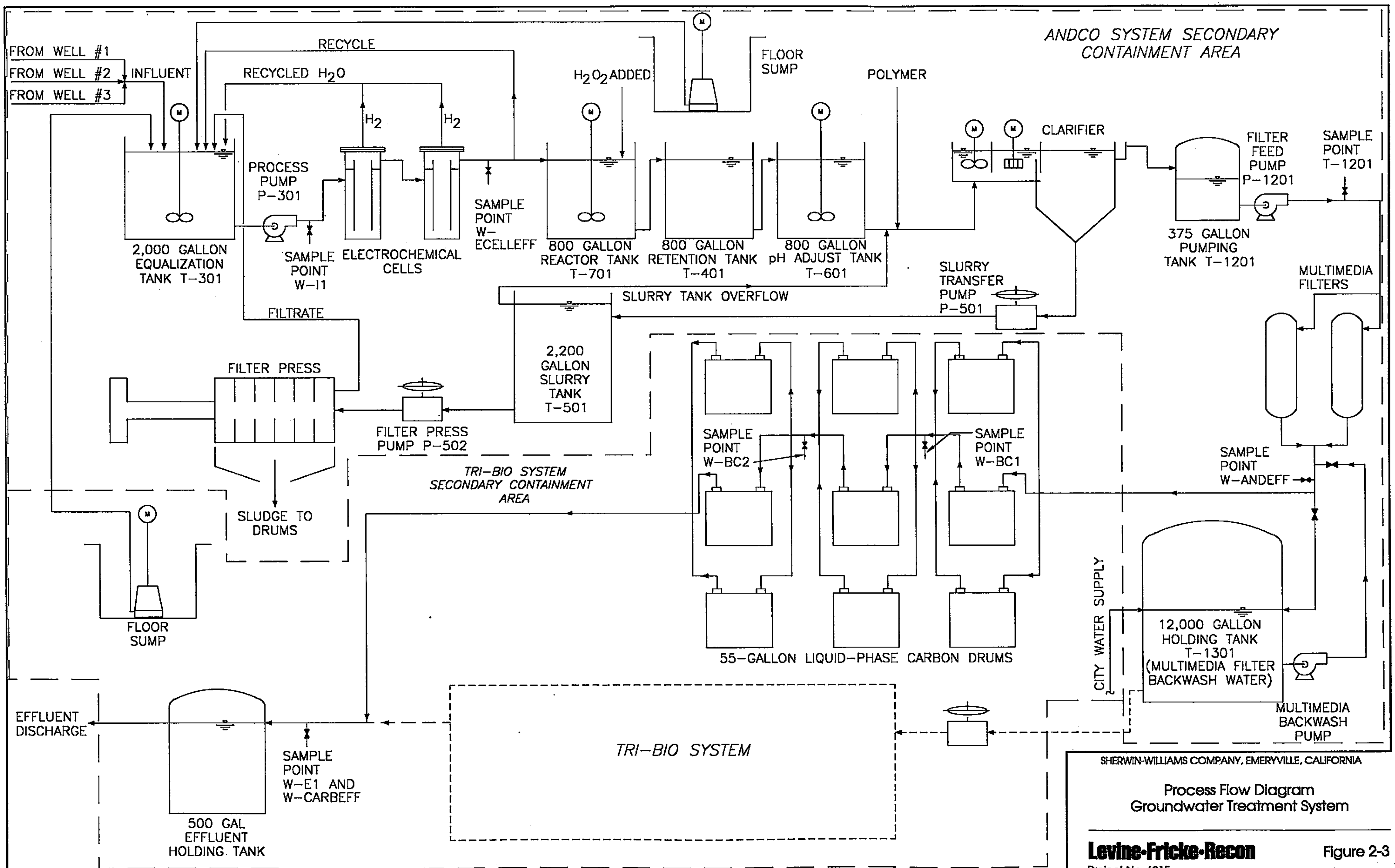
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Results of Surficial Inspection of Concrete and Asphalt Cap

Levine·Fricke·Recon

Figure 2-2

Project No. 6215



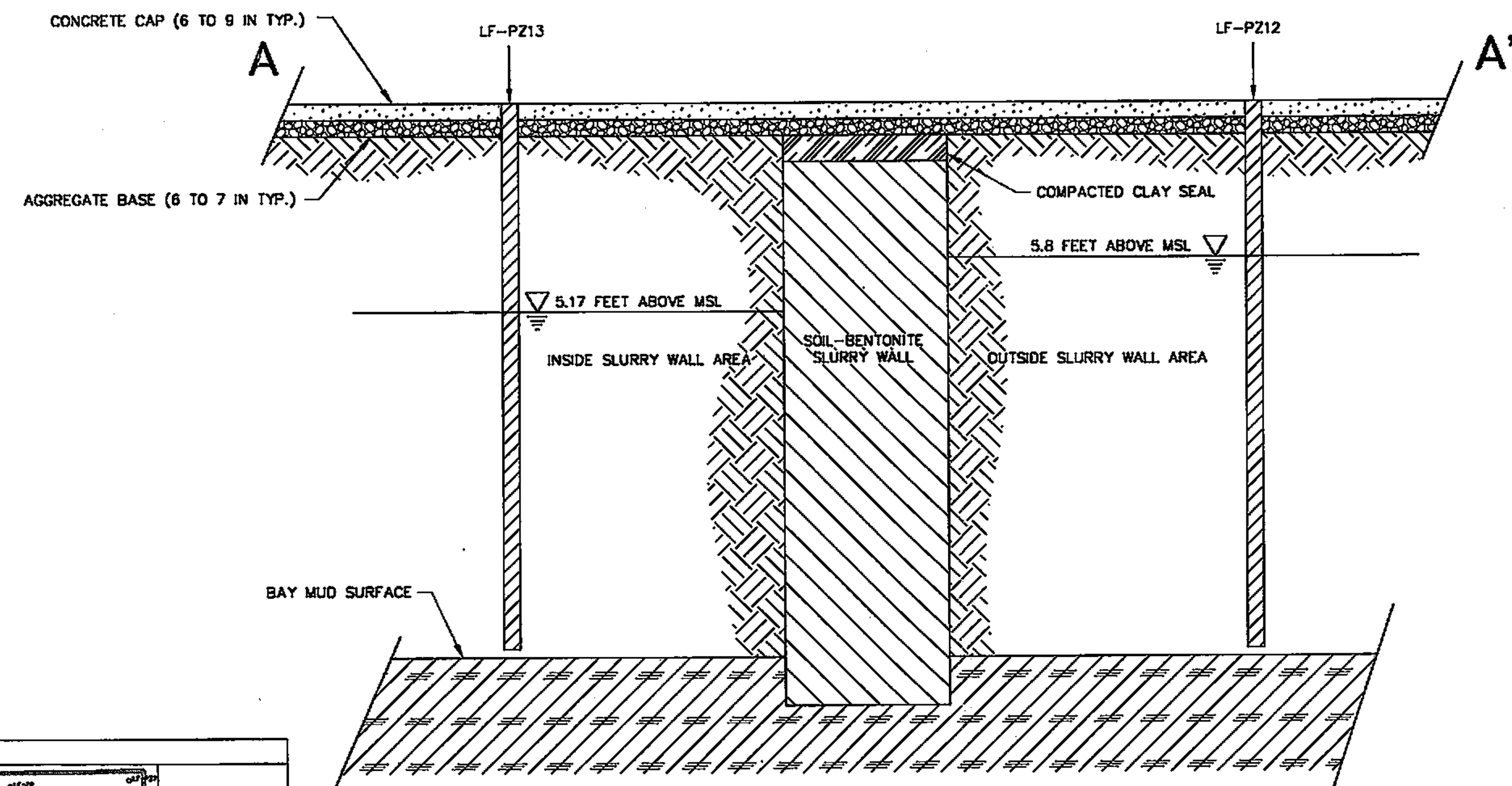
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Process Flow Diagram
Groundwater Treatment System

Levine·Fricke·Recon

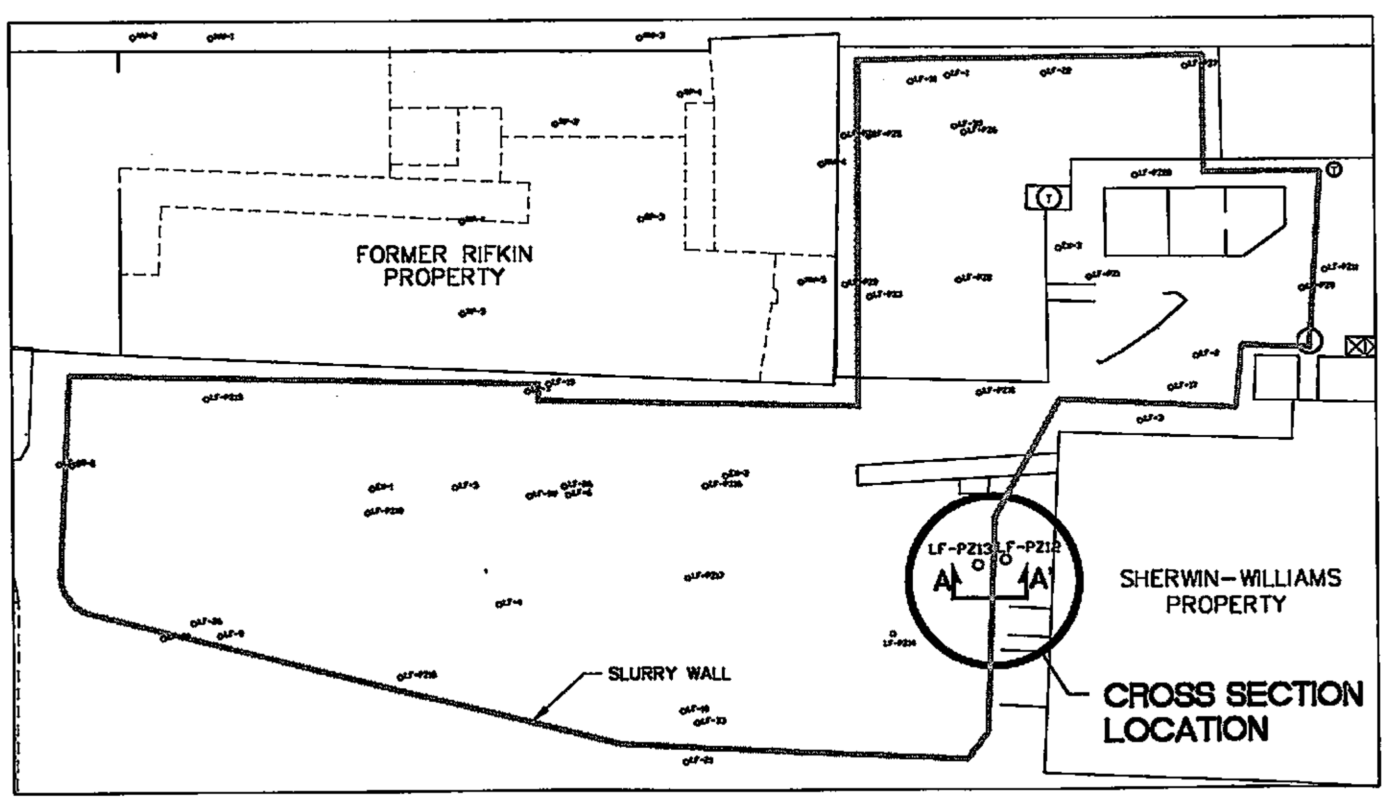
Project No. 6215

Figure 2-3



Not to Scale

NOTE:
GROUNDWATER ELEVATIONS FOR LF-PZ12 AND LF-PZ13 MEASURED ON JULY 2, 1998.



CROSS SECTION LOCATION MAP

SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Conceptual Model Showing Inward Hydraulic Gradient Across Slurry Wall

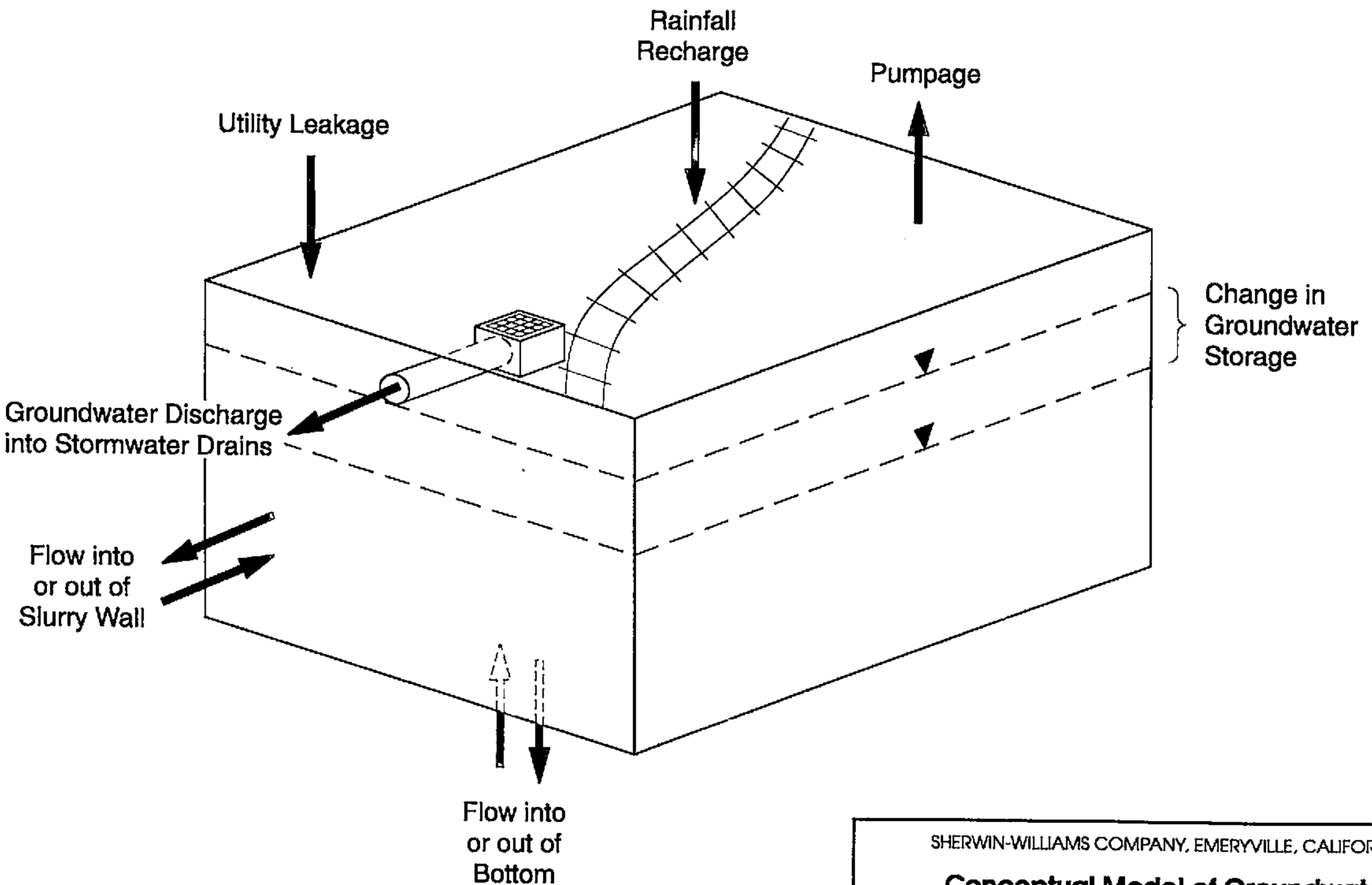
Levine·Fricke·Recon

Figure 2-4

Project No. 6215

8/7/1998 8:49 A.M. LTScale: 0.50 Drawing File(.DWG): J:\ENGCAD\SHERWIN\6215\SLURRYWALLSECTION.DWG

6215S101.CDR 071698



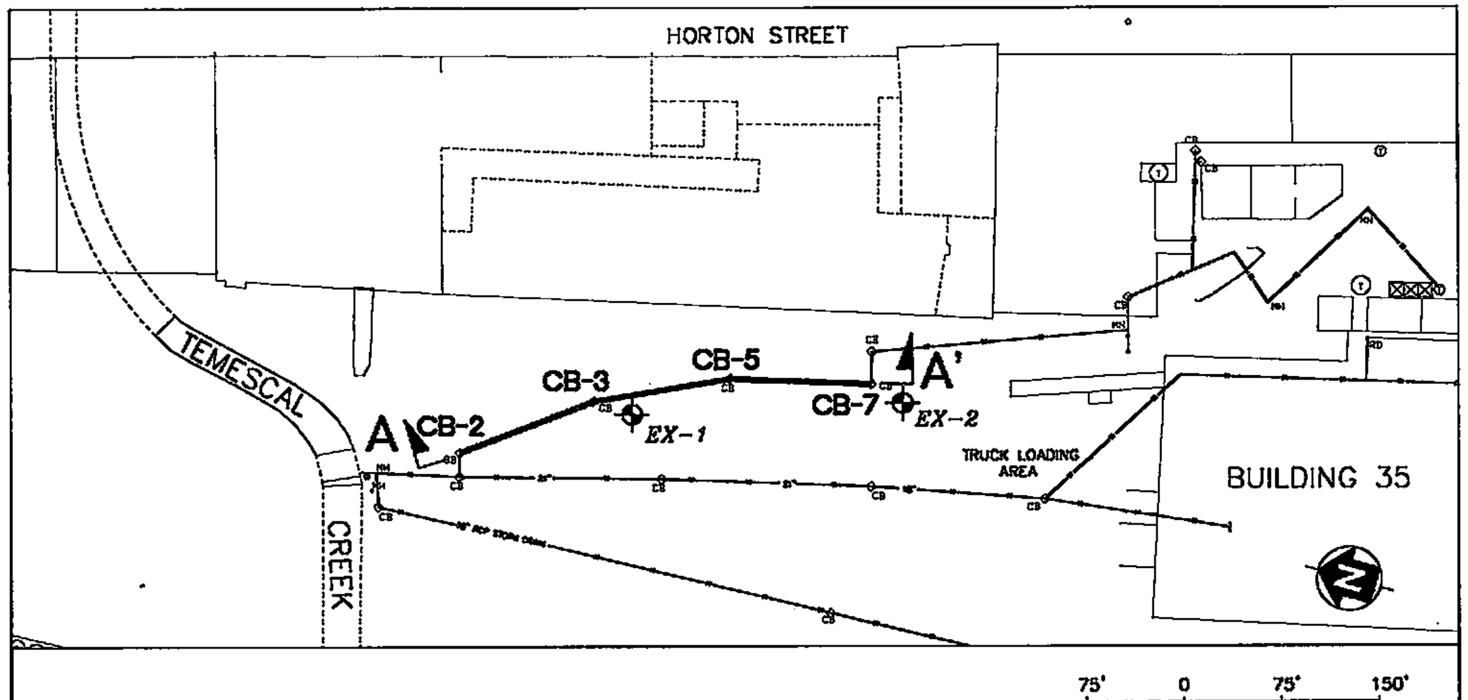
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Conceptual Model of Groundwater Balance Within Slurry Wall

Levine·Fricke·Recon

Project No. 6215

Figure 3-1

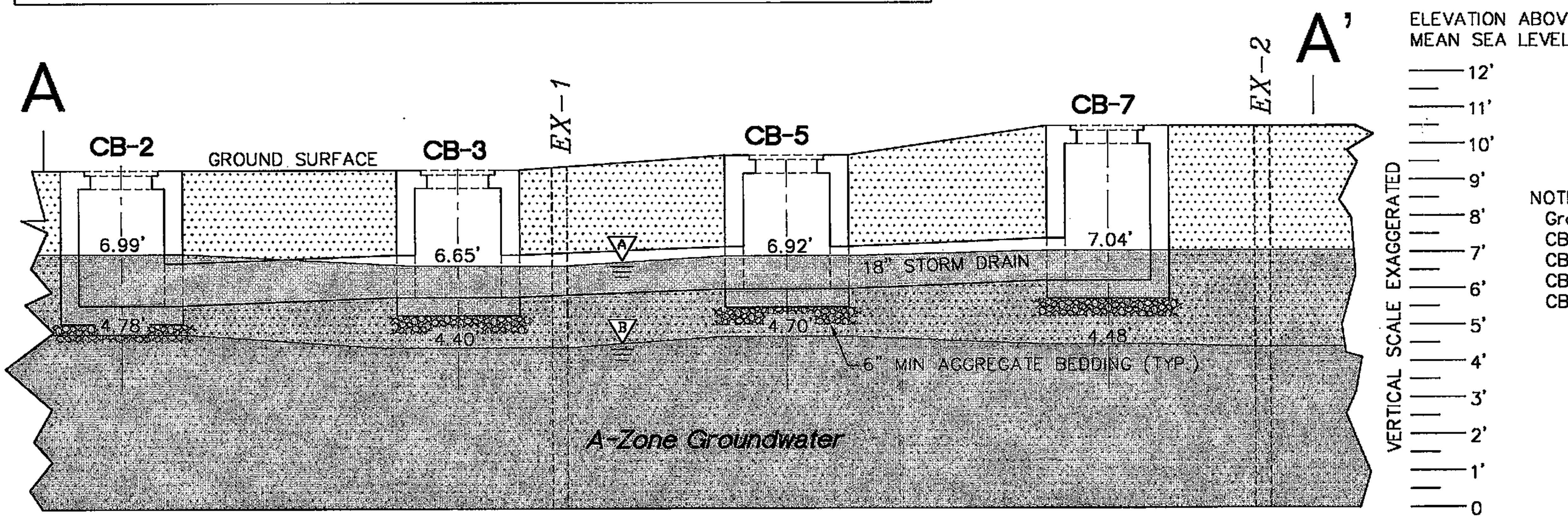


Cross Section Location

CATCH BASIN (CB) ID.	TOP OF GRATE	INVERT ELEVATION	WATER LEVEL APRIL 1998	WATER LEVEL JULY 1998
CB-2	9.30 FT	5.57 FT	6.99 FT	4.78 FT
CB-3	9.30 FT	5.79 FT	6.65 FT	4.40 FT
CB-5	9.70 FT	6.01 FT	6.92 FT	4.70 FT
CB-7	10.5 FT	6.23 FT	7.04 FT	4.48 FT

(A) GROUNDWATER ELEVATION – APRIL 1998

(B) GROUNDWATER ELEVATION – JULY 1998



NOTE:
Groundwater Elevations Shown for
CB-2 Measured in LF-26;
CB-3 Measured in EX-1;
CB-5 Measured in LF-7;
CB-7 Measured in LF-PZ16.

Cross Section Through Storm Drain A - A'

HORIZONTAL NOT TO SCALE

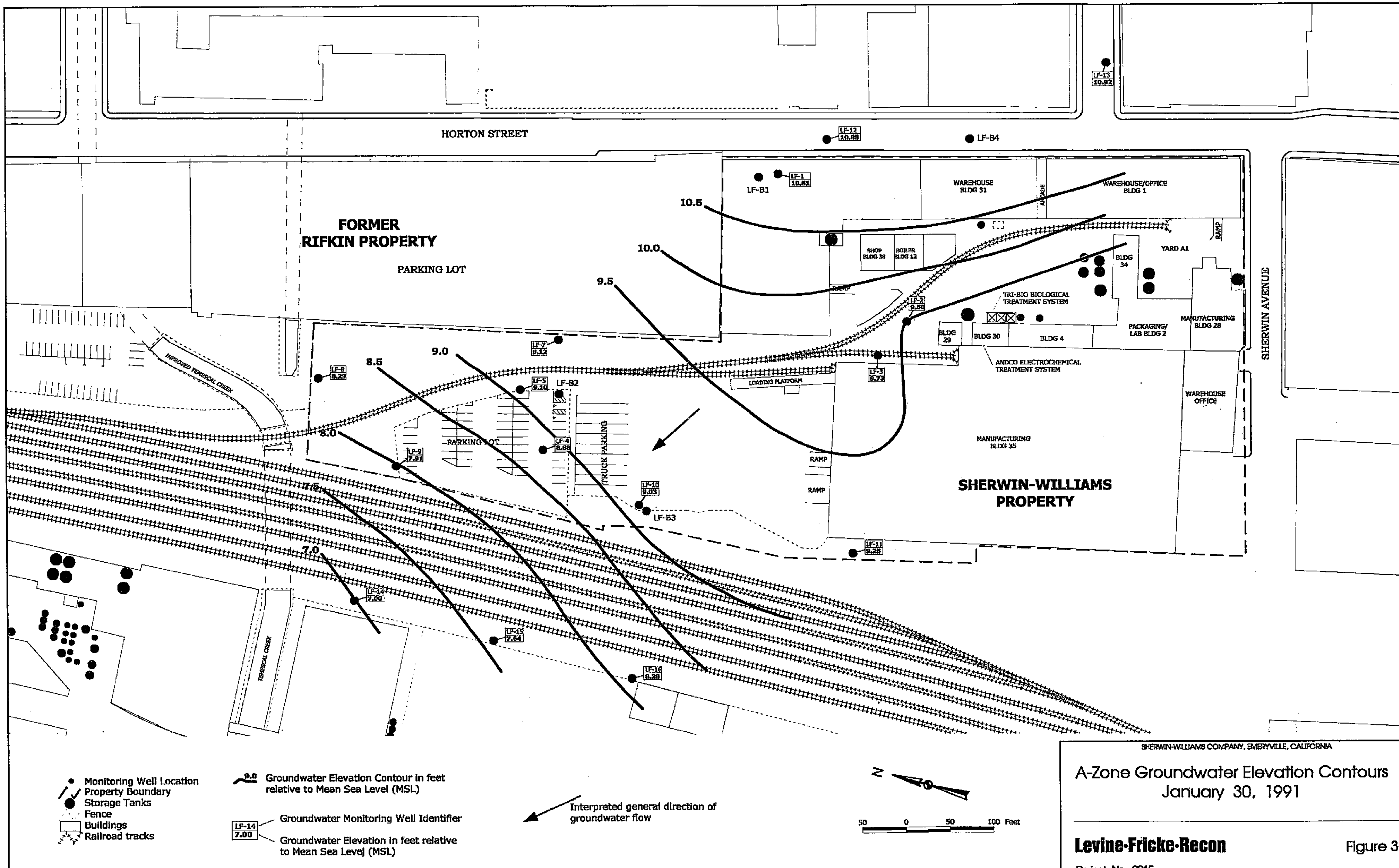
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Cross Section Showing Groundwater Elevations In Relation to Storm-Drain Catch Basin Invert Elevations

Levine·Fricke·Recon Figure 3-2

Project No. 6215

8/6/1998 12:32 P.M. LTScale: 0.25 Drawing File(.DWG): J:\ENGCAD\SHERWIN\6215\STORMDRAINCROSSSECT1.DWG



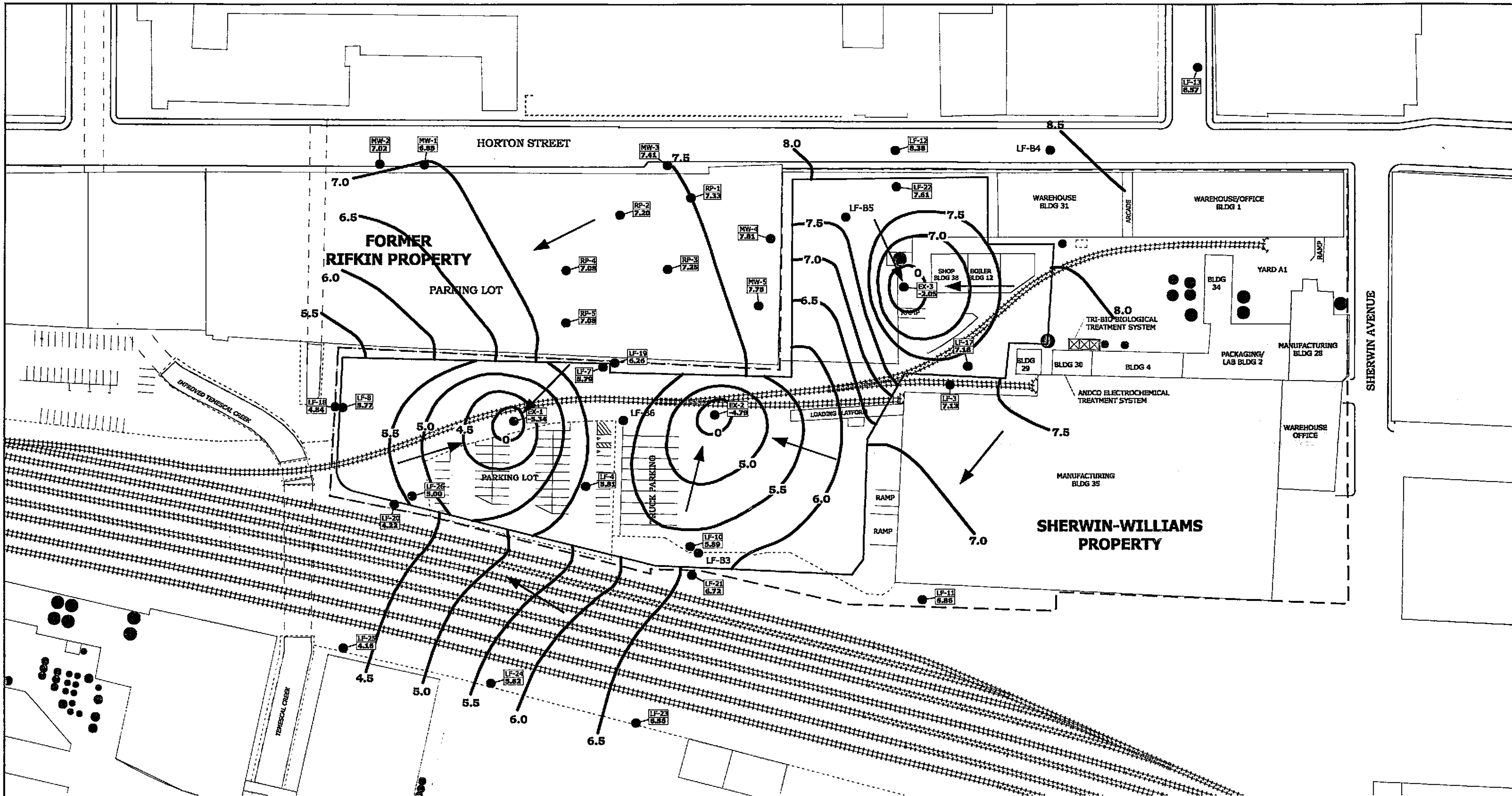
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

A-Zone Groundwater Elevation Contours
January 30, 1991

Levine·Fricke·Recon

Figure 3-3

Project No. 6215



- Monitoring Well Location
- Property Boundary
- Storage Tanks
- Fence
- Buildings
- Slurry Wall
- Railroad tracks

7.0 Groundwater Elevation Contour in feet relative to Mean Sea Level (MSL)

LF-25 — Groundwater Monitoring Well Identifier
4.16 — Groundwater Elevation in feet relative to Mean Sea Level (MSL)

Interpreted general direction of groundwater flow

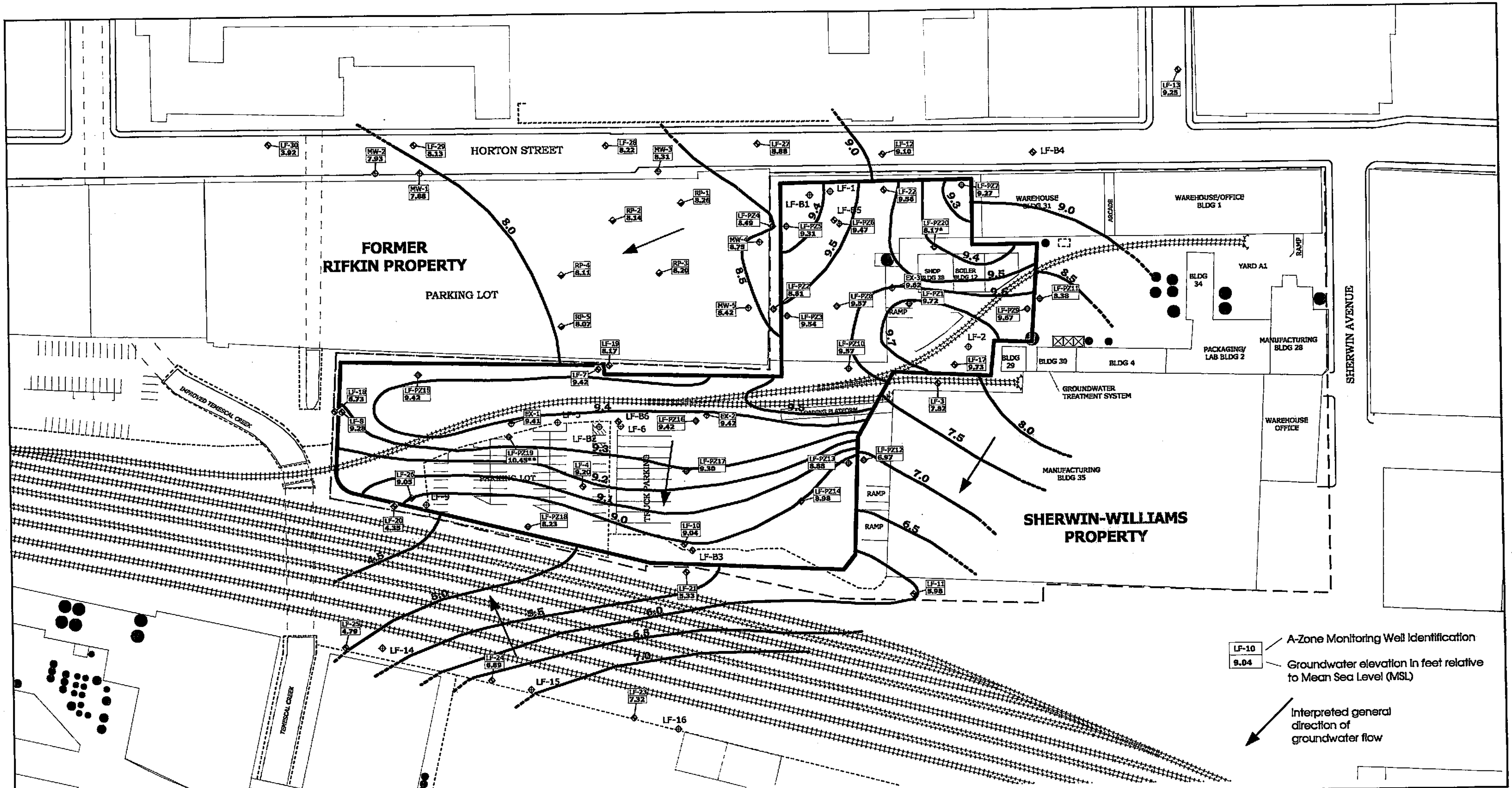
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

A-Zone Groundwater Elevation Contours
April 24, 1996

Levine·Fricke·Recon

Figure 3-4

Project No. 6215



- LF-10 / 9.04 — A-Zone Monitoring Well Identification; Groundwater elevation in feet relative to Mean Sea Level (MSL)
- Interpreted general direction of groundwater flow

Property Boundary
Slurry Wall
Storage Tanks
Fence
Buildings & Other Structures
Railroad tracks

- LF-10 A-Zone Monitoring Well
- LF-B3 B-Zone Monitoring Well
- EX-1 Groundwater Extraction Well
- RP-1 Rifkin Property Monitoring Well (LFR)
- MW-4 Rifkin Property Monitoring Well (TMC)
- LF-PZ1 A-Zone Piezometer
- Monitoring well destroyed or abandoned

9.0 Groundwater Elevation Contour in feet relative to Mean Sea Level (MSL)

* Water level believed to be the result of measurement error, based on historical measurements. Reading not used in contouring.

** Anomalous reading not used in contouring.

N

50 0 50 100 Feet

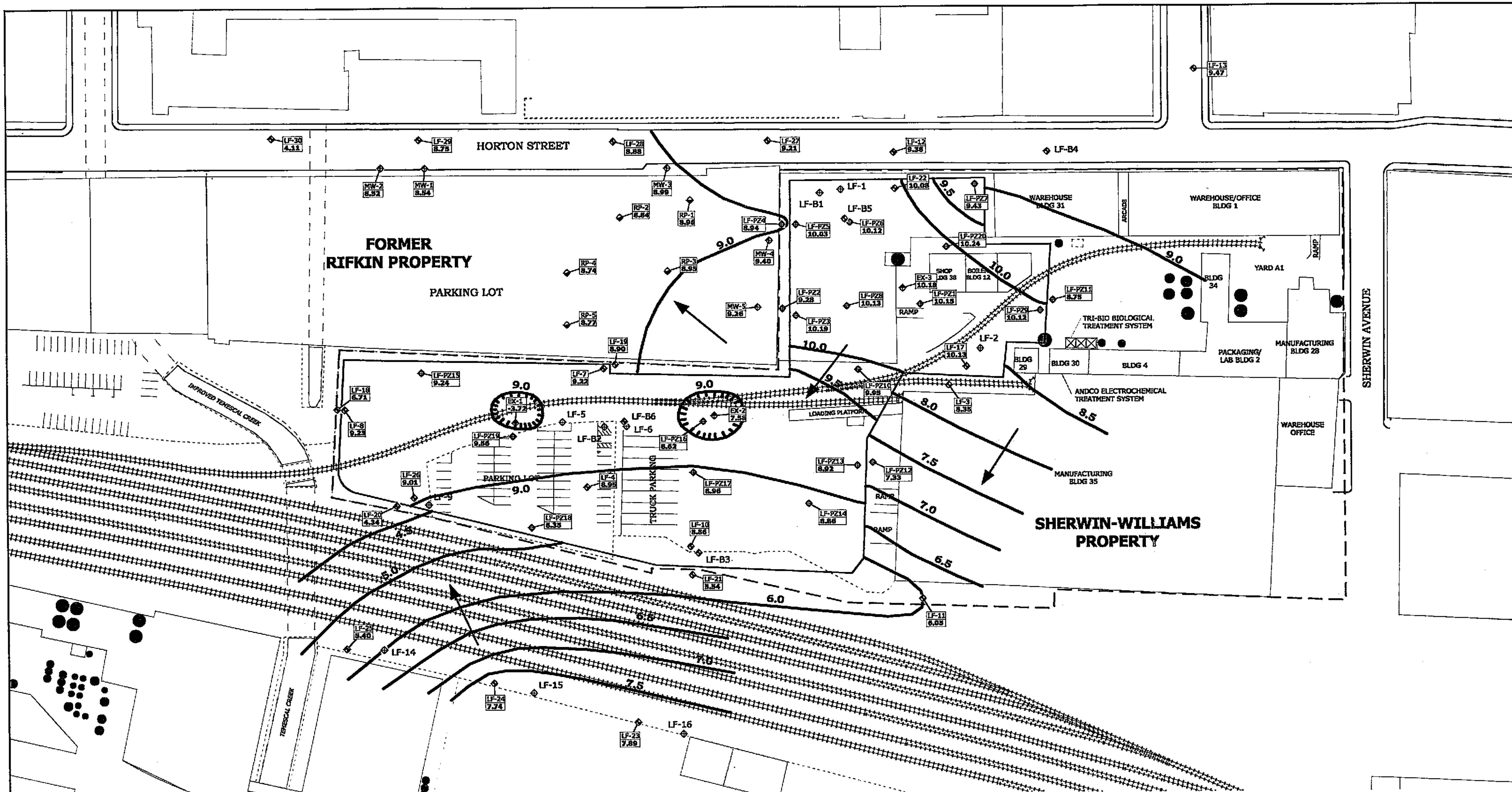
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

A-Zone Groundwater Elevation Contours
January 24, 1998

Levine-Fricke-Recon

Figure 3-5

Project No. 6215



Legend

- Property Boundary
- Storage Tanks
- Fence
- Buildings
- Slurry Wall
- Railroad tracks
- LF-10 A-Zone Monitoring Well
- LF-B3 B-Zone Monitoring Well
- EX-1 Groundwater Extraction Well
- RP-1 Rifkin Property Monitoring Well (LFR)
- MW-4 Rifkin Property Monitoring Well (TMC)
- LF-PZ1 A-Zone Piezometer
- Monitoring well destroyed or abandoned
- 9.0 Groundwater Elevation Contour in feet relative to Mean Sea Level (MSL)
- Depression in Groundwater Surface
- LF-25 Groundwater Monitoring Well Identifier
- 5.40 Groundwater Elevation in feet relative to Mean Sea Level (MSL)
- Interpreted general direction of groundwater flow

N

50 0 50 100 Feet

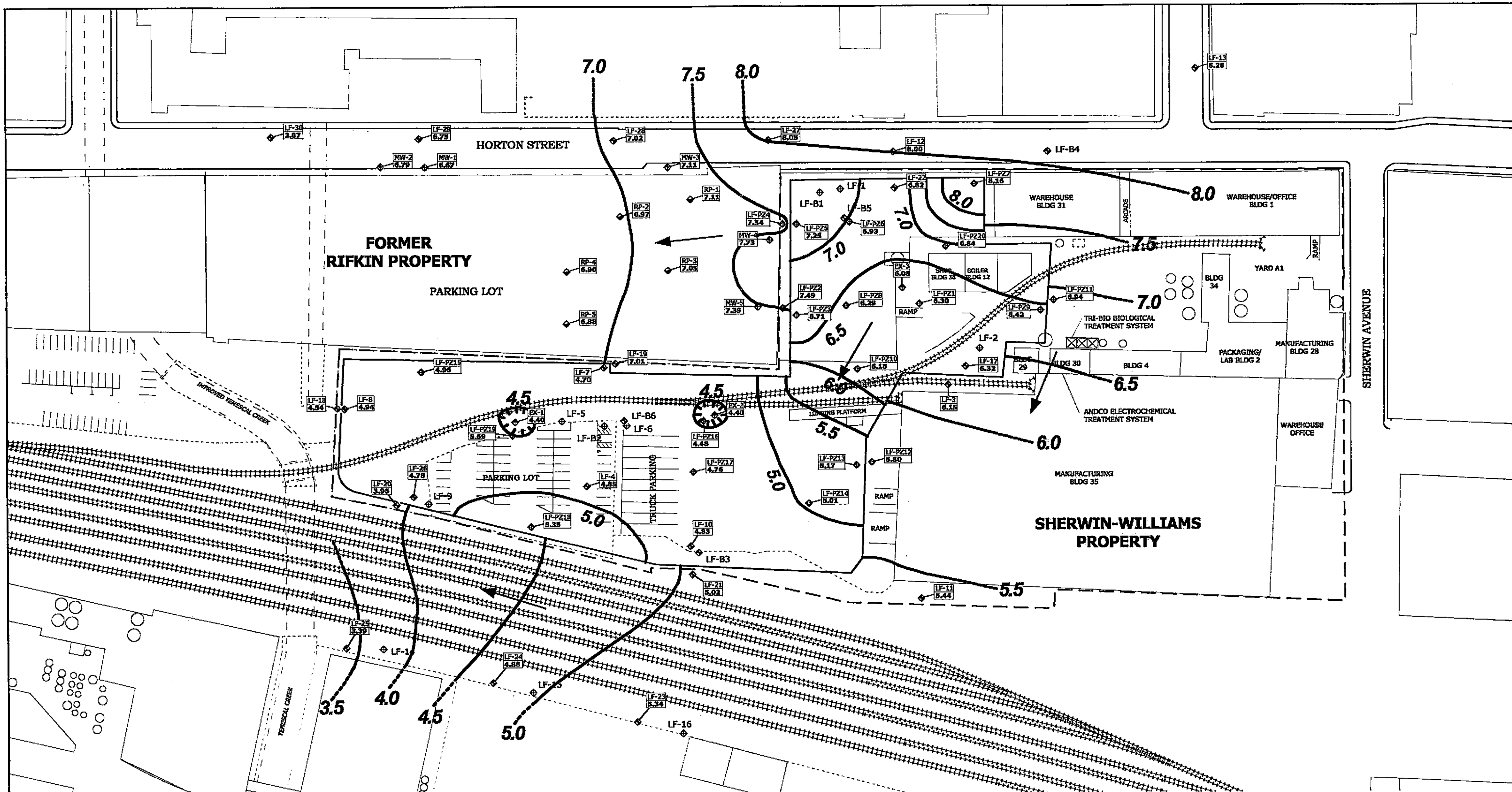
SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

A-Zone Groundwater Elevation Contours February 24, 1998

Levine·Fricke·Recon

Figure 3-6

Project No. 6215



Property Boundary
Storage Tanks
Fence
Buildings
Slurry Wall
Railroad tracks

LF-10 A-Zone Monitoring Well
LF-B3 B-Zone Monitoring Well
EX-1 Groundwater Extraction Well
RP-1 Rifkin Property Monitoring Well (LFR)
MW-4 Rifkin Property Monitoring Well (TMC)
LF-PZ1 A-Zone Piezometer
Monitoring well destroyed or abandoned

7.0 Groundwater Elevation Contour in feet relative to Mean Sea Level (MSL)

Depression in Groundwater Surface

LF-10 / 4.83 — A-Zone Monitoring Well Identification; Groundwater elevation in feet relative to Mean Sea Level (MSL).

Interpreted general direction of groundwater flow

N

50 0 50 100 Feet

SHERWIN-WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

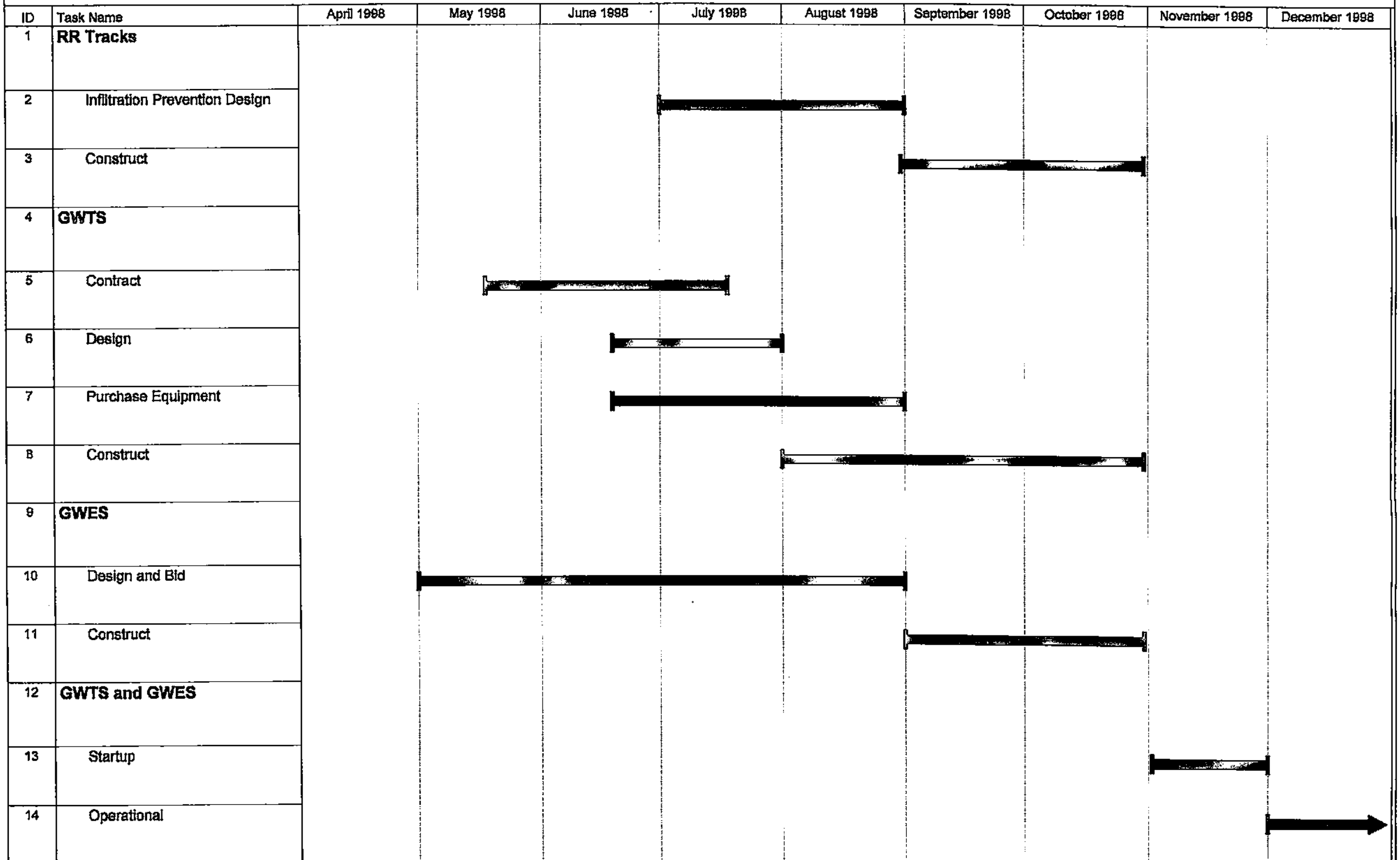
A-Zone Groundwater Elevation Contours
July 2, 1998

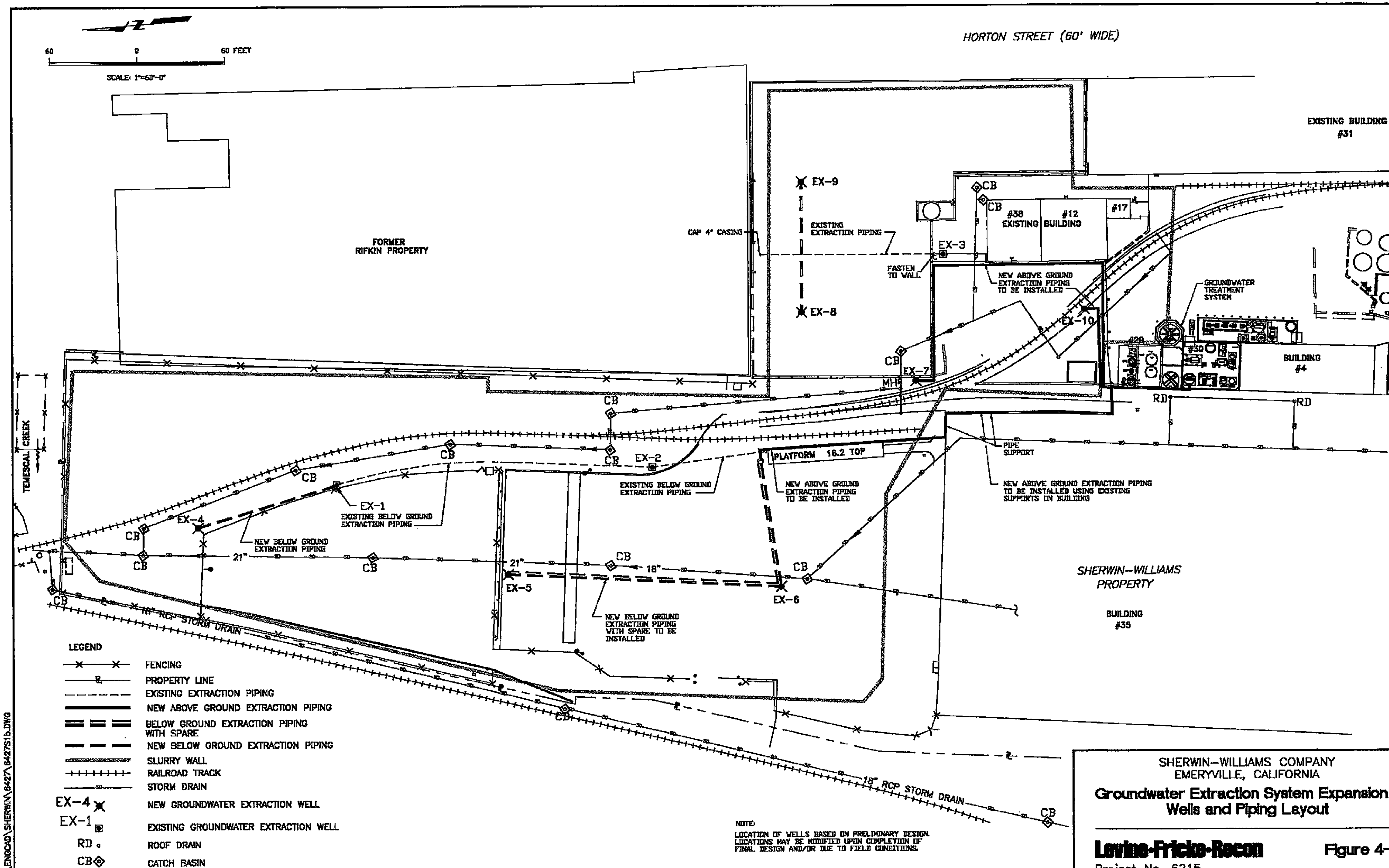
Levine·Fricke·Recon

Figure 3-7

Project No. 6495

FIGURE 4-1
IRM Workplan Schedule
Sherwin-Williams Facility, Emeryville, California





SHERWIN-WILLIAMS COMPANY
EMERYVILLE, CALIFORNIA

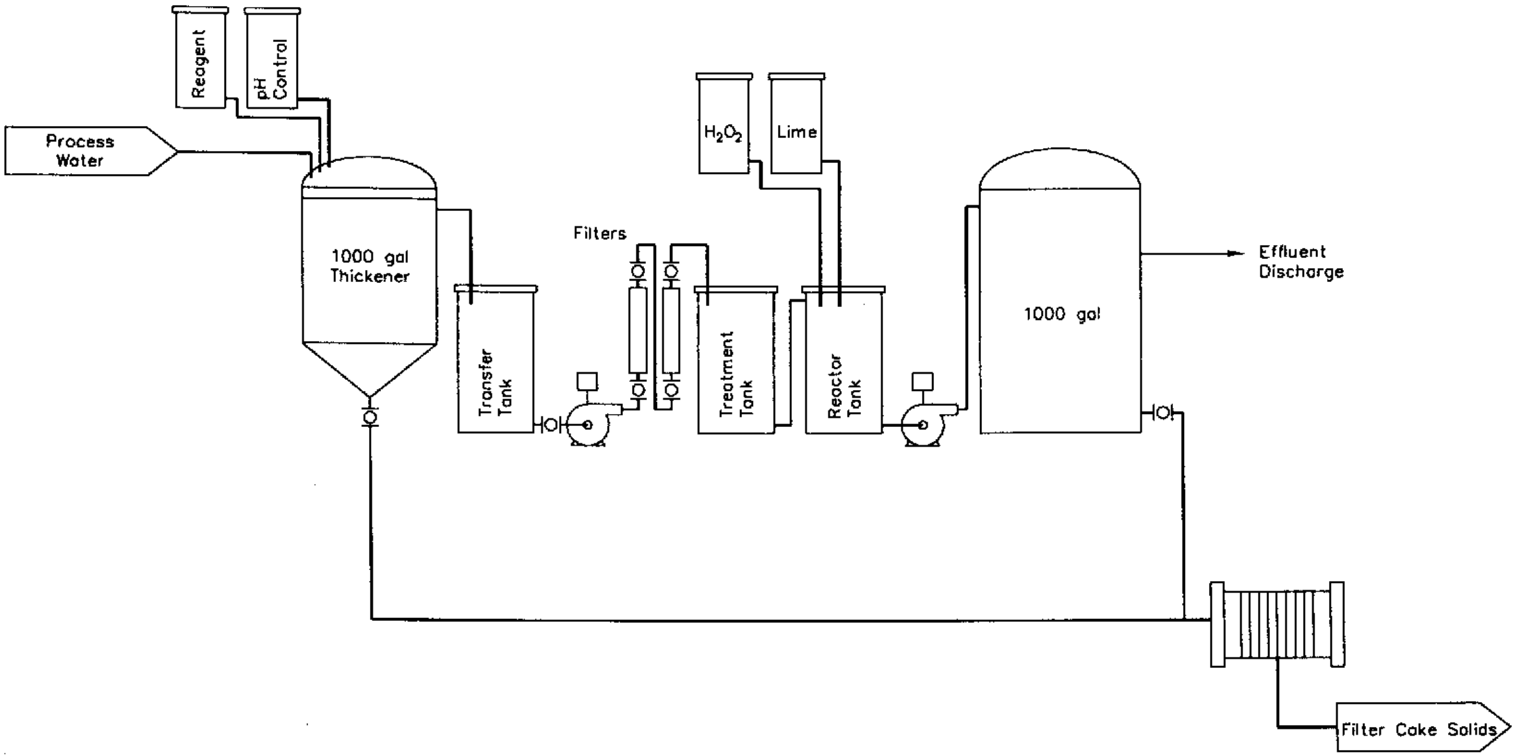
Groundwater Extraction System Expansion – Wells and Piping Layout

Levine-Fricke-Recon

Figure 4-2

Project No. 6215

6215-a.pcp



SHERWIN–WILLIAMS COMPANY, EMERYVILLE, CALIFORNIA

Preliminary Flow Diagram of the Proprietary Reductive Precipitation Process

Levine·Fricke·Recon

Project No. 6215

Figure 4-3

ECM/ 07/16/98 9:41 A.M. LTScale: 0.50 Drawing File(.DWG): J:\ENGCAD\SHERWIN\6215\Reductive-Precipitation.dwg

Appendix A

Responses to Comments on the Draft Final Evaluation of Existing Interim Remedial Measures and Work Plan for Implementation of Future Interim Remedial Measures, dated May 20, 1998

RESPONSES TO COMMENTS ON THE DRAFT FINAL EVALUATION OF EXISTING INTERIM REMEDIAL MEASURES AND WORK PLAN FOR IMPLEMENTATION OF FUTURE INTERIM REMEDIAL MEASURES

Sherwin-Williams Facility
Emeryville, California

dated May 20, 1998

CONTENTS

COMMENTS FROM THE REGIONAL WATER QUALITY CONTROL BOARD (RWQCB)

hydraulic gradient is predicted and justify how you have come to this conclusion. Furthermore, should this additional IRM not result in an inward gradient within a reasonable time period, the Board will require further actions be taken.

As stated previously, DTSC and Chiron have submitted comments. Copies of these comments are attached. We request that you address each of these comments. We do recognize, however, that some of these comments may be more appropriately addressed, and will be addressed in other documents that shall be prepared pursuant to the Site Cleanup Requirements. Should this be the case, please state so in your response and also state which document will address the comment.

RESPONSE:

The draft final IRM report dated May 20, 1998 has been revised extensively to evaluate the IRMs collectively, rather than individually, because they were designed to work together to achieve the specified objectives. (The revised final report is referred to herein as "the Revised IRM Report.")

We agree with the RWQCB that source soils exist outside of the slurry wall and that groundwater concentrations may actually increase in some areas before the final remedy is implemented. Please note that an analysis of concentration trends in the site wells only identified rising concentrations in 2 of 25 A-zone wells located outside the slurry wall. The Revised IRM Report now provides the analyses of the concentration trends (Section 3.1.3) for the wells and possible reasons why two of the wells are indicating a rising trend (p. 26).

Since submittal of the draft final IRM report in May 1998, LFR collected groundwater elevations at piezometers, monitoring wells, and extraction wells on July 2, 1998. The data show that an inward hydraulic gradient has been achieved at numerous locations along the slurry wall. The lower groundwater elevations have been achieved due to increased operating time by the GWTS and GWES during the first half of 1998 and drier weather in May and June 1998. The Revised IRM Report now includes the July 1998 groundwater level data as well as the work plan outlining the future performance evaluation criteria and monitoring requirements.

Comments submitted by DTSC, Chiron [by Erler & Kalinowski (EKI)], and the City of Emeryville have been incorporated, where applicable. Written responses to the DTSC, EKI, and the City of Emeryville comments are also included in the Revised IRM Report.

COMMENTS FROM THE DEPARTMENT OF TOXIC SUBSTANCES CONTROL (DTSC)

COMMENTS FROM THE DEPARTMENT OF TOXIC SUBSTANCES CONTROL (DTSC)

1. **Page iii. The report must be signed and stamped by a registered engineer in the State of California.**

RESPONSE:

The final Revised IRM Report will be signed and stamped by a California registered engineer.

DTSC COMMENT:

2. **Section 1.1.2. Please include a brief description of the contamination found both in soil and groundwater and the range of concentrations found.**

RESPONSE:

Section 1.3 has been added to the Revised IRM Report. It summarizes the hydrogeologic, and soil and groundwater quality conditions at the Site. A summary table (Table 1-1) was prepared and is included in the Revised IRM Report. Table 1-1 identifies the concentrations of metals (arsenic and lead), volatile organic compounds (VOCs), benzene, toluene, ethylbenzene, and xylene (BTEX), total petroleum hydrocarbons (TPH) as diesel, and TPH as gasoline at three areas at the Site (Sherwin-Williams property, former Rifkin property, and Horton Street). A more detailed description of the historical and present-day concentrations in soil and groundwater is presented in the recently submitted report entitled, "Current Conditions Report, Sherwin-Williams Facility, Emeryville, California," dated June 19, 1998 ("Current Conditions Report"; LFR 1998a).

DTSC COMMENT:

3. **Section 1.1.4. Please give a general description of what the three IRMs are. Including, but not limited to, the depth of the slurry wall, what it was keyed into, the construction material (concrete vs. soil bentonite), the number of extraction wells installed, and cap and storm water collection construction details.**

RESPONSE:

The Revised IRM Report includes a more detailed description of each of the IRMs. A full description of the IRMs can be found in the report entitled, "Interim Remedial

(5) evaluating potential contributions from an abandoned fire line within the slurry wall area

(6) performing general mineral analyses of groundwater

The cap was inspected by LFR in September 1997 and found to be in good to excellent condition. Annual inspections of the cap will be performed and maintenance of the concrete and asphalt will be performed as required.

Surface-water sources contributing to groundwater recharge within the containment area have been investigated including storm-water infiltration through the existing railroad tracks and associated switch gear. LFR has identified a qualified railroad design engineer to evaluate alternatives to prevent surface water from infiltrating the cap underneath the railroad track and switch gear. One such alternative being evaluated includes a subsurface geocomposite drainage system with concrete manholes serving as collection and pumping points. Specific recommendations for preventing infiltration around the railroad tracks will be submitted to the RWQCB upon completion of an engineering analysis by the railroad design engineer and LFR.

DTSC COMMENT:

7. **Section 2.3.1. DTSC agrees with EKI assessment that a thorough water balance analysis should be conducted.**

RESPONSE:

A water balance analysis is provided in Section 3.1.1 of the Revised IRM Report (see response to DTSC Comment #6).

DTSC COMMENT:

8. **Section 2.3.2. DTSC agrees that the groundwater extraction and treatment system must be upgraded.**

RESPONSE:

Section 4.3 of the Revised IRM Report presents a work plan for upgrading the groundwater extraction and treatment system. The work plan includes installation of seven groundwater extraction wells in August 1998. In addition, the design of a 30-gallon-per-minute (gpm) groundwater treatment system is more than 90 percent complete and should be implemented in September to October 1998.

DTSC COMMENT:

9. **Section 2.4.2. Please include the design capacity of the current treatment system.**

RESPONSE:

The current GWTS manufacturer's design capacity of 12 gpm has been included in Sections 2.1.3 and 4.3 of the Revised IRM Report. However, the GWTS actually operates on average between 5 and 7 gpm.

COMMENTS FROM THE CITY OF EMERYVILLE

COMMENTS FROM THE CITY OF EMERYVILLE

1. **Please provide a conceptual graphic(s) depicting existing and ideal differences in water elevations on both sides of the slurry wall, depths of the water bearing zones, elevations at points of extraction, storm drains and other man-made conduits.**

RESPONSE:

A figure has been added showing a cross section of a 320-foot portion of the storm drain system (Figure 3-2) that shows April and July 1998 water levels and their relation to the invert depths of the catch basins and storm-water system. Extraction wells EX-1 and EX-2 are projected onto the cross section and indicate groundwater elevations for these two wells.

The Revised IRM Report includes figures showing groundwater elevation contours inside and outside the slurry wall. Text has been added to the Revised IRM Report that summarizes the hydrogeologic conditions at the Site.

CITY OF EMERYVILLE COMMENT:

2. **In areas where "city water sources" are cited, please make reference to what the actual or suspected sources are (i.e., supply, storm, sewer, etc.). Given the fact that the City does not own the water, perhaps it is more appropriate to use the term "other water sources." Also, given indications that the slurry wall may be inadequate, is it not premature to rule out groundwater as one of the "other water sources"? Please provide a map showing areas of known and suspected water sources and conduits.**

RESPONSE:

Text referencing to "city water sources" has been removed and a more detailed water balance evaluation has been performed and is included in Section 3.1.1 of the revised IRM report. The source is presumed to be a "city water source" based on oxygen isotope analysis performed and interpreted by Lawrence Livermore National Laboratory. Results of this investigation indicated that groundwater in a small area within the slurry wall had a similar isotopic composition to treated drinking water supplied by East Bay Municipal Utilities District (EBMUD). A conceptual diagram identifying the inputs and outputs of water into the area contained by the slurry wall has been added to the report. The known and suspected conduits at the Site are provided in the Current Conditions Report (LFR 1998a) for the Sherwin-Williams facility and are referenced where appropriate in the Revised IRM Report.

CITY OF EMERYVILLE COMMENT:

3. **Figure 4 and Section 2.2.1 describe suspected areas where surface waters may be infiltrating the cap. The City understands that the cap is composed of a concrete asphalt layer. Are the cap and underlying soils structurally able to support foot/vehicle traffic loads and Baker tanks – and could these be causes of infiltration? The report states that a "superficial" inspection of the cap was conducted. Will a more extensive inspection of the cap be conducted? What are the criteria for measuring stability?**

RESPONSE:

A more thorough description of the asphalt and concrete cap at the Site has been included in Section 2.1.2 of the Revised IRM Report. The new text describes that the cap thickness varies across the Site and was designed to accommodate the projected vehicular traffic at the various locations at the Site. The most likely location where water infiltrates through the cap is along the railroad tracks. As described in the Work Plan for implementation of future IRMs (see Section 4 of the Revised IRM Report), Sherwin-Williams is working with a qualified railroad engineer to address the issues associated with infiltration of surface water through the cap along the Southern Pacific railroad spur at the Site. The May 20, 1998 draft final IRM report identified a "surficial" inspection of the cap (not a "superficial" inspection), which constituted a thorough visual check on the surface conditions. A surficial inspection will be performed on the cap on an annual basis. Visual inspections of the cap for cracks and chips will be an indication for measuring stability. At this time, the cap remains to be in good condition and will be repaired on an as needed basis.

CITY OF EMERYVILLE COMMENT:

4. **Is there any correlation between the locations of the worse groundwater and soil hotspots? If so, would it be appropriate to conduct in-situ soil treatment on the most contaminated soils to reduce leaching to groundwater? Alternatively, while we are aware that these are interim measures, given the lack of proven technologies to stabilize arsenic impacted soil, would it not appear to be most appropriate to remove and off-haul these soils? The proximity of this site to Temescal Creek, which flows into the Emeryville Crescent and San Francisco Bay concerns the City immensely that arsenic will continue to leach into the groundwater for many years to come and impact these areas. While it may be the rightful jurisdiction of the state and federal governments to protect these bodies of water, it is the City of Emeryville that holds the public trust over the Emeryville crescent tidelands, as exercised by the City on May 2, 1989, by Resolution No. 89-31. The Emeryville Crescent is an environmentally sensitive area, which is to be preserved in its natural state as ecological units for scientific study, as open space and an environment that provides food and habitat for birds and marine life. Consequently, protection of the crescent's**

water quality is of critical concern and continued exposure to arsenic impacted groundwater is inconsistent with the Trust. Likewise, discharges of treated groundwater directly to Temescal Creek are of concern.

RESPONSE:

There generally is a correlation between high concentrations of chemicals of concern detected in soil and high concentrations of chemicals of concern detected in groundwater. As described in Section 1.5 of the Revised IRM Report, Sherwin-Williams has implemented remedial actions, in addition to the IRMs, to reduce the potential for leaching of chemicals in soil to groundwater. These additional remedial actions included a "hot-spot" excavation and disposal of affected soil from the former solvent tank storage area, and the excavation and disposal of soil primarily affected with arsenic and lead from the Horton Street area.

As described in Section 2.2.2 of the Revised IRM Report, the cap and storm-water collection system IRMs were designed to significantly reduce the potential for vertical leaching of chemicals in groundwater from rainwater infiltration. The cap will be improved, as discussed in Section 4.2 of the Revised IRM Report, to reduce infiltration around the railroad tracks. Based on visual inspection of the cap, it appears to be an effective barrier to infiltration of surface water in the most highly contaminated source areas within the slurry wall.

The performance of the IRMs will be assessed after improvements (Section 4 of the Revised IRM Report) have been implemented. Soil treatment/stabilization/excavation remedial actions will be evaluated as part of the remedial investigation/feasibility study (RI/FS) process to be conducted as required by the RWQCB SCR Order for the Site. It is premature to conclude that excavating and hauling contaminated soils are the preferred options considering these actions can increase the potential for public impact and exposure to contaminants.

We share your concerns regarding the need to protect the environment from migration of chemicals of concern at the Site to off-site areas, including Temescal Creek, the Emeryville Crescent and San Francisco Bay. We believe that the improvements to the IRMs, described in Section 4 of the Revised IRM Report, and continued monitoring of the performance of the IRMs will address these concerns in the short term and the final RI/FS will address the long-range plan to reduce or eliminate potential site discharges.

CITY OF EMERYVILLE COMMENT:

5. **As noted above, the Emeryville Crescent is an important ecological resource that warrants protection from discharges of arsenic impacted groundwater. The storm water discharge system utilizes Temescal Creek, which flows directly into the Crescent. The City understands that arsenic impacted groundwater may possibly be infiltrating the storm water discharge system in the area, as**

well as the sanitary sewer system, thereby discharging untreated groundwater to Temescal Creek, the Emeryville Crescent and the EBMUD treatment facility. Please consider the replacement of sanitary sewer and storm water facilities in the area as an interim remedial measure.

RESPONSE:

As discussed in the recently submitted Final Report of Storm Drain Emergency Response Activities and Corrective Actions, Sherwin-Williams Facility (LFR 1998b), the installation of the temporary above ground multipoint collection system with steel slip liners in early December 1997 effectively isolated the storm-water system from further infiltration of contaminated groundwater. The selected long-term alternative involves lowering the groundwater levels to below the storm-water collection system piping and catch basins through expansion of the GWES. Increasing the GWES capacity, resulting in a lowered groundwater table, will prevent the chemically affected groundwater from infiltrating into the storm-water collection system piping and other identified conduits such as sanitary sewer lines. Once these actions are completed, then the storm-drain system will function as designed and replacement will not be necessary.

It is uncertain whether the potential impacts from contaminated groundwater entering the sanitary sewer (if any) are significant enough to warrant pipe replacement. These impacts and recommended remedial actions will be evaluated as part of the RI/FS process.

CITY OF EMERYVILLE COMMENT:

6. **As you are aware, portions of the sidewalk along the west side of Horton Street adjacent to the site were recently fenced off and contained, due perhaps to the inadequacy of the slurry wall, resulting in the presence of arsenic crystals in the public right-of-way. This fence remains in place to this day in order to protect the public from this public nuisance. All the more reason to order the removal of soil, at least to the street level, to remove this on-going trespass into the public right-of-way.**

RESPONSE:

We agree that the fencing along Horton Street needs to be removed. However, please note that the covering and fencing of the retaining wall along Horton Street is unrelated to the adequacy of the slurry wall. This is primarily due to the fact that the retaining wall is above the street elevation and above the groundwater surface elevation. The slurry wall was designed to contain contaminated groundwater, which is approximately 5 feet below the bottom of the retaining wall.

The issues surrounding the retaining wall along Horton Street were addressed in a February 2, 1998 letter report to the RWQCB. To date, only DTSC has provided comments on the February 2, 1998 letter report. In response to DTSC's comment, Sherwin-Williams will evaluate risk issues for the retaining wall in context of the overall risk assessment for the Site to be prepared as part of the RI/FS process as required by the RWQCB SCR Order. In the interim and as discussed at the July 22, 1998 Consultative Workgroup meeting, Sherwin-Williams has decided to place a steel barrier plate on the retaining wall to eliminate potential exposure pathways. A work plan dated July 31, 1998, which describes the design and implementation schedule, has been submitted to the RWQCB and copies submitted to the Consultative Workgroup. With regards to the City's comment concerning removal of soil, as stated in response to comment #4 above, soil treatment/stabilization/excavation remedial actions will be evaluated as part of the RI/FS process to be conducted as required by the RWQCB SCR Order for the Site.

CITY OF EMERYVILLE COMMENT:

7. **The City vehemently contests any claims of delayed approval of connection from the treatment system to the sewer system, and any references to this must be stricken form the report. The delay stems from Sherwin-Williams' refusal to comply with valid and reasonable condition of the City. As you will recall, on very short notice, the City Manager, City Attorney, other City staff and myself met with you, Larry Mencin of Sherwin-Williams and Mark Knox of Levine·Fricke·Recon in the City's offices on February 3, 1998, to discuss the conditions under which the City would issue a permit. The City Attorney prepared the conditions which were discussed and agreed to by Mr. Mencin and Mr. Knox and sent them to these gentlemen and Mr. Allen Danzig the very next day, February 4, 1998. A copy of the cover memo, conditions and facsimile confirmation sheets are enclosed. Thereafter, Sherwin-Williams continued to try and negotiate revisions since they didn't want to pay the sewer connection fee set forth as condition no. 2. Further, and of greater significance to the City and its Redevelopment Agency, Sherwin-Williams was unable to obtain the confirmation from EBMUD that these discharges of approximately 29,000 gallons of water per day would <u>not</u> be counted towards the allowable design flows from Sewer Basin 23 to the EBMUD Interceptor. To the extent Sherwin-Williams' discharges take up capacity of the sewer basin, it effectively precludes redevelopment of other areas of the City. However, recently, the City Attorney has advised that discharge of groundwater to the sanitary sewer system is not permitted by the City's Sanitary Sewer Ordinance. Therefore, it appears that it will be necessary for Sherwin-Williams to request an amendment to the Sewer Ordinance or some other special consideration before such a connection is made. Such an amendment or special consideration will require an action of the Emeryville City Council along with the appropriate environmental review under the California Environmental Quality Act. All costs of conducting the review, including City staff time, and all costs of appropriate mitigation measures will be the responsibility of Sherwin-Williams.**

RESPONSE:

All text referring to claims of delayed approval of connection from the treatment system to the sewer system as a result of the City of Emeryville have been removed. Text has been revised to indicate that Sherwin-Williams is currently negotiating with the City of Emeryville for obtaining approval for discharge of treated groundwater to the sanitary sewer system. Sherwin-Williams hopes that the issues surrounding the request for discharge to the sanitary sewer can be resolved to everyone's satisfaction.

COMMENTS FROM ERLER & KALINOWSKI, INC. (EKI)

COMMENTS FROM ERLER & KALINOWSKI, INC. (EKI)

I.A. Comments Regarding Assessment of IRM Effectiveness

1. **No discussion or evaluation of concentrations of COCs outside of the slurry wall is provided. Chemical concentrations and trends in wells outside the slurry wall are not reported at all. Such an evaluation is critical to judge the effectiveness of the IRMs. The cause and significance of any increasing COC concentrations in monitoring wells outside of the slurry wall should be included in the IRM Evaluation Report. For reference, figures depicting arsenic concentrations detected in selected monitoring wells located outside of the slurry wall have been included as Attachment A.**

RESPONSE:

See response to DTSC Comment #4.

EKI COMMENT:

2. **No discussion or evaluation of downward vertical hydraulic gradients and potential downward vertical migration of COCs within the area of the slurry wall is provided. The cause and significance of downward vertical gradients and potential downward COC migration should be included in the IRM Evaluation Report, particularly due to increasing water levels within the A-aquifer zone caused by the existing IRMs.**

RESPONSE:

Section 3.1.2 of the Revised IRM Report includes a discussion of downward vertical gradients and potential downward vertical migration of COCs within the slurry wall area.

EKI COMMENT:

3. **Conclusions regarding the hydraulic effectiveness of the slurry wall are not supported and should be removed from the IRM Evaluation Report. Although increasing water levels within the wall do indicate that the slurry wall has a lower hydraulic conductivity than surrounding soils (i.e., estimated by Sherwin-Williams to be in the range between 6.4 x 10^{-4} centimeters per second to 7.4 x 10^{-2} centimeters per second; LFR 1990), this does not demonstrate that COCs are being contained or that chemical migration is being inhibited. The only conclusion that can be made on the basis of existing data is that there is more**

water flowing into the area of the slurry wall than flowing out. Therefore, given that the quantity of water entering the area within the slurry wall is unknown, the effectiveness of the slurry wall cannot be assessed on the basis of potentiometric head data.

In fact, water level data indicate that groundwater conditions within the slurry wall are not flat or stable and that groundwater continues to migrate from the southeast to the northwest in the area encompassed by the slurry wall (see Figure 3 of IRM Evaluation Report). The effectiveness of the slurry wall needs to be reassessed after sources of water to the slurry wall area are identified and mitigated, inward hydraulic gradients are established, and groundwater conditions have stabilized. A schedule, procedures, and criteria for this assessment should be provided in the IRM Evaluation Report. In addition, the IRM Evaluation Report should clearly acknowledge that there have been and currently are outward gradients across the slurry wall all around the Site, which is a fundamental noncompliance with original design goals.

Finally, it should be noted that, contrary to statements made by Sherwin-Williams on page 5 of the Draft IRM Evaluation Report, permeability testing conducted at the time that the slurry wall was installed <u>did not</u> verify that the permeability of the wall met the objectives for construction. In fact, the *Interim Remedial Measures Completion Report* states that permeability testing results conducted for the cement bentonite portion of the wall were below specification. However, LFR stated "Since the pumping wells are expected to create an inward hydraulic gradient, it was determined that the measured permeability for the cement-bentonite wall was acceptable" (LFR 1996). As is demonstrated by the existing data, inward hydraulic gradients have not been achieved.

RESPONSE:

Section 3.1.1 of the Revised IRM Report evaluates the water balance inside the slurry wall area and Section 3.1.2 discusses groundwater elevations and flow directions inside and outside the slurry wall. The Revised IRM Report clearly states that the IRMs have not maintained an inward hydraulic gradient across the slurry wall. However, the most recent groundwater elevation data collected on July 2, 1998 indicate that the IRMs have recently achieved an inward hydraulic gradient at most locations across the slurry wall due to improved operations of the GWTS and GWES in addition to drier weather in May and June 1998. As long as an inward hydraulic gradient across the slurry wall is maintained, the potential for chemically affected groundwater to flow from inside the slurry wall to outside the slurry wall does not exist. As discussed in Section 3.1.1 of the Revised IRM Report, regardless of the direction of the hydraulic gradient across the slurry wall (inward or outward), the potential rate of groundwater flow across the entire length of the slurry wall is estimated to be relatively low. (This estimate is on the order of 23 gallons per day, which is equivalent to 0.0004 gallons per day moving through each square foot of the slurry wall [23 gallons per day/55,250 square feet = 0.0004 gallons per day per square foot]).

A work plan for implementation of future IRMs is presented in Section 4 of the Revised IRM Report. The effectiveness of the IRMs will be reassessed after the remedial measures discussed in Section 4 have been implemented.

The Revised IRM Report (Section 2.1.1) explains that most of the slurry wall (approximately 2,000 linear feet) was constructed of soil-bentonite backfill. All soil-bentonite samples tested for hydraulic conductivity met or exceeded the design specification of 1×10^{-7} centimeters per second (cm/sec). A shorter portion of the slurry wall (210 linear feet) adjacent to the former Rifkin property was constructed of cement-bentonite backfill. The design specification for the hydraulic conductivity of this material was 1×10^{-6} cm/sec. During installation of this portion of the slurry wall, two sets of samples were taken to measure the hydraulic conductivity of the cement-bentonite slurry wall. One set of samples had a measured hydraulic conductivity (9.9×10^{-7} cm/sec) that exceeded the design specifications. The second set had a measured hydraulic conductivity (2×10^{-6} cm/sec) that was slightly below the design specification. In other terms, the difference between the design specification (0.000001 cm/sec) and the measured hydraulic conductivity at this location (0.000002 cm/sec) was 0.000001 cm/sec or one one-millionth of a cm/sec. As such, the testing of the slurry wall did verify that the hydraulic conductivity of the wall met design objectives within a reasonable and acceptable tolerance.

EKI COMMENT:

4. **The elevated potentiometric surface observed at wells MW-4 and MW-5 located on the former Rifkin Property indicates that substantial leakage of groundwater may be occurring across the slurry wall at this location. The competency of the slurry wall at this location is of particular concern because: (a) highly elevated concentrations of COCs exist within the slurry wall immediately upgradient from wells MW-4 and MW-5 (LFR 1998a); (b) specified permeability criteria for the cement bentonite slurry wall that was installed along the former Rifkin Property were not achieved (LFR 1996); (c) low pH levels identified in groundwater adjacent to the former Sherwin-Williams acid plant may be impacting the cement bentonite slurry wall at this location; and (d) concentrations of COCs have significantly increased in wells MW-4 and MW-5 since the slurry wall was installed. Further assessment of potential leakage across the slurry wall adjacent to wells MW-4 and MW-5 should be performed. Assessment of the competency of the slurry wall in this location is very important because additional IRMs are planned in this area (LFR 1997) and Sherwin-Williams's ability to maintain inward hydraulic gradients across the wall at this location must be verified prior to design and installation of these additional IRMs, which will be located outside of the slurry wall.**

RESPONSE:

Groundwater elevations in the vicinity of wells MW-4 and MW-5 were generally higher before the slurry wall was installed than after the wall was installed. This is evident by comparing the groundwater elevation contour map for January 1991 (Figure 3-3 of the Revised IRM Report) with groundwater elevation contour maps for times after the slurry wall was installed (e.g., Figures 3-4 through 3-7 of the Revised IRM Report). The most recent groundwater elevation data collected on July 2, 1998 indicate that there is an inward hydraulic gradient across the slurry wall in the vicinity of wells MW-4 and MW-5. Consequently, the potential for groundwater to flow from inside the slurry wall to outside the slurry wall currently does not exist in this area. As discussed in Section 3.1.1 of the Revised IRM Report, regardless of the direction of the hydraulic gradient across the slurry wall (inward or outward), the potential rate of groundwater flow across the entire length of the slurry wall is estimated to be relatively low. (This estimate is approximately 23 gallons per day or 0.0004 gallon per day per square foot).

As discussed in Section 3.1.3 of the Revised IRM Report, concentrations of arsenic detected in well MW-5 exhibit a statistically significant increasing trend; however there has not been a statistically significant increasing trend in arsenic concentrations detected at well MW-4. The cause of the statistically significant increasing trend in arsenic concentrations detected in well MW-5 is currently uncertain. In general, increases in arsenic concentrations at well MW-5 may have resulted from 1) migration of arsenic-affected groundwater through the slurry wall, from inside to outside; and/or 2) migration of arsenic from other areas outside the slurry wall.

LFR will continue to monitor chemical concentrations in groundwater at well MW-5 to evaluate the cause(s) of the increasing trend in arsenic concentration at well MW-5.

EKI COMMENT:

5. **LFR's calculations indicate that rates of inflow into the slurry wall exceed 30% of measures rainfall rates (page 8 of draft IRM Evaluation Report). One of the primary stated purposes of the cap and storm-water collection system is to "significantly reduce the potential for vertical leaching of chemicals into groundwater from rainwater infiltration." Although the actual sources of water to the Sherwin-Williams Site are unclear, these data indicate that objectives of the cap and storm-water collection system are not being met and that appropriate measures need to be taken to stop further infiltration of water into the area of the slurry wall. Specific steps to identify sources of water infiltration should be stated and the schedule for implementation included in the IRM Evaluation Report. The possibility of artesian conditions in the reported former deep production well located on the Sherwin-Williams property (EKI 1997a; EKI 1997b) should also be assessed as a potential source of water inflows to shallower zones.**

RESPONSE:

Section 3.1.1 of the Revised IRM Report evaluates the water balance inside the slurry wall, including potential sources and loses of water within the slurry wall area. As described in Section 4 of the Revised IRM Report, Sherwin-Williams is working with a qualified railroad engineer to address infiltration of surface water through the cap along the Southern Pacific railroad spur at the Site. Sherwin-Williams will continue to perform a surficial inspection of the cap on an annual basis. At this time, the cap appears to be in good condition and appears to be preventing surface water from infiltrating into source areas. The cap will be repaired on an as needed basis. As discussed in Section 4.2, the storm-water collection system does not require modification if the groundwater elevations remain below the inverts of the storm-water collection system piping.

Section 3.1.1 of the Revised IRM Report also summarizes the numerous investigations performed at the Site to evaluate the potential significance of leaking utility water into the slurry wall area including: 1) conducting a study of the oxygen isotope composition, 2) conducting a review of historical facility drawings and construction field logs, and interviews regarding slurry wall installation, 3) analyzing fecal coliform count and surfactants in groundwater samples collected from Site piezometers and wells, 4) conducting a geophysical survey to evaluate the presence of water, sanitary sewer or storm drain lines within the slurry wall area, and 5) evaluating potential contributions from an abandoned fire line within the slurry wall area.

Sherwin-Williams has decided to proceed with locating the deep well by excavating soil in the area where the well is shown on historical drawings. If the well can be located, Sherwin-Williams can determine if the well was previously abandoned properly. Locating the well will also identify whether the well has served as a conduit for water to flow upward from deeper to shallower zones will be assessed based on results of that investigation.

After the improvements to the IRMs discussed in Section 4 of the Revised IRM Report are implemented, the effectiveness of the IRMs in meeting remedial objectives will be assessed and the need for any additional improvements will be evaluated as part of the RI/FS process.

EKI COMMENT:

6. **Data presented in the IRM Report indicate that water levels are elevated in the vicinity of the railroad tracks that run internal to the Sherwin-Williams Site. Although these data indicate that infiltration may be occurring along these tracks, as suggested by LFR, the possibility that gravel backfill along the storm sewer pipeline that runs along the railroad tracks (LFR 1996) is acting as a preferential pathway for groundwater should also be assessed.**

RESPONSE:

Section 2.1.1 of the Revised IRM Report includes a discussion and evaluation of the storm-water collection system piping that passes through the slurry wall. A conceptual model showing an isometric view of the storm-drain line passing through the slurry wall has been added to the IRM report (Figure 2-1). The storm-water collection system piping is surrounded by backfill material along the length of the line, therefore, measures were taken during the slurry wall construction to ensure a seal was maintained around the storm drain line at locations where it passes through the slurry wall. Native soil and backfill material surrounding the storm drain piping were removed and the slurry pumped into the excavation, forming a seal around the line. Therefore, the potential on- and off-site migration of groundwater along this pathway is not considered complete.

I.B. Comments Regarding the Need for Procedures, Criteria, and Schedule to Verify that the Proposed IRM Modifications are Adequate and Effective

EKI COMMENT:

1. **Until inward hydraulic gradients are established, further off-site migration of COCs will continue. Therefore, in order to judge the effectiveness of the proposed IRM modifications, the length of time that will be required to reverse current head differences across the slurry wall must be estimated and a schedule and date by which inward hydraulic gradients will be achieved must be included in the IRM Evaluation Report.**

   The schedule should also specify minimum reductions in outward hydraulic gradients that will be achieved over time so the effectiveness of the proposed IRM expansions can be assessed and modified as necessary to meet the ultimate schedule for creation of inward hydraulic gradients. The desired magnitude of the inward gradient, i.e., head differences, along the wall and the schedule to achieve it should be specified. The adjoining property owners should not be required to wait years to find out if the modified IRMs will meet the established objectives.

RESPONSE:

Groundwater elevations collected on July 2, 1998 indicate that an inward hydraulic gradient has been achieved at numerous locations along the slurry wall. Lowering of the groundwater elevations within the slurry wall area are a result of increased operating time by the GWTS and GWES in the first half of 1998, in conjunction with drier weather since June 1998. The GWES and GWTS expansions are scheduled to be completed by the end of 1998. Groundwater elevations will be monitored on a monthly basis following startup of the GWES and GWTS and through the first rainy season. The Revised IRM Report has been modified to include the above information.

Groundwater elevations will continue to be measured on a quarterly basis to evaluate the effectiveness of the IRMs in maintaining an inward hydraulic gradient across the slurry wall and groundwater elevations below the storm-water collection system piping. This information will be included in each quarterly groundwater monitoring report and will be available to adjoining property owners on a quarterly basis. By implementing improvements to the IRMs, it is expected that the IRMs will soon achieve inward hydraulic gradients across the entire slurry wall and groundwater elevations will be maintained below the storm-water collection system piping.

EKI COMMENT:

2. **Chiron agrees with Sherwin-Williams's stated objective that water levels within the slurry wall should be lowered below the existing storm sewer pipeline. However, the elevations of this pipeline and the base of the gravel backfill should be presented in the IRM Evaluation Report so the effectiveness of the IRMs can be independently assessed based on water elevations reported to the RWQCB. The potential for other underground conduits to act as pathways for contaminant migration should also be assessed with water levels within the slurry wall managed appropriately.**

RESPONSE:

The Revised IRM Report includes a discussion of storm-water collection system piping inverts in relation to groundwater elevations. A figure showing a cross section of a 320-foot section of the storm-water collection system in relation to the groundwater elevations is included in Section 3. The groundwater levels recently collected on July 2, 1998 indicate that groundwater levels inside the slurry wall area are below the storm-water collection system piping.

The recently submitted Current Conditions Report (LFR 1998a) includes a complete evaluation of potential on- and off-site migration of contaminants through lateral conduits. Section 2.1.1 of the Revised IRM Report provides text describing how underground utilities encountered during installation of the slurry wall were either: 1) removed to the extent necessary to complete the work and plugged with grout or 2) left in place by excavating the surrounding soil and backfill material and sealing with soil- and/or cement-bentonite slurry.

EKI COMMENT:

3. **As indicated by the data presented in the IRM Evaluation Report, the existing IRMs are not adequate or effective and require modification. The schedule, procedures, and criteria that will ultimately be used to determine the**

effectiveness of the IRMs should be clearly stated in the IRM Evaluation Report. Established criteria should include: (a) minimum head differences that will be maintained across the slurry wall, (b) maximum water level elevations that will be allowed within the slurry wall, and (c) decreasing trends in COC concentrations outside of the slurry wall. Regular reports evaluating the effectiveness of the modified IRMs should be prepared and submitted to the RWQCB. The schedule for submittal of these reports should be included in the IRM Evaluation Report.

RESPONSE:

Section 4 of the Revised IRM Report includes a more thorough discussion of the tasks that will be implemented to enhance the performance of the IRMs. The following addresses EKI comments 3(a) through 3(c).

3(a). LFR proposes that the criteria for maintaining head differences across the slurry wall be stated such that a measurable difference in groundwater elevations be maintained for well pairs with a lower groundwater elevation required within the slurry wall.

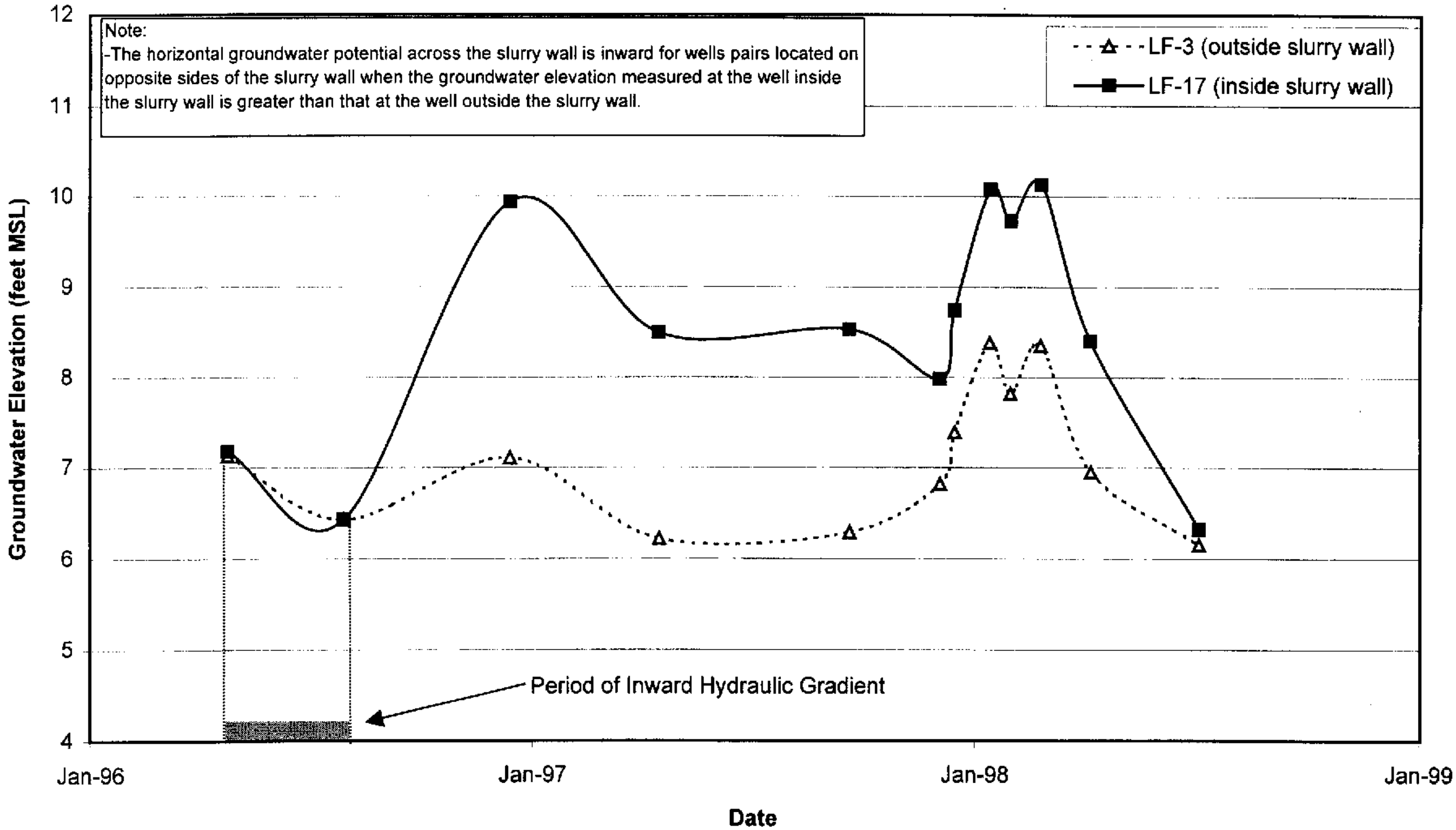
3(b). LFR proposes that the criteria for water levels below the storm drain be maintained such that the groundwater elevations within the slurry wall be maintained a minimum of 1 foot below the pipe invert to ensure that groundwater does not enter the pipe backfill (the bottom of the pipe backfill is approximately 6 inches below the bottom of the pipe).

3(c). Due to the presence of contaminants outside the slurry wall, it may not be feasible to maintain decreasing COC concentrations until the final remedial actions are selected. As such, this comment should be addressed as part of the RI/FS process. In the interim, the quarterly groundwater monitoring reports will continue to be the report where the effectiveness of IRMs are evaluated.

Appendix B

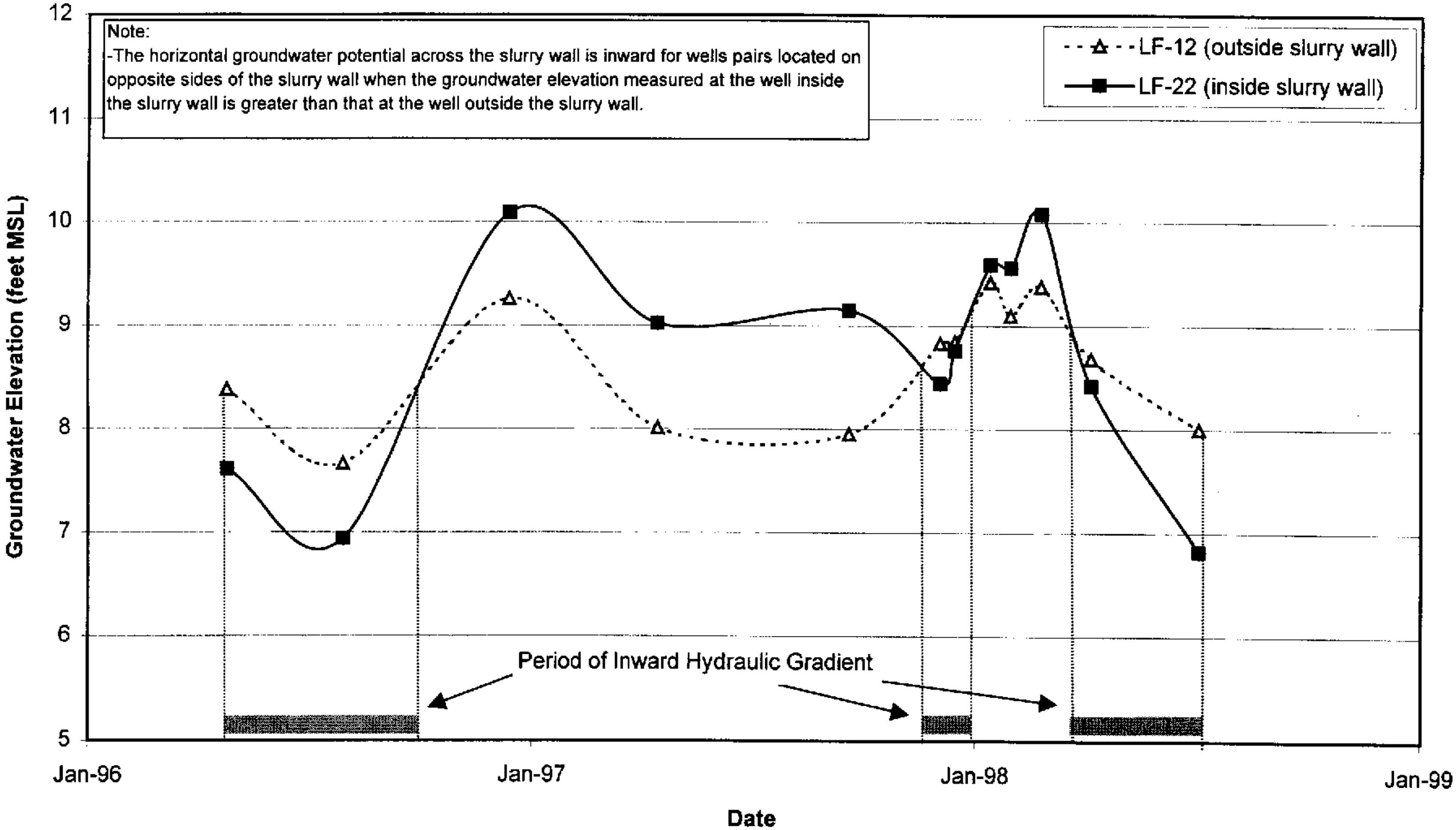
Groundwater Hydrographs

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998



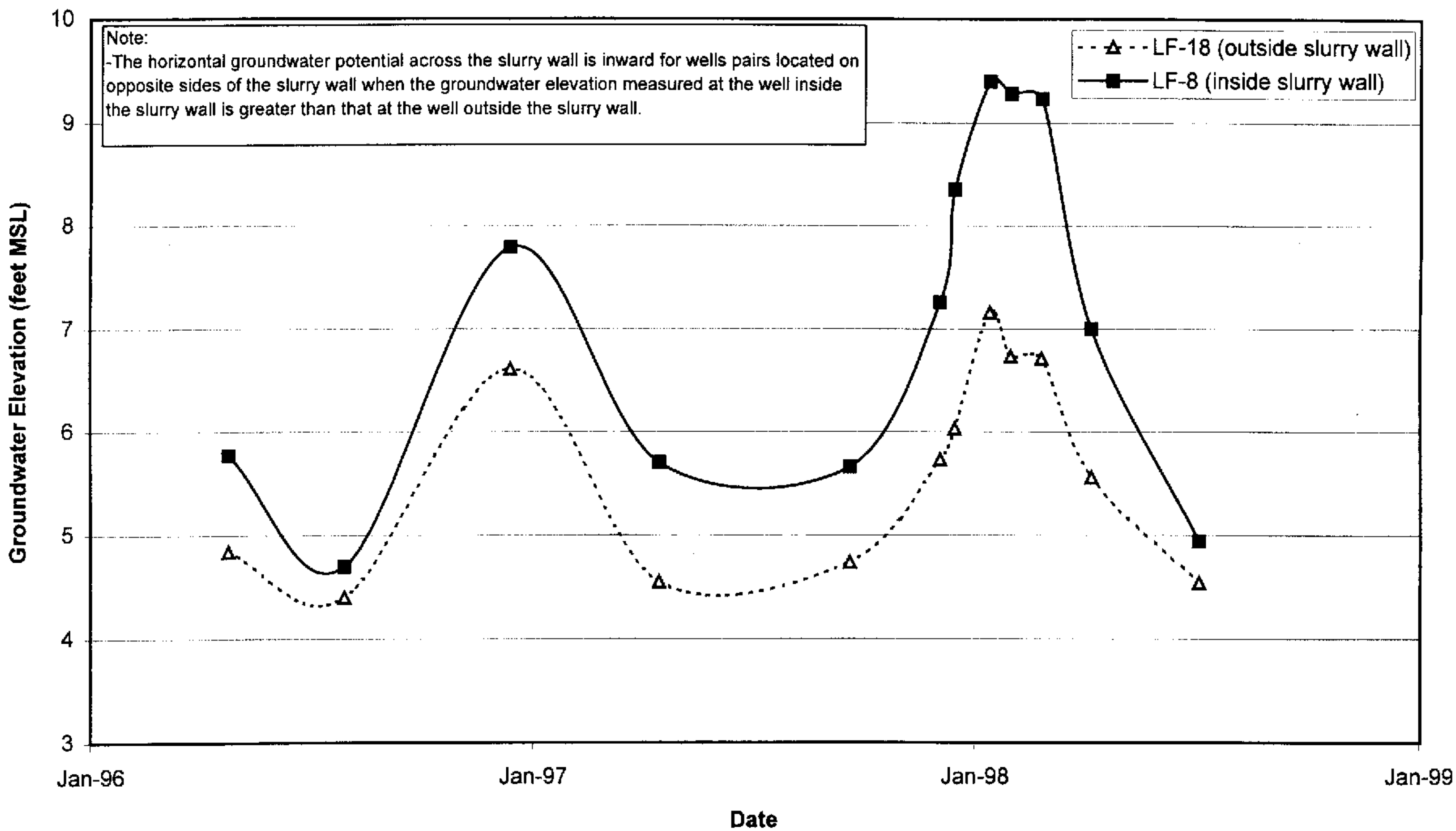
Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998



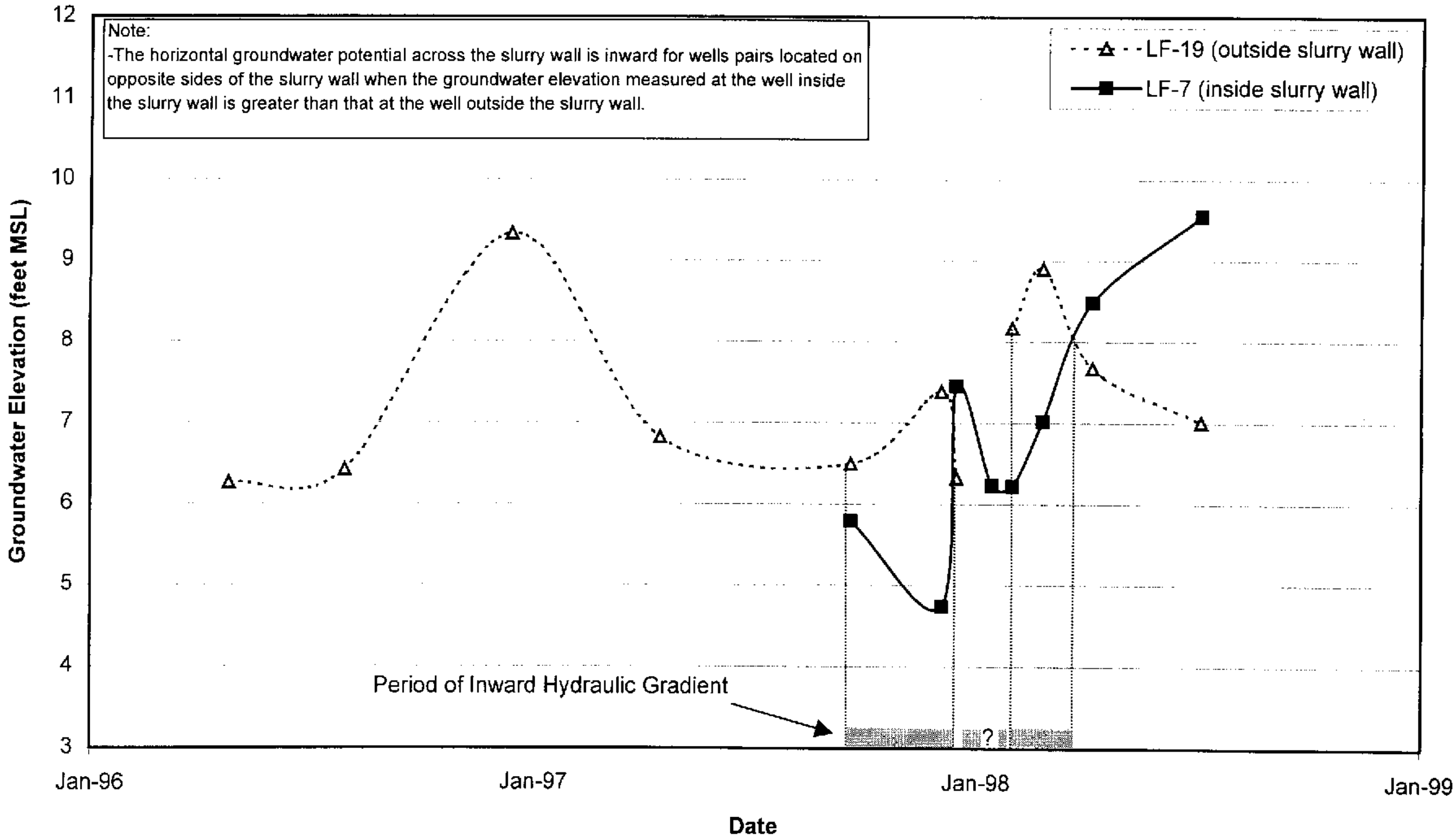
Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1990-1998



Levine·Fricke·Recon

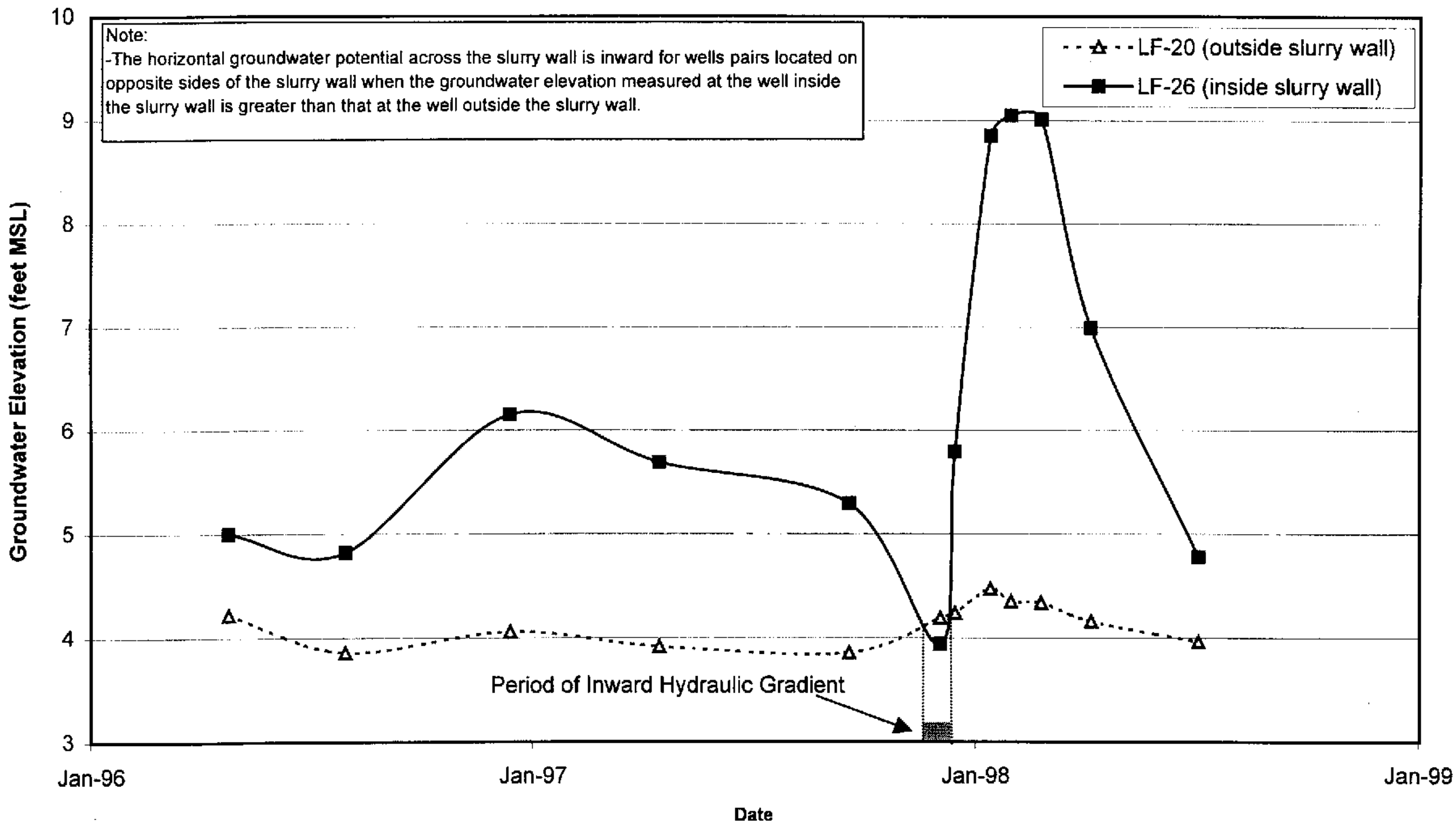
GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998



Levine·Fricke·Recon

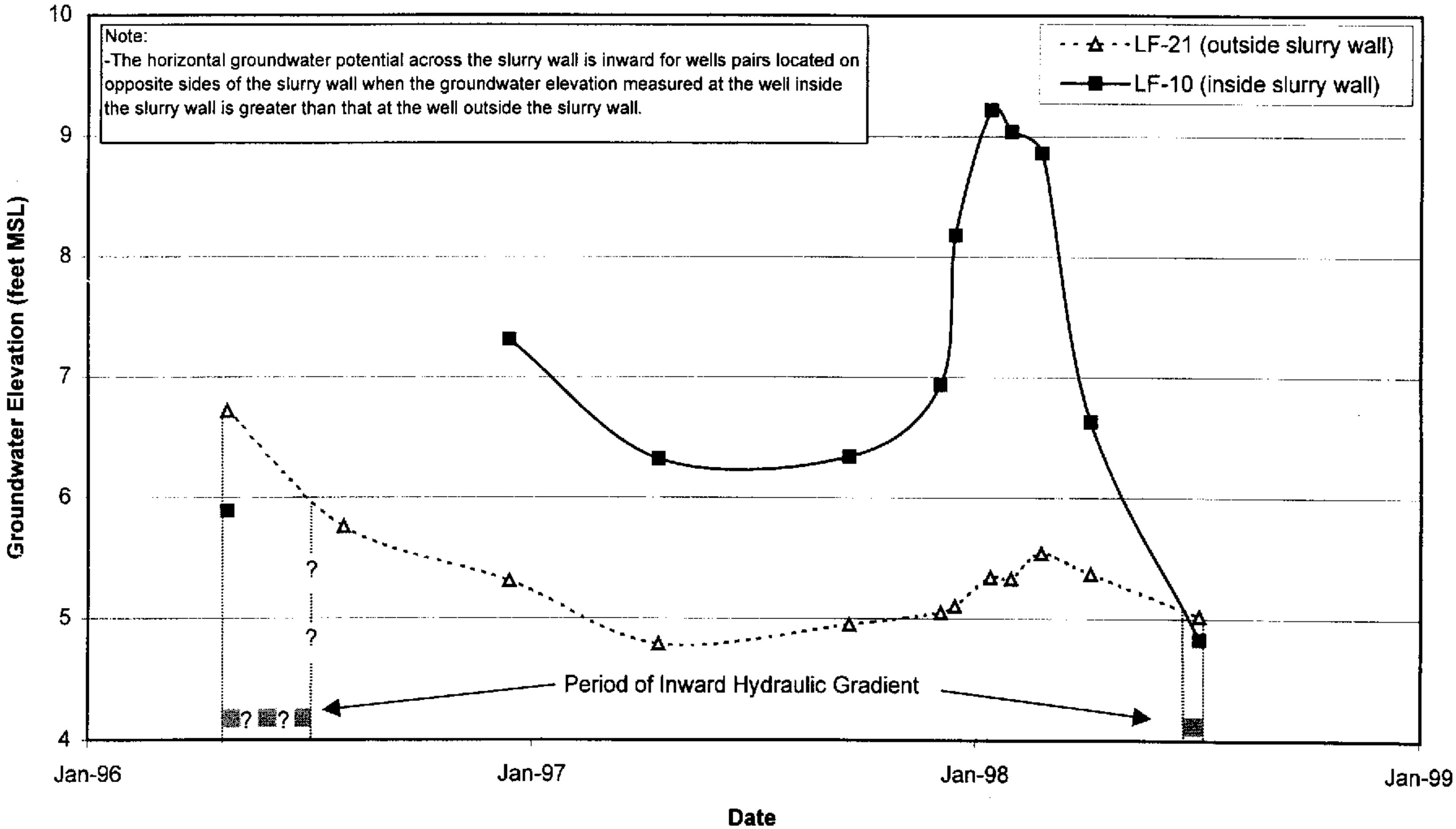
[redacted]

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998



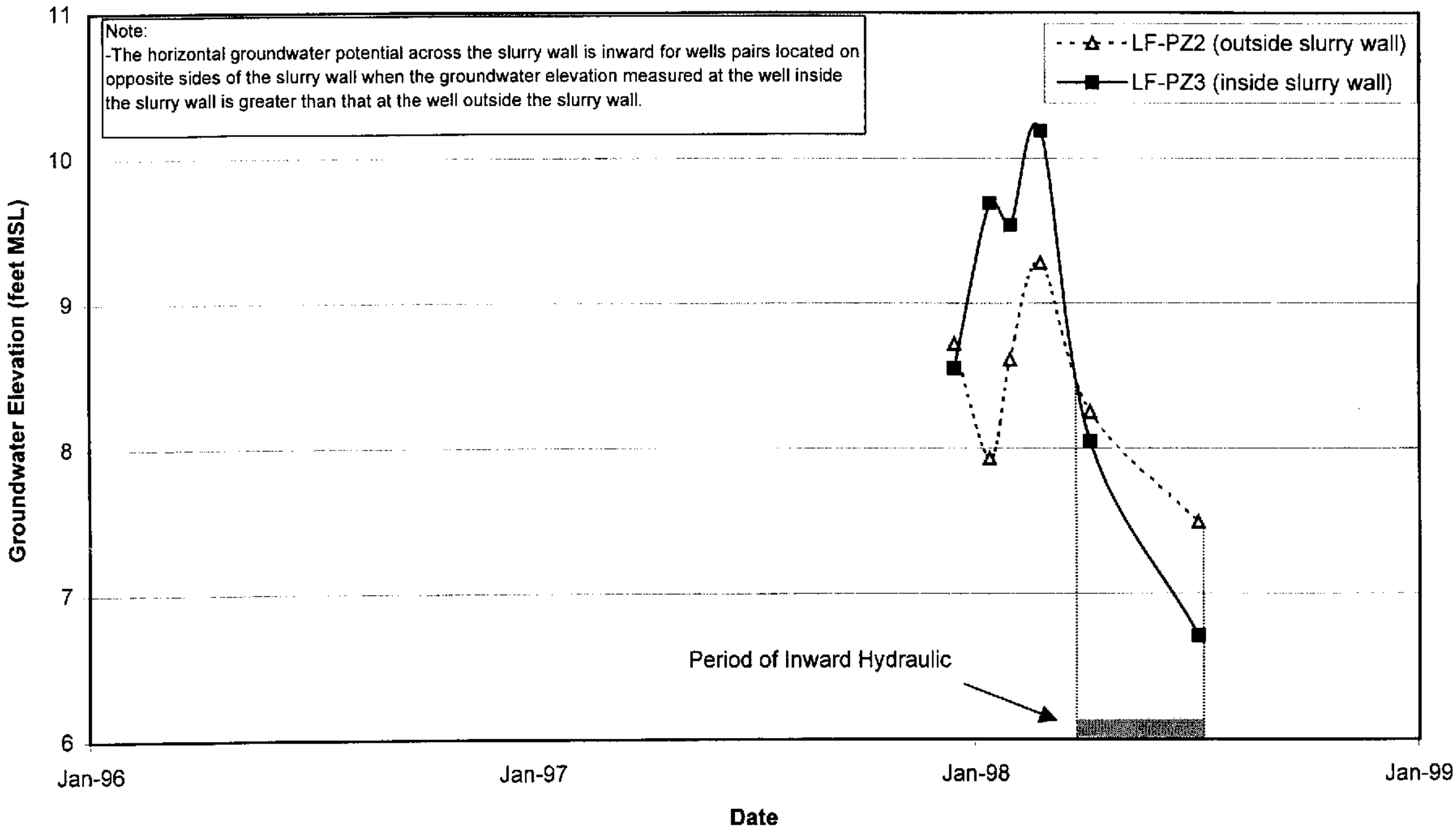
Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998

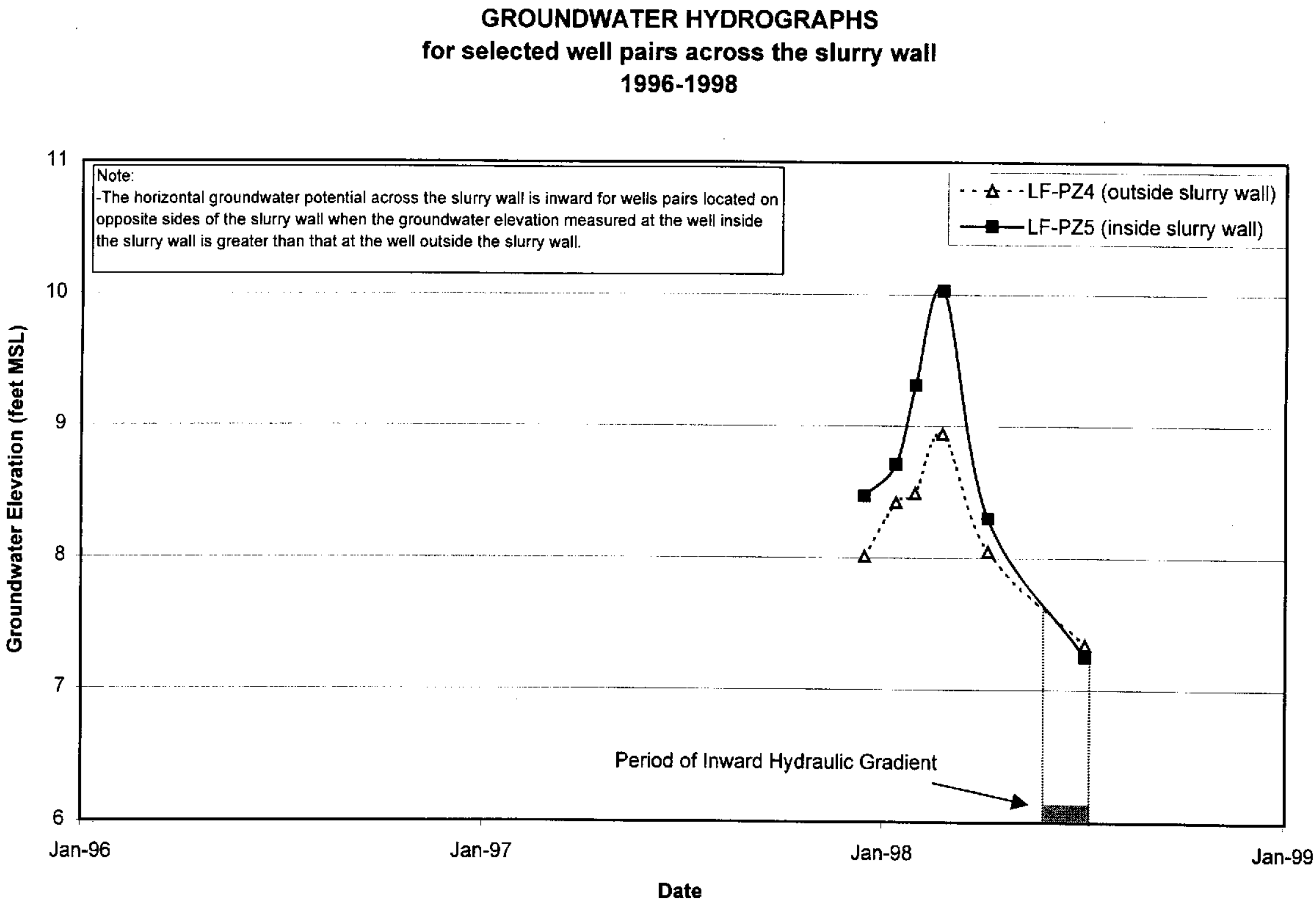


Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998

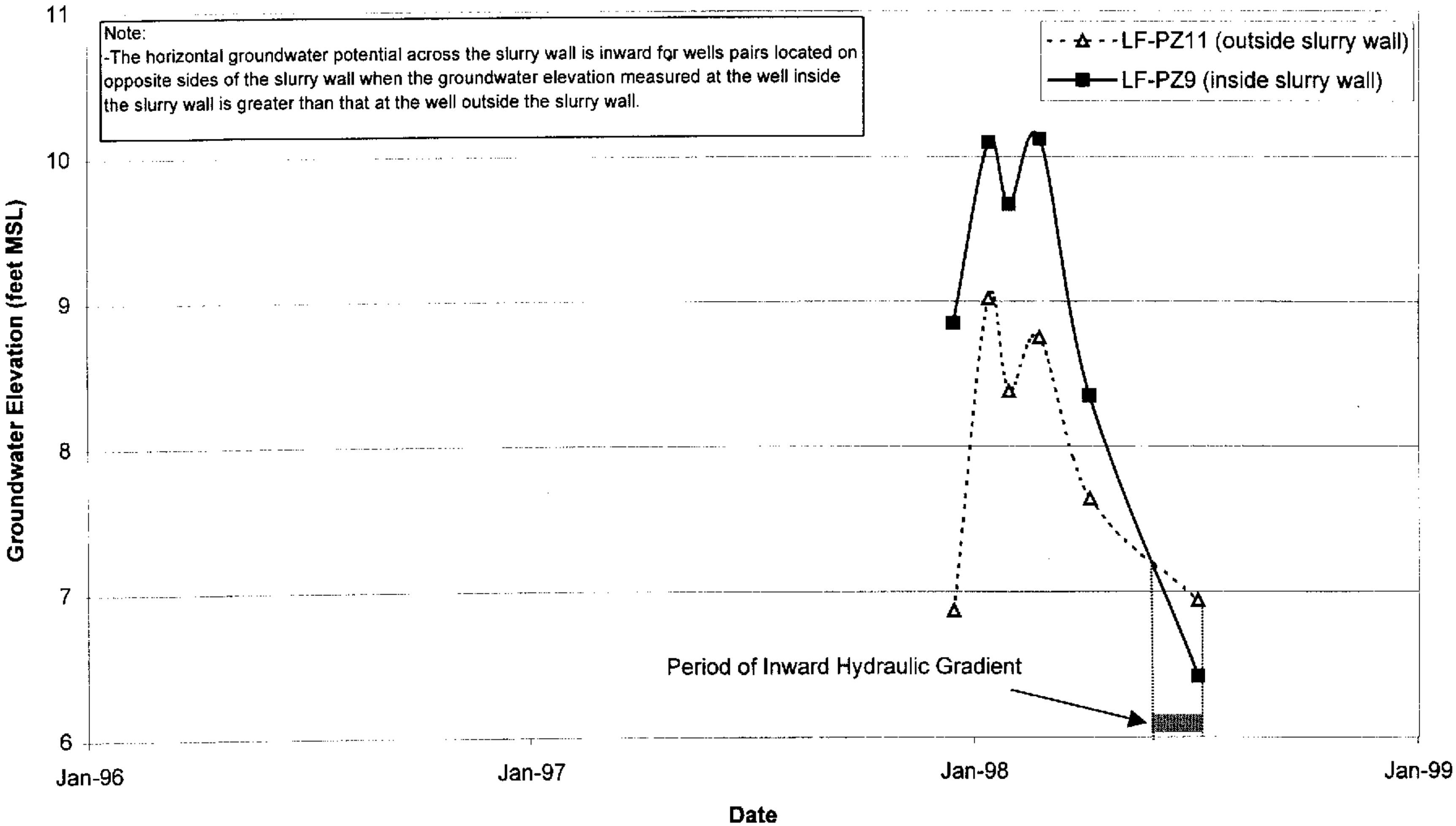


Levine·Fricke·Recon



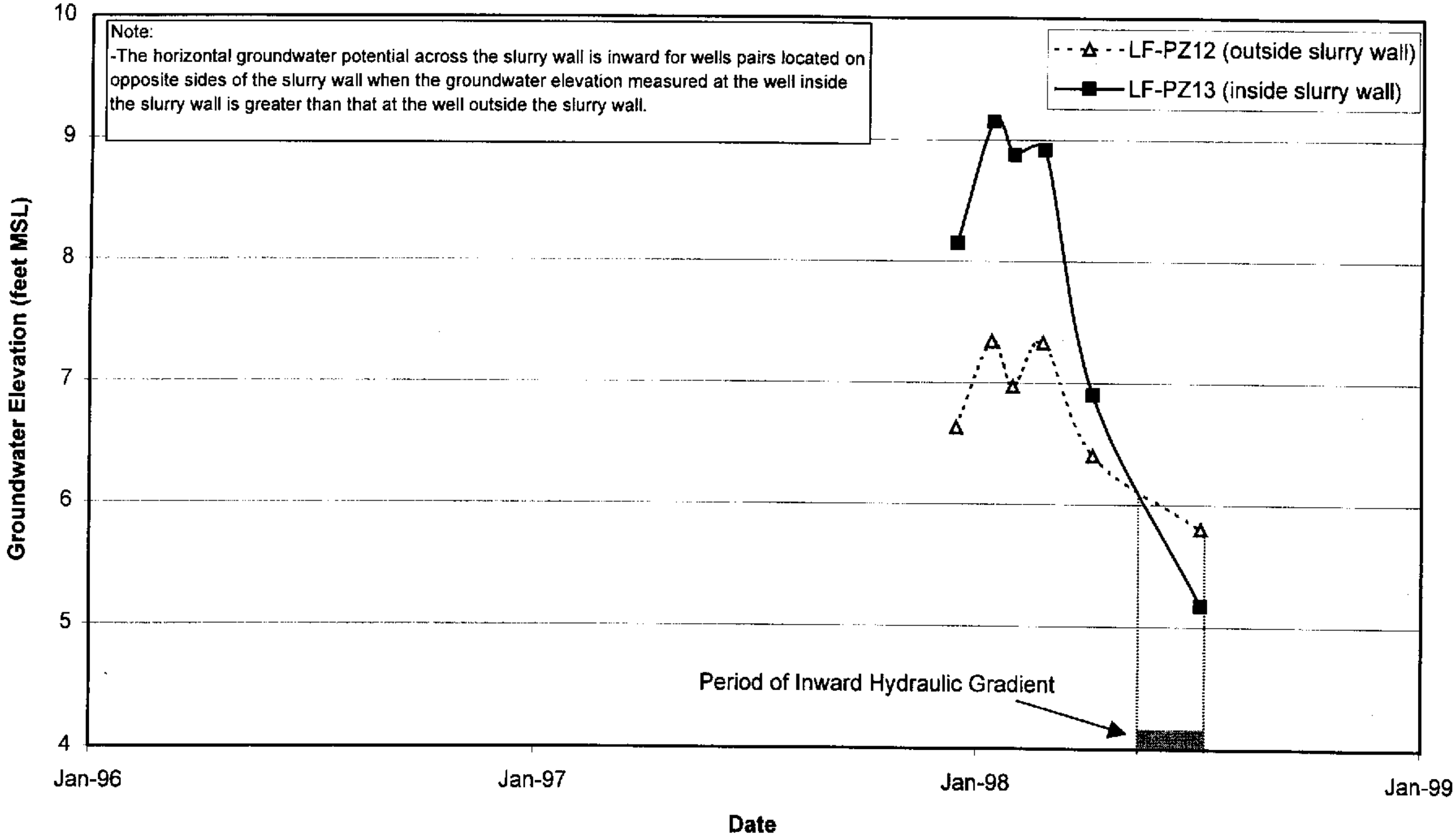
Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998



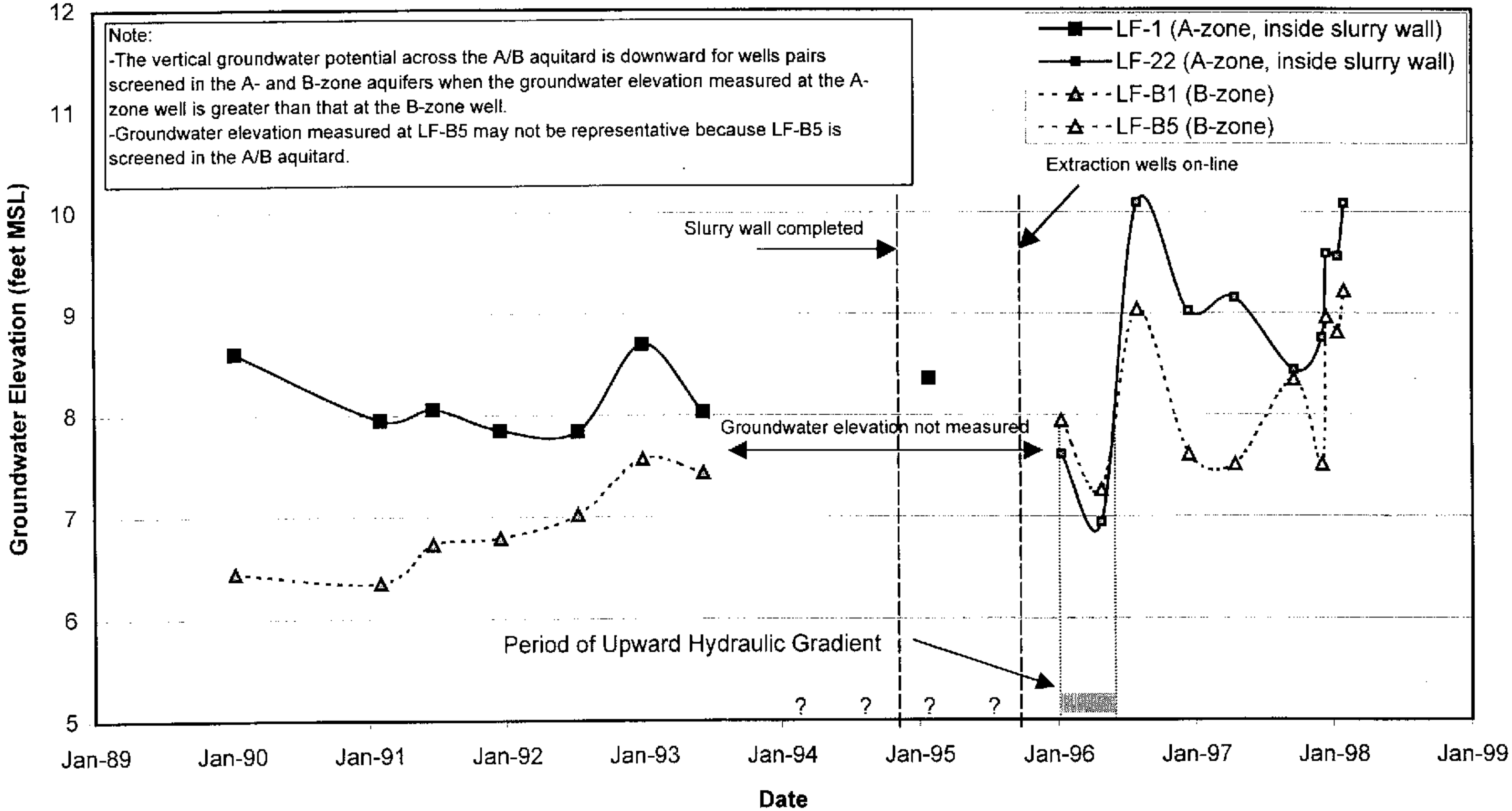
Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the slurry wall
1996-1998



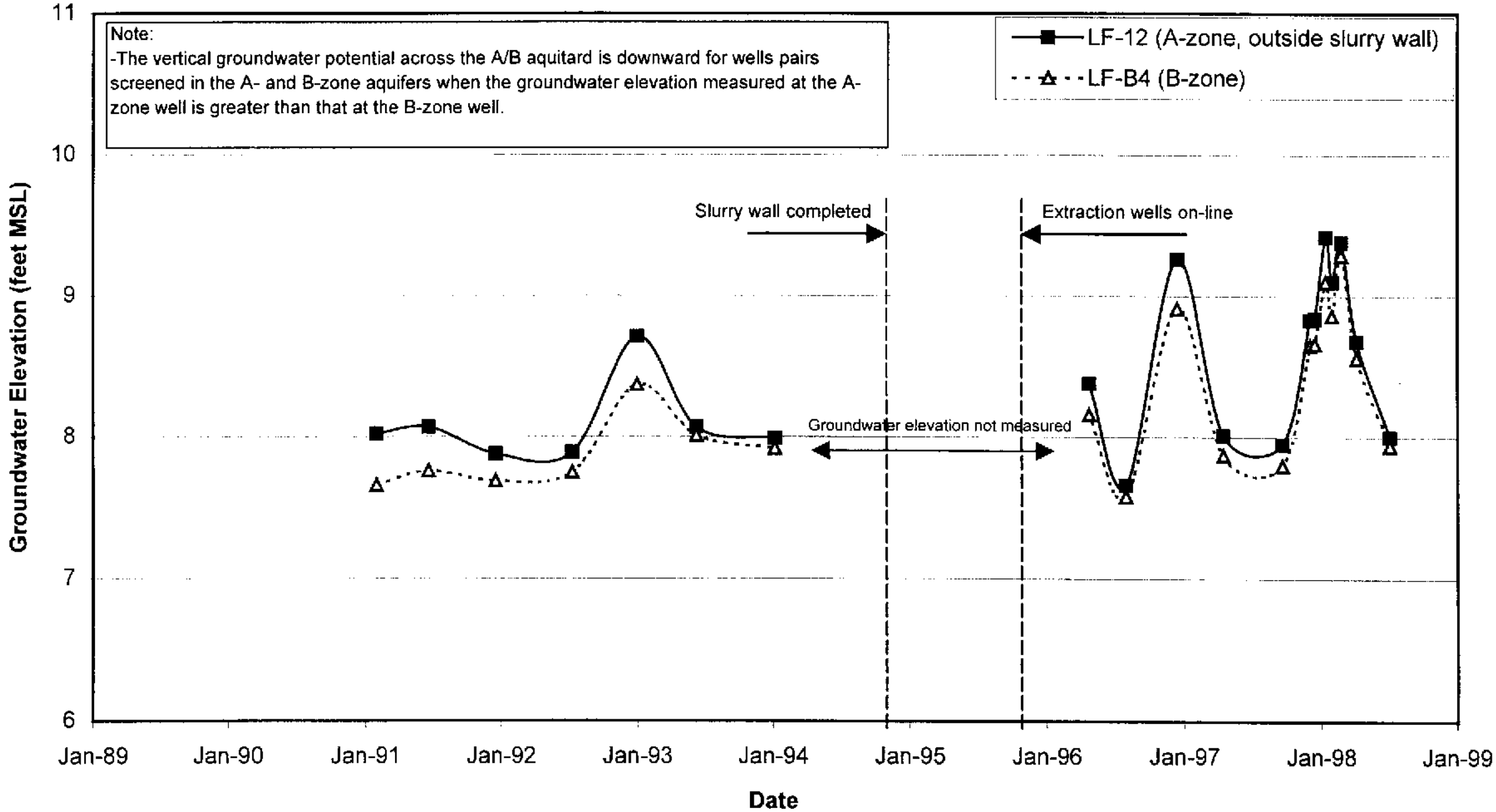
Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the A and B zone aquifers
1990-1998



Levine·Fricke·Recon

GROUNDWATER HYDROGRAPHS
for selected well pairs across the A and B zone aquifers
1990-1998

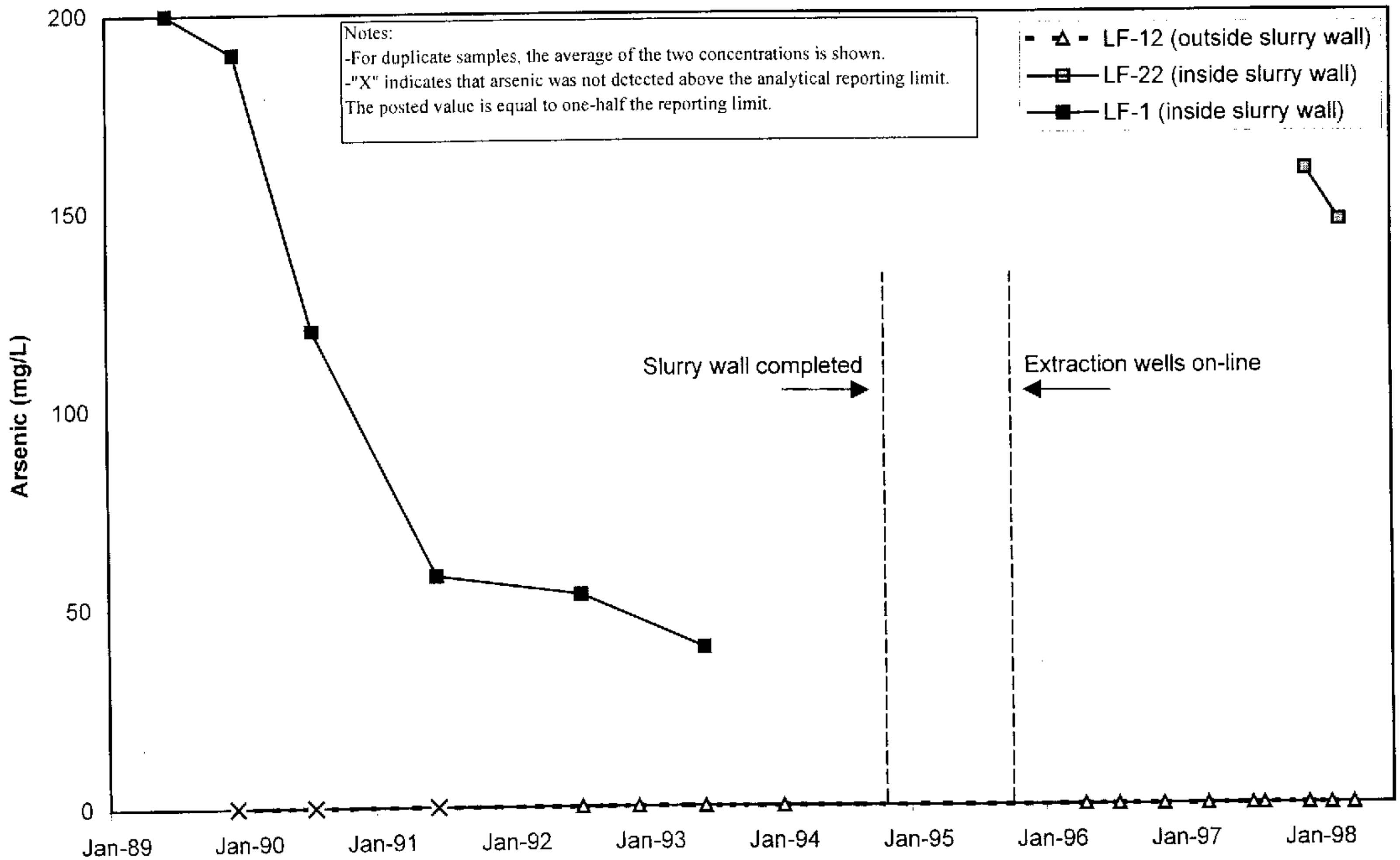


Levine·Fricke·Recon

Appendix C

Graphs of Concentrations of Arsenic in Groundwater Versus Time

Concentration of Arsenic in Groundwater
Inside (LF-1 and LF-22) and Outside (LF-12) the Slurry Wall Versus Time
Sherwin Williams, Emeryville, CA



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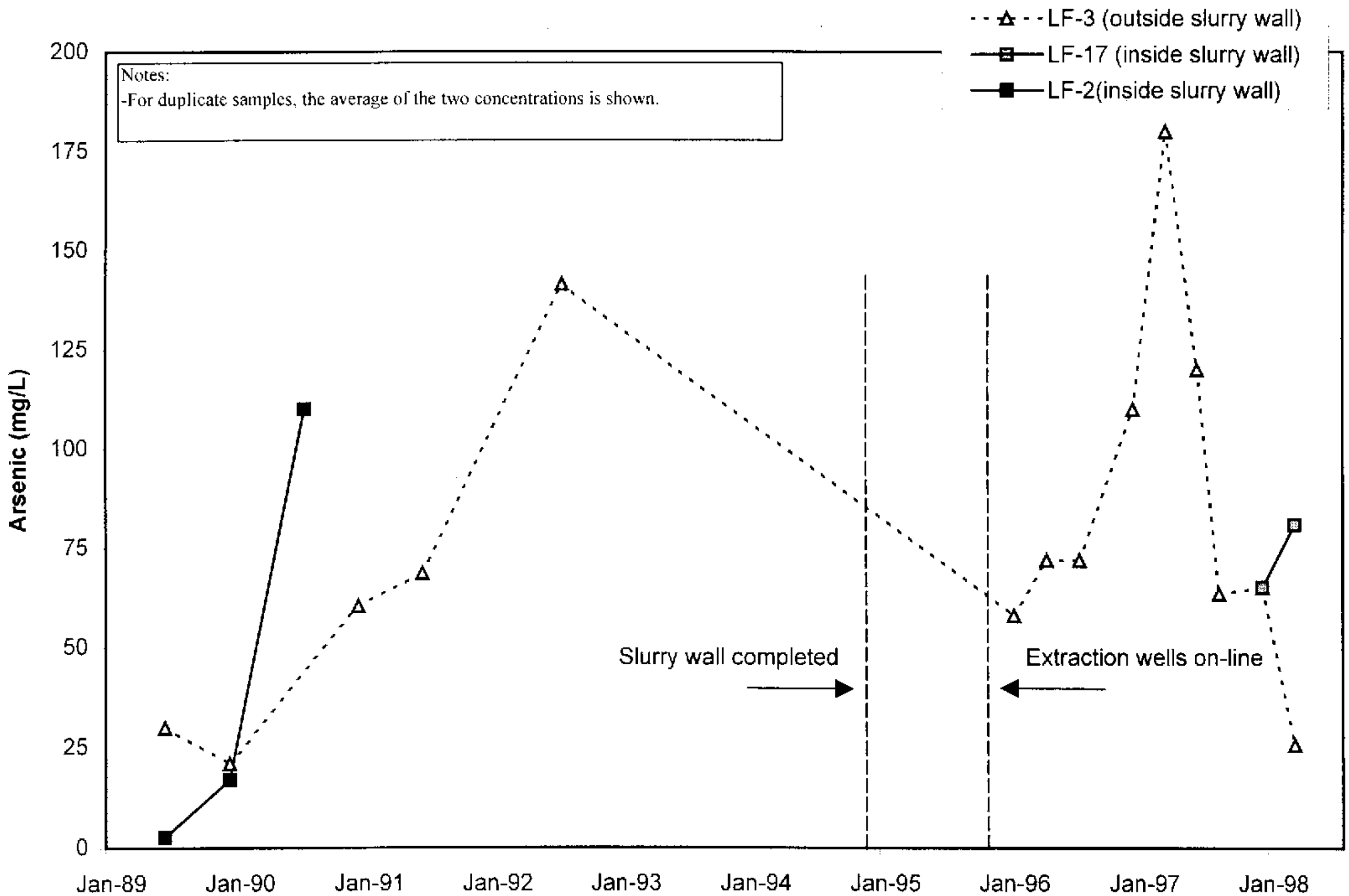
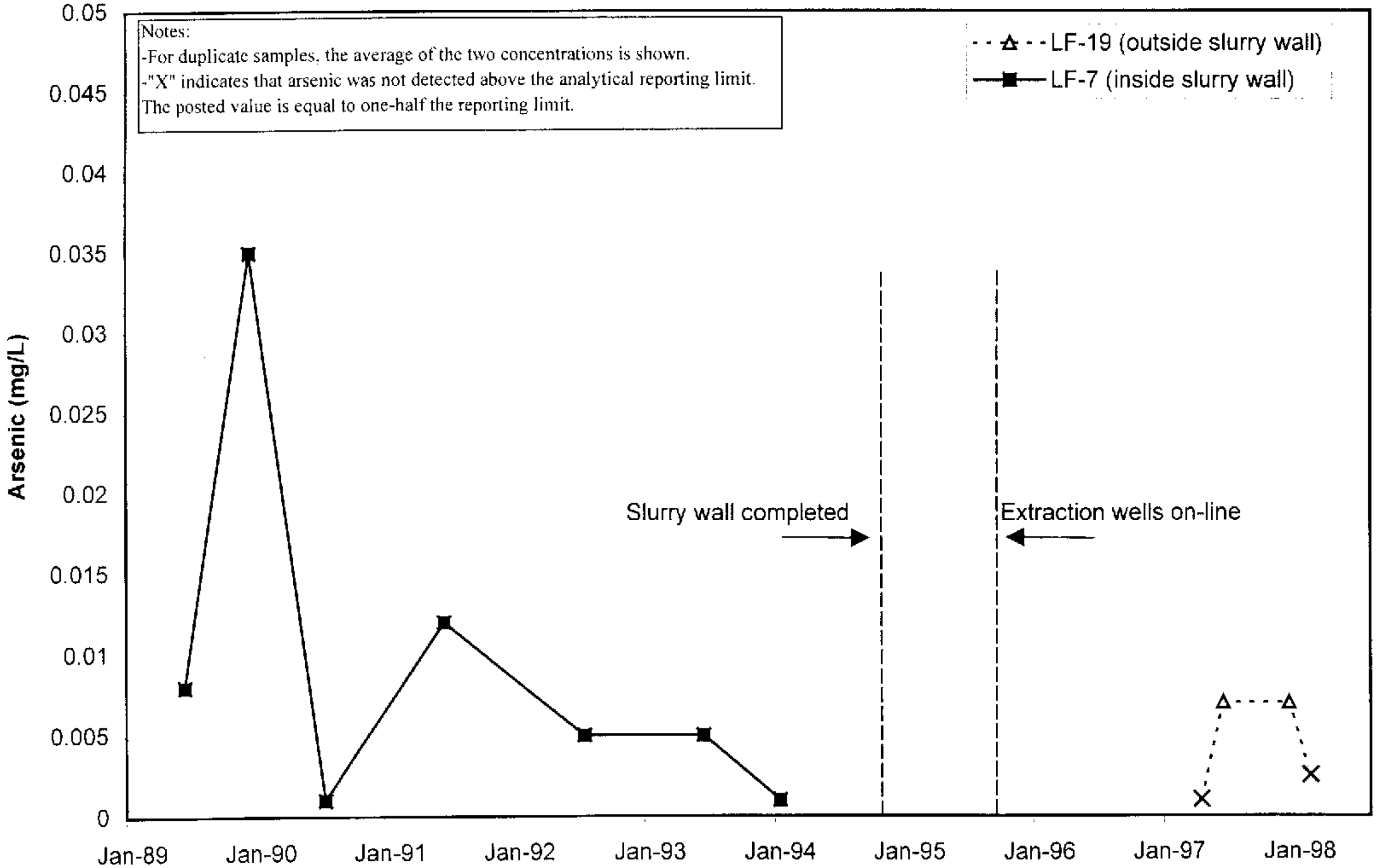
Concentration of Arsenic in Groundwater
Inside (LF-2 and LF-17) and Outside (LF-3) the Slurry Wall Versus Time
Sherwin Williams, Emeryville, CA



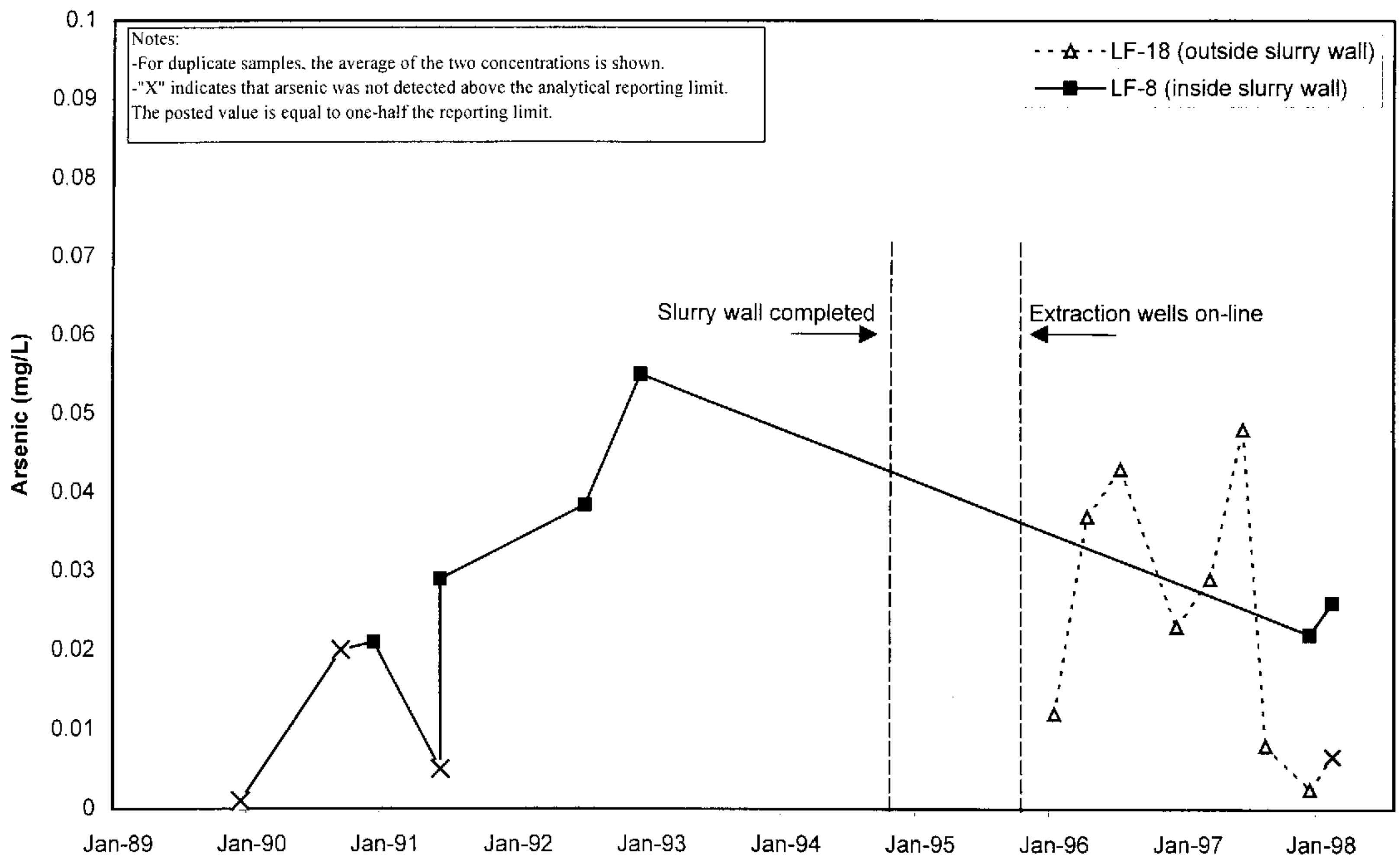
Levine·Fricke·Recon

Concentration of Arsenic in Groundwater
Inside (LF-7) and Outside (LF-19) the Slurry Wall Versus Time
Sherwin Williams, Emeryville, CA



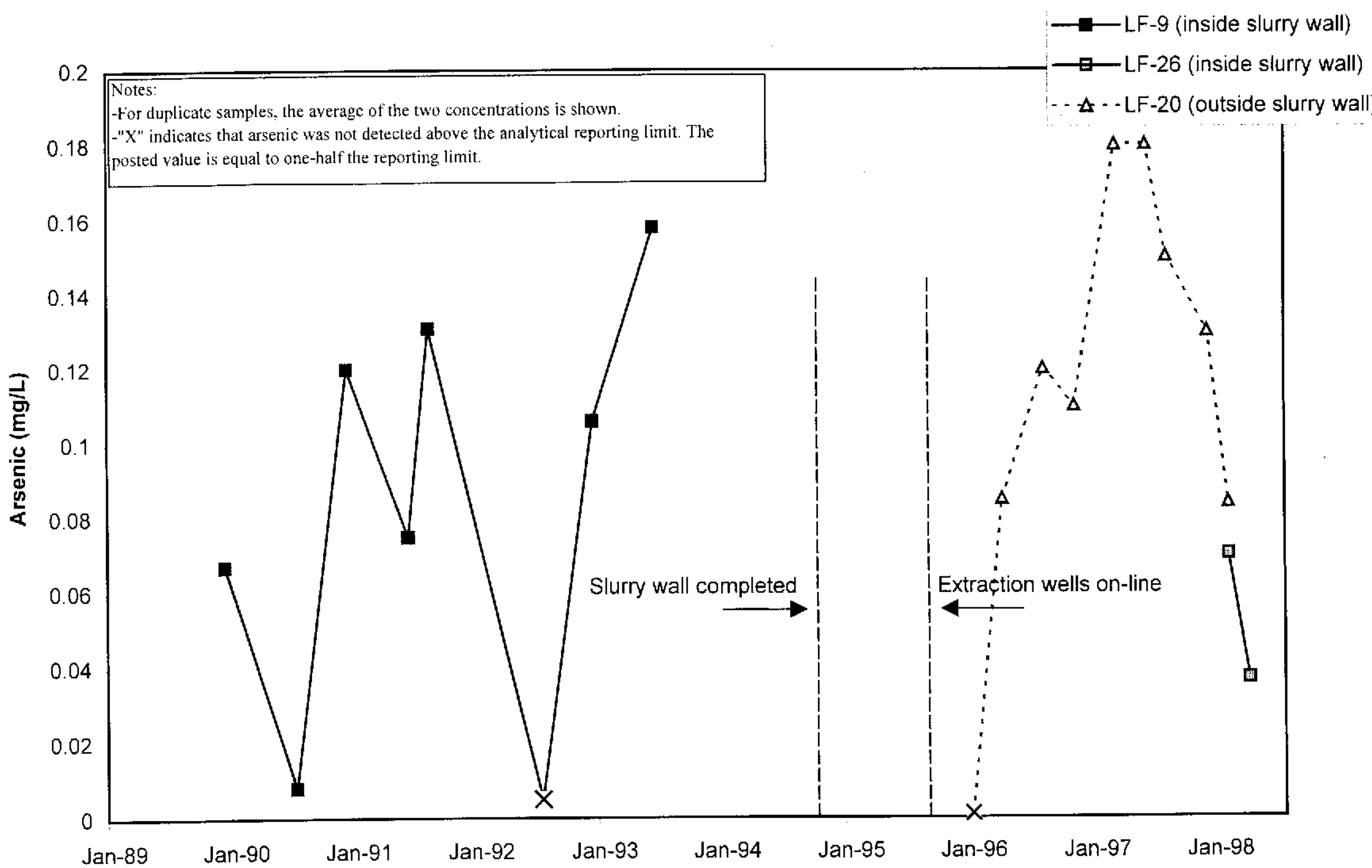
Levine·Fricke·Recon

Concentration of Arsenic in Groundwater
Inside (LF-8) and Outside (LF-18) the Slurry Wall Versus Time
Sherwin Williams, Emeryville, CA



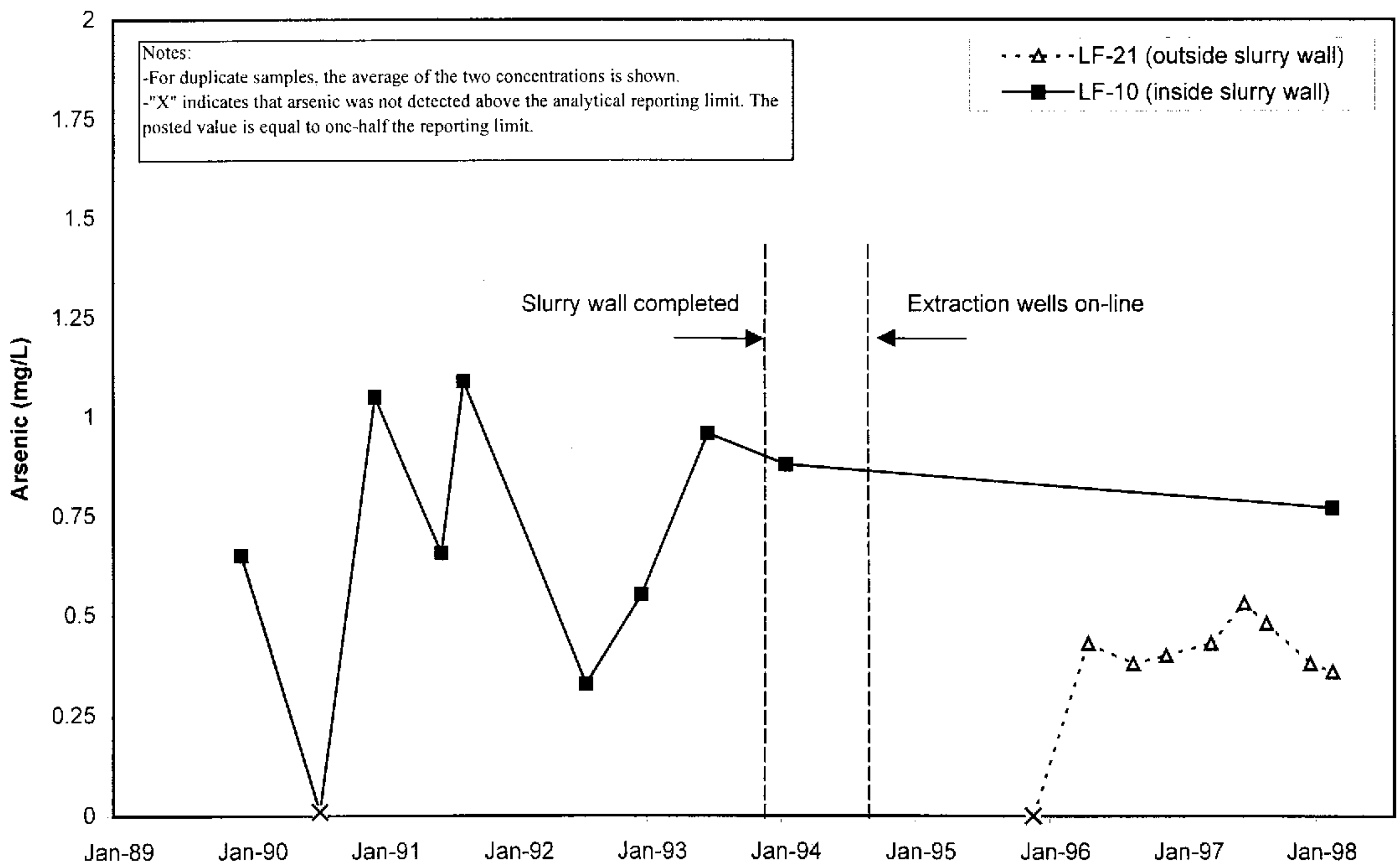
Levine·Fricke·Recon

Concentration of Arsenic in Groundwater
Inside (LF-9 and LF-26) and Outside (LF-20) the Slurry Wall Versus Time
Sherwin Williams, Emeryville, CA

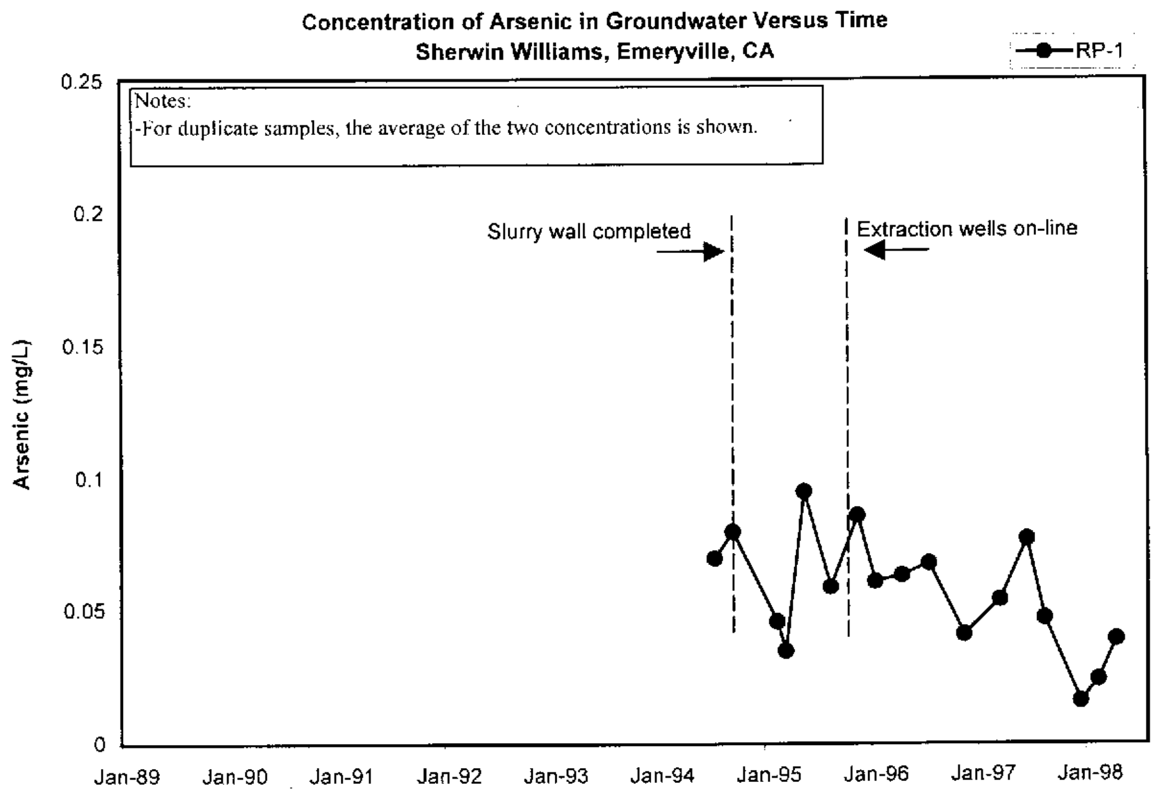


Levine·Fricke·Recon

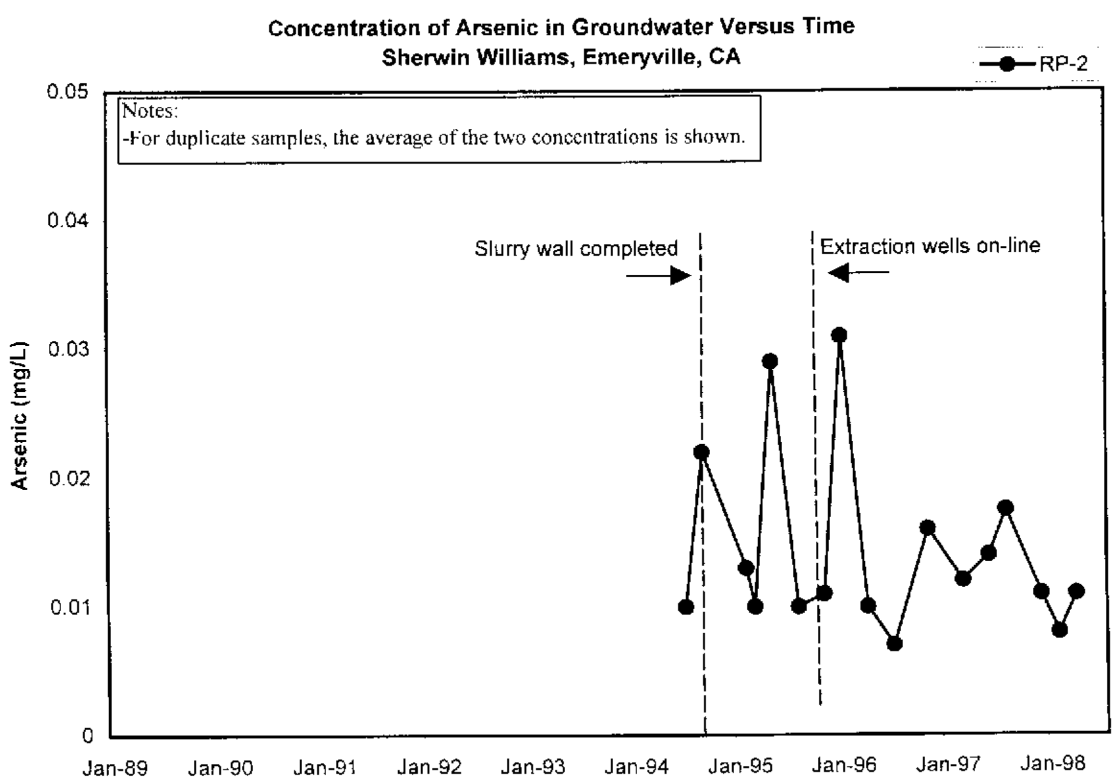
Concentration of Arsenic in Groundwater
Inside (LF-10) and Outside (LF-21) the Slurry Wall Versus Time
Sherwin Williams, Emeryville, CA



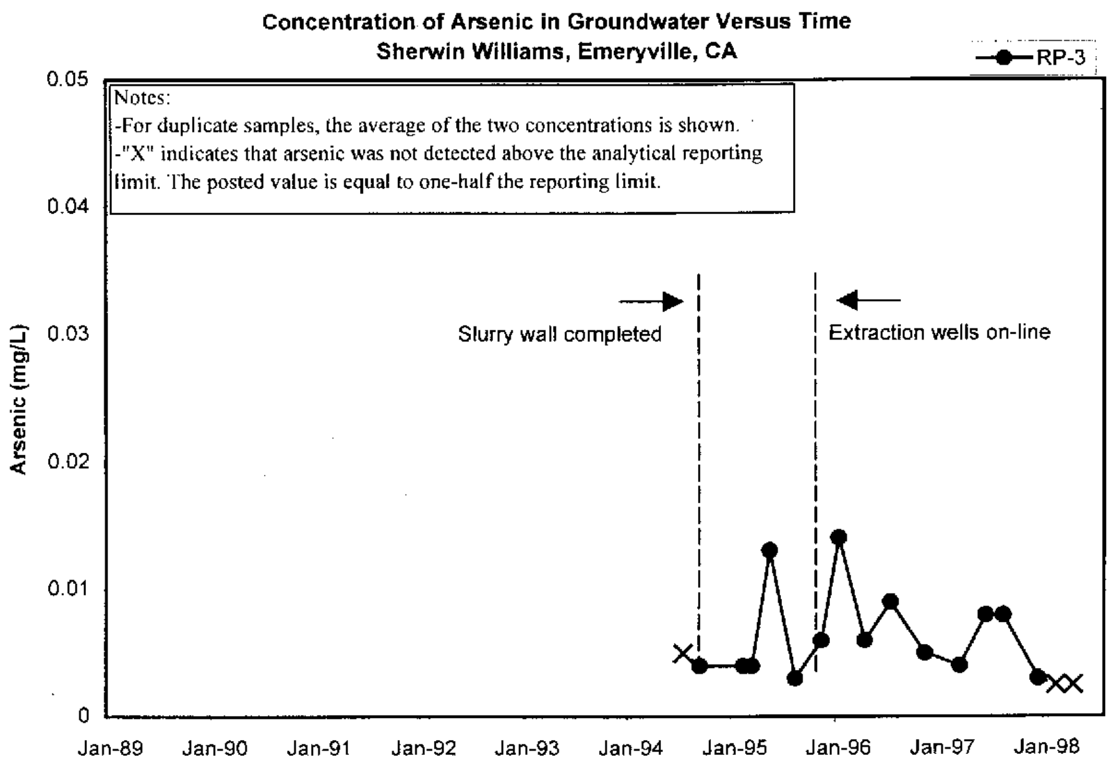
Levine·Fricke·Recon

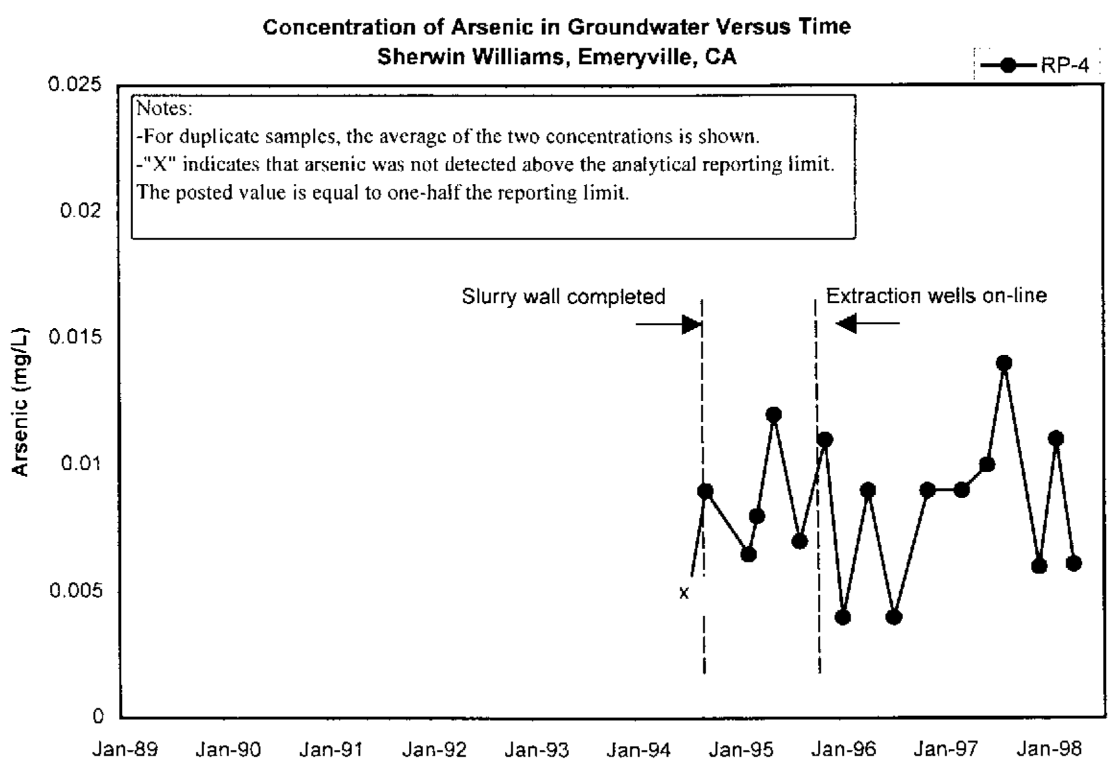


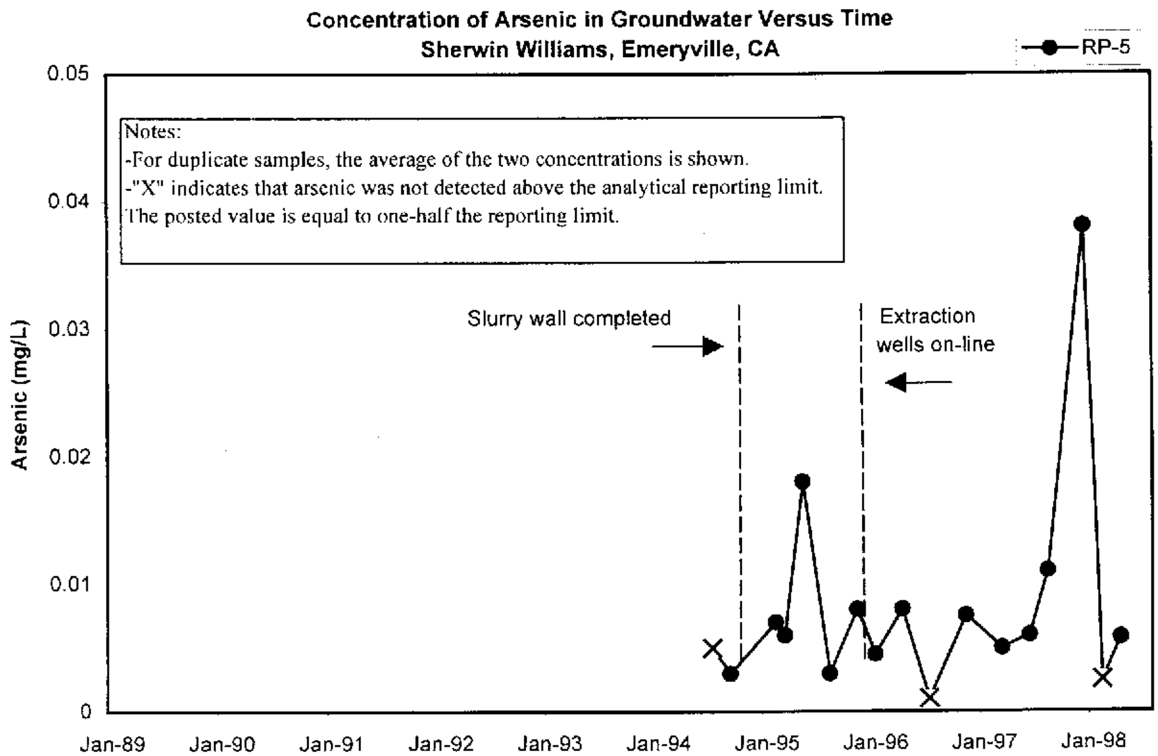
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
RP-1
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.25
0.2
0.15
0.1
0.05
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



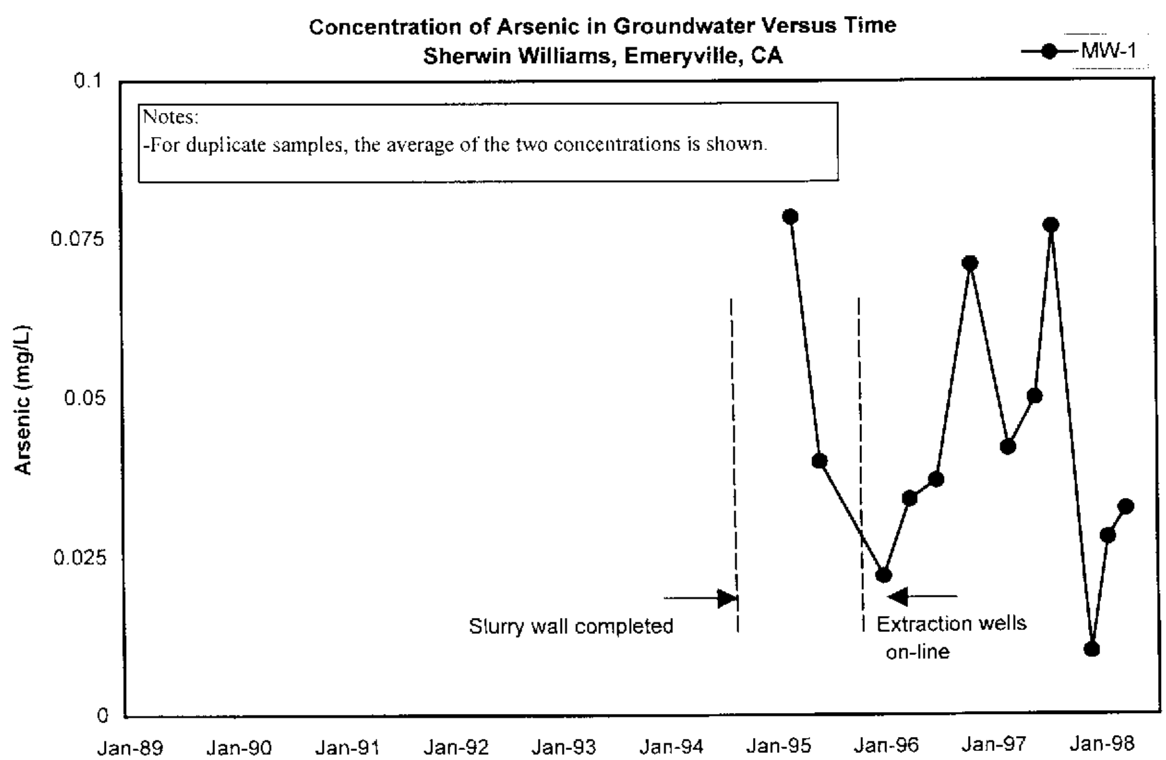
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
RP-2
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.05
0.04
0.03
0.02
0.01
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98


Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
RP-3
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.05
0.04
0.03
0.02
0.01
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

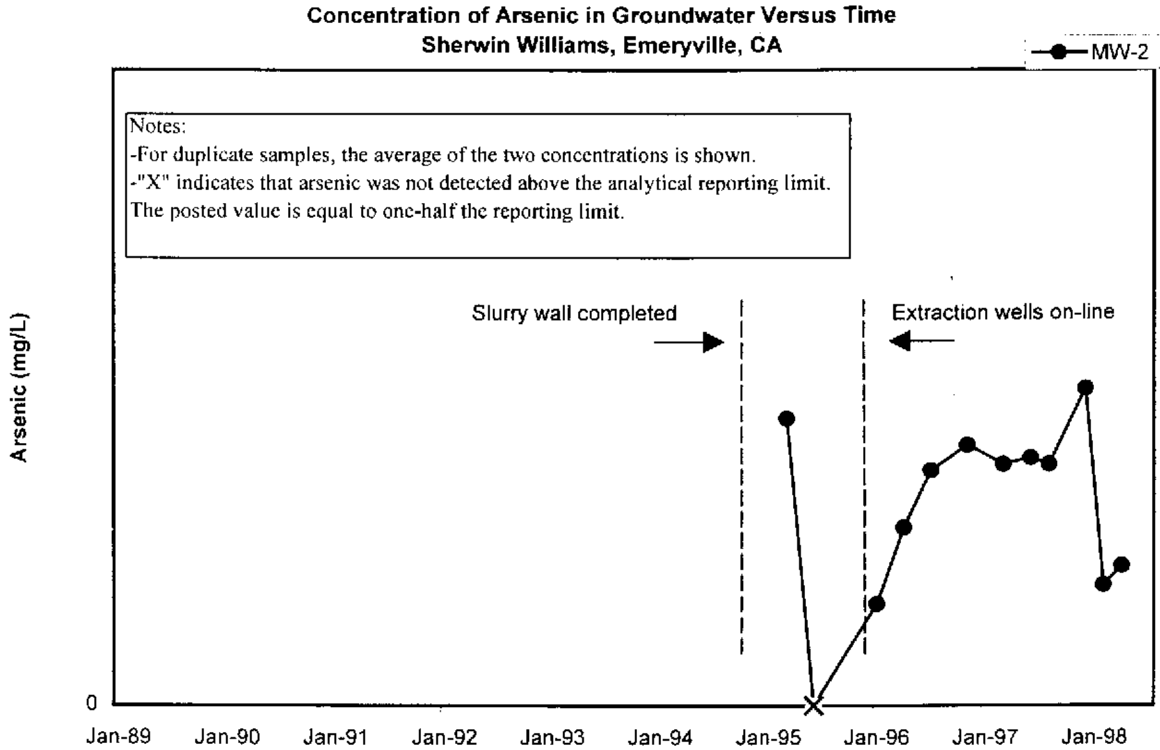

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
RP-4
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
x
Arsenic (mg/L)
0.025
0.02
0.015
0.01
0.005
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

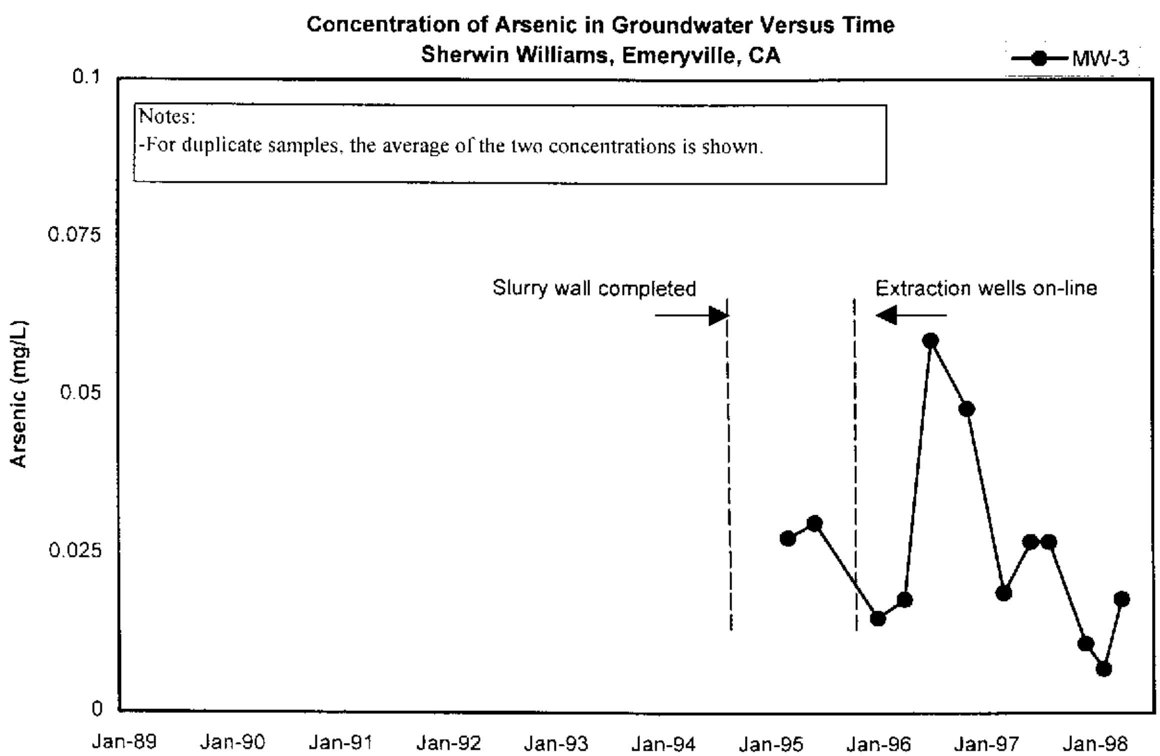


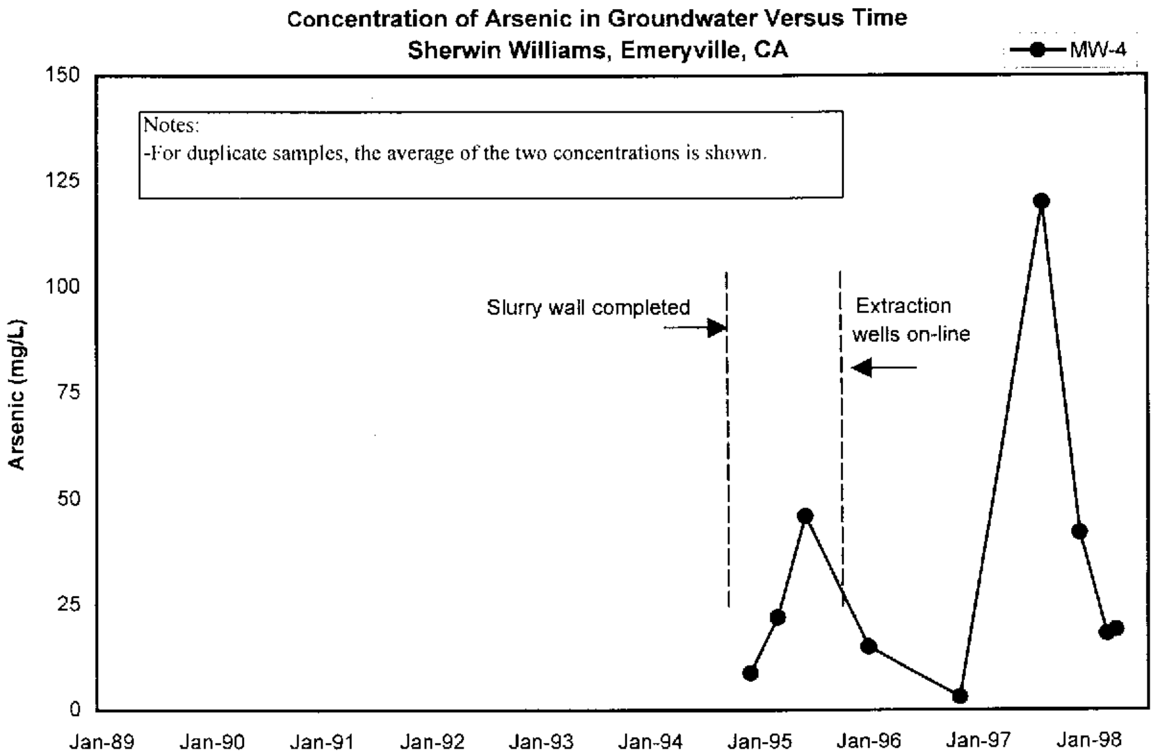
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
RP-5
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.05
0.04
0.03
0.02
0.01
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

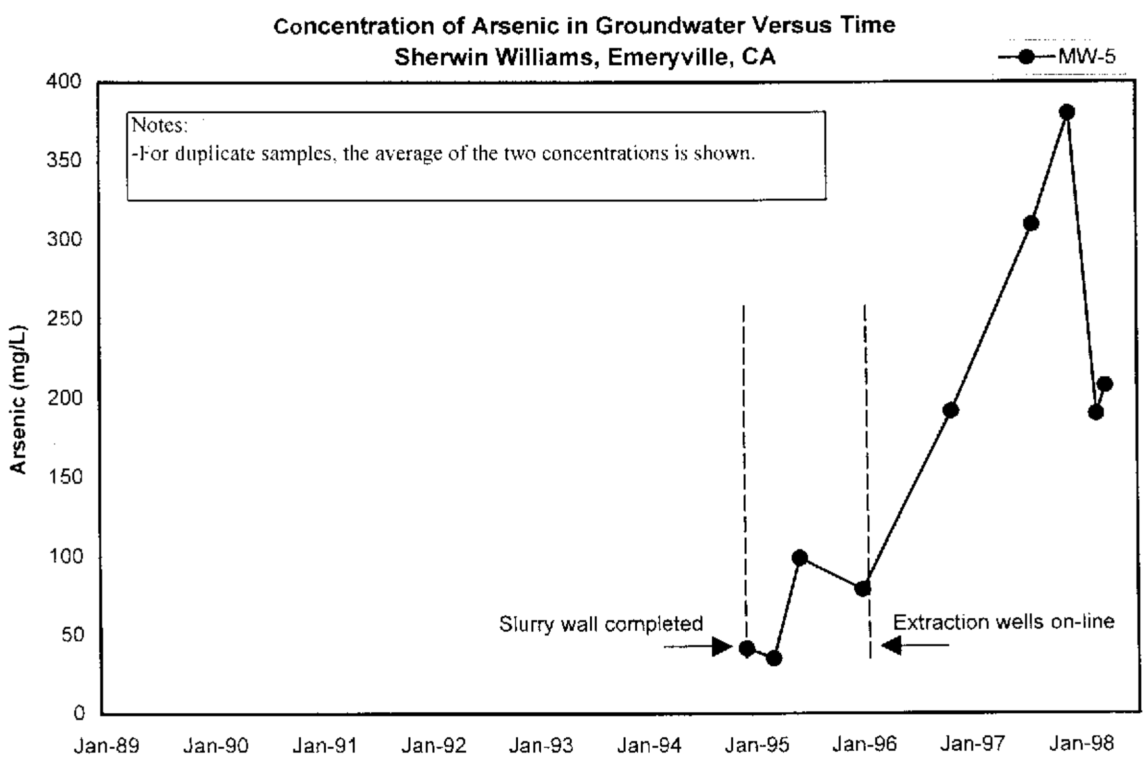


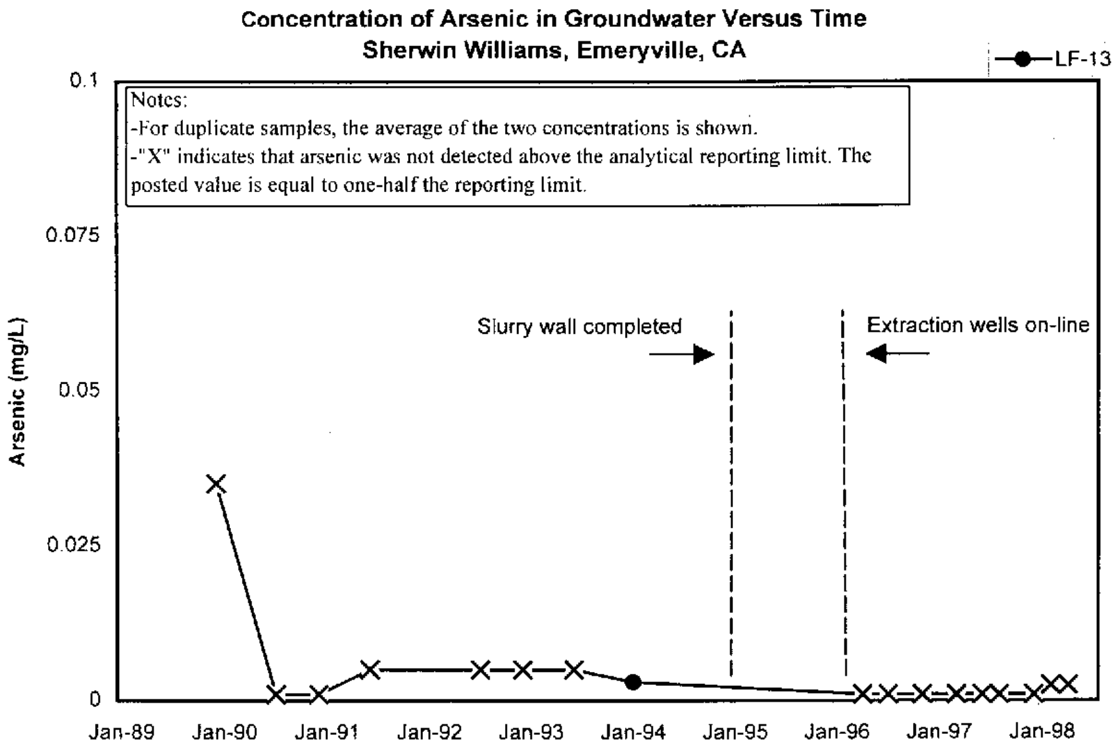
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
MW-1
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.1
0.075
0.05
0.025
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

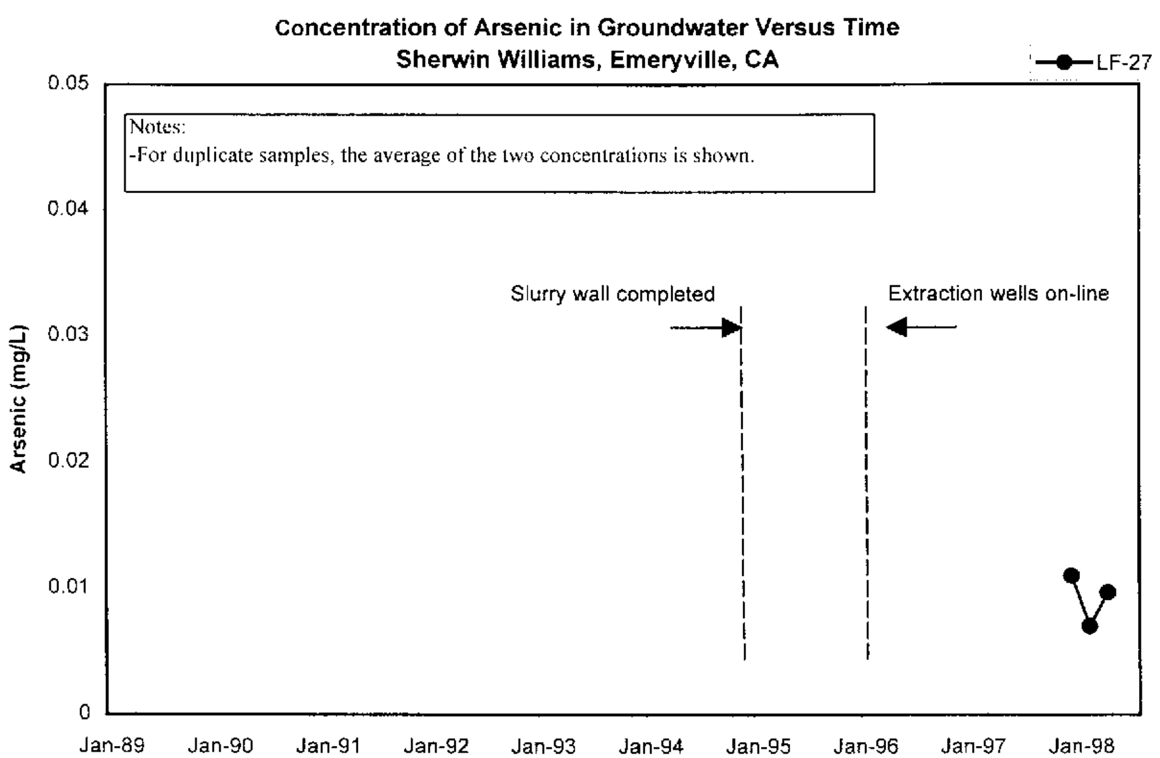

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
MW-2
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

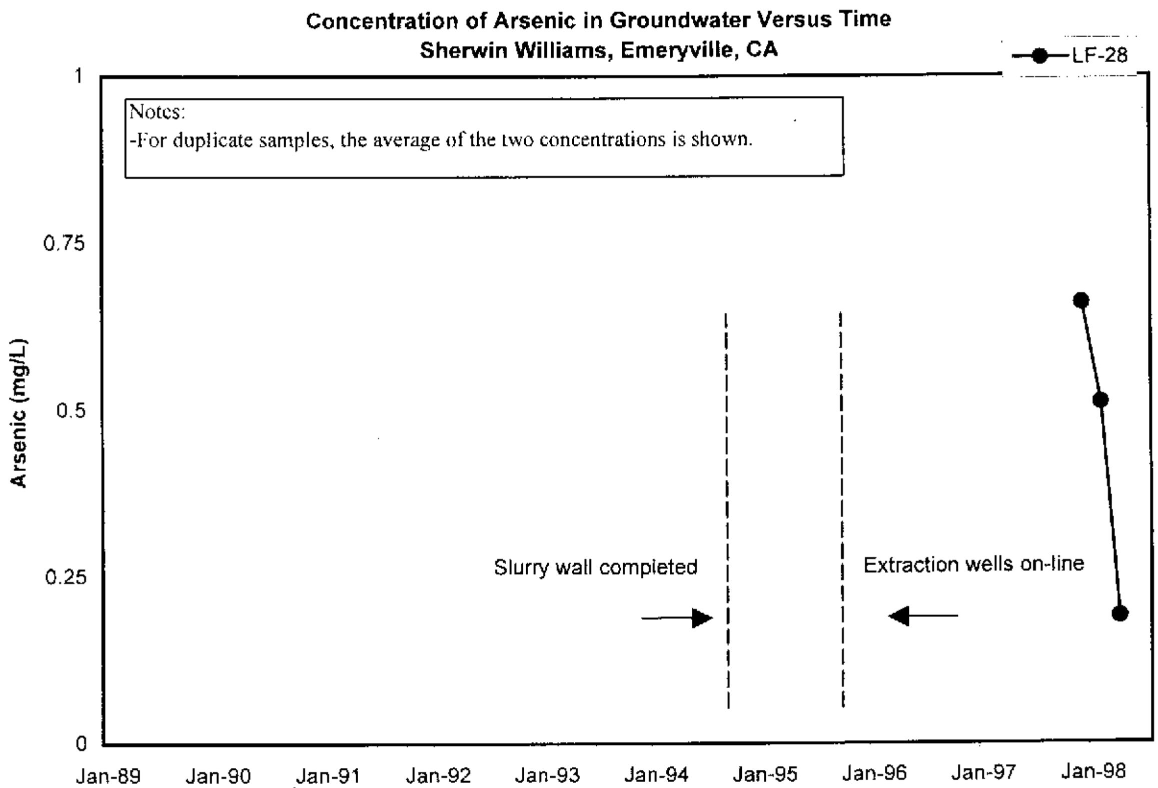

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
MW-3
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.1
0.075
0.05
0.025
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

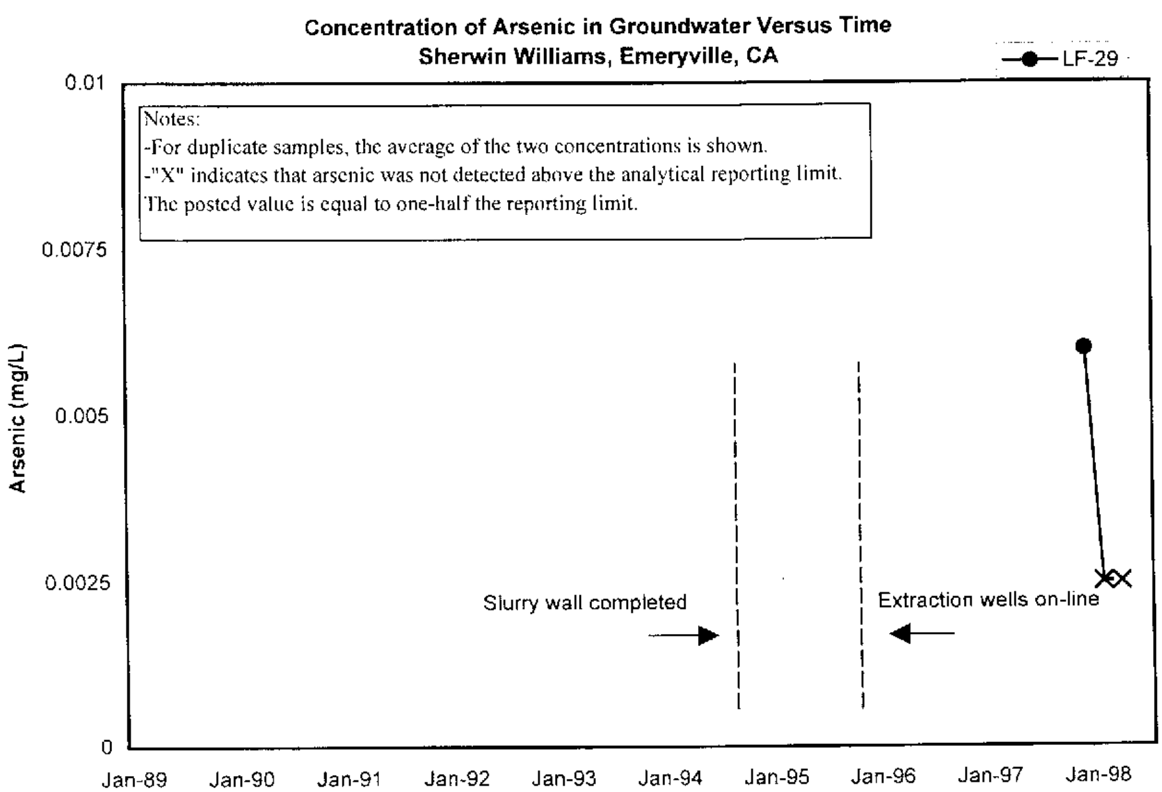

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
MW-4
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0
25
50
75
100
125
150
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

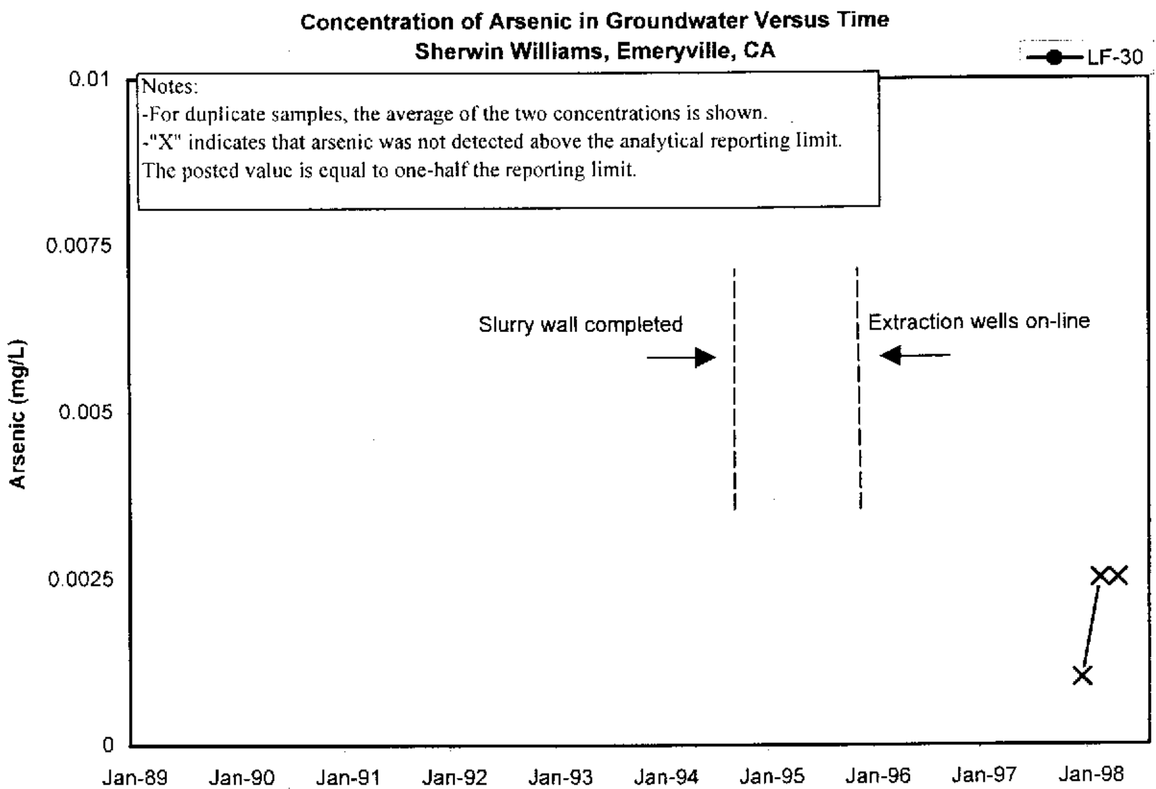

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
MW-5
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0
50
100
150
200
250
300
350
400
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98


Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-13
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.1
0.075
0.05
0.025
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

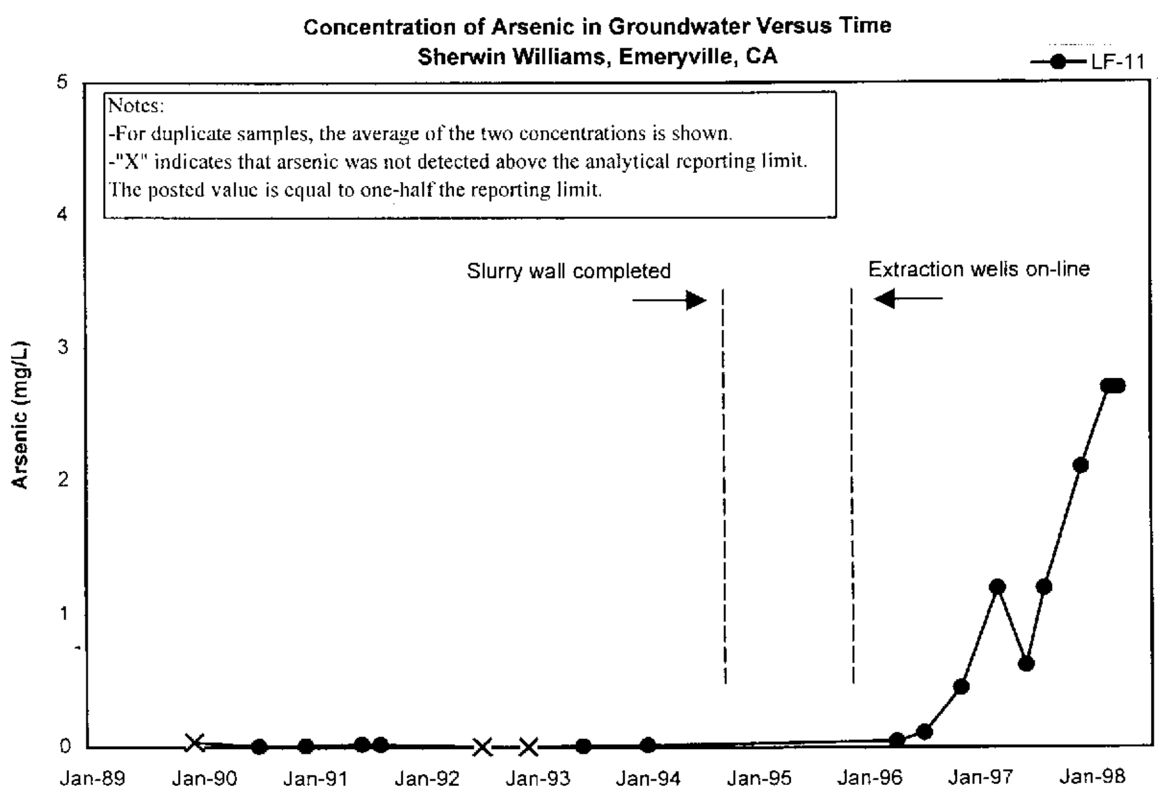

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-27
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.05
0.04
0.03
0.02
0.01
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98


Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-28
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Arsenic (mg/L)
1
0.75
0.5
0.25
0
Slurry wall completed
Extraction wells on-line
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

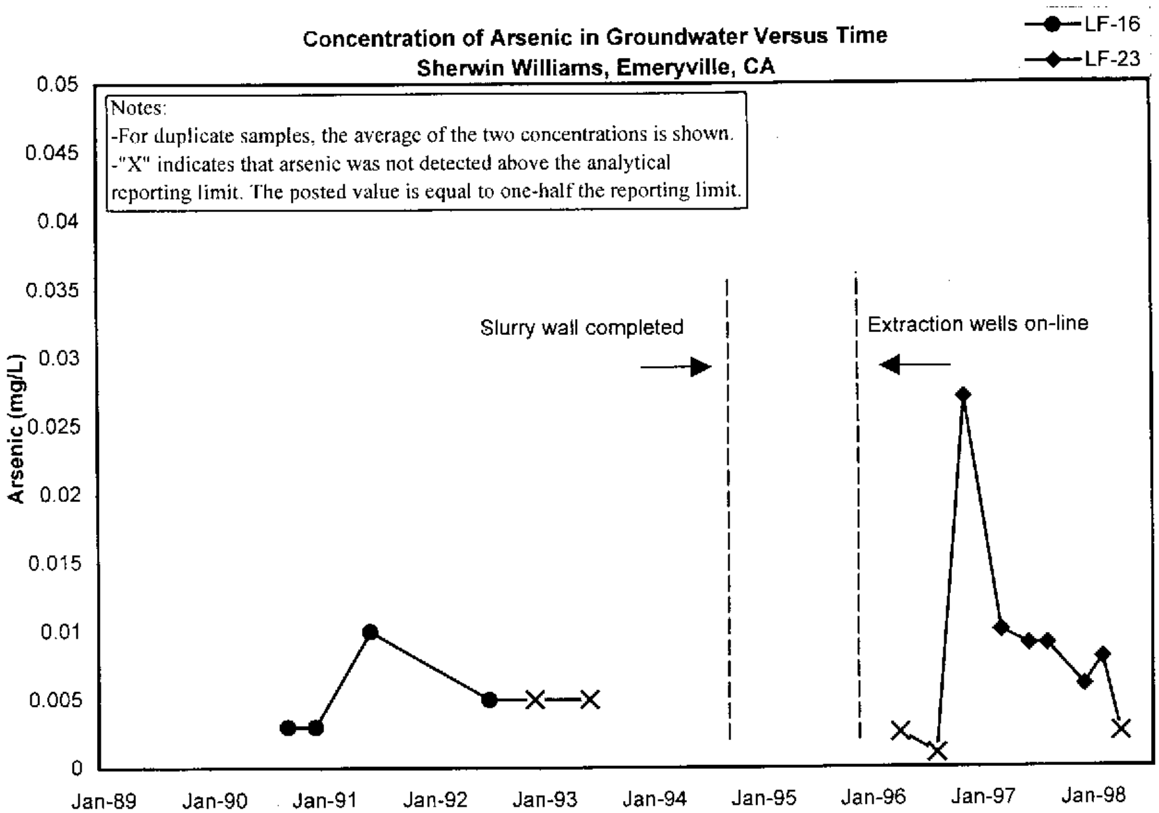

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-29
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Arsenic (mg/L)
0.01
0.0075
0.005
0.0025
0
Slurry wall completed
Extraction wells on-line
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



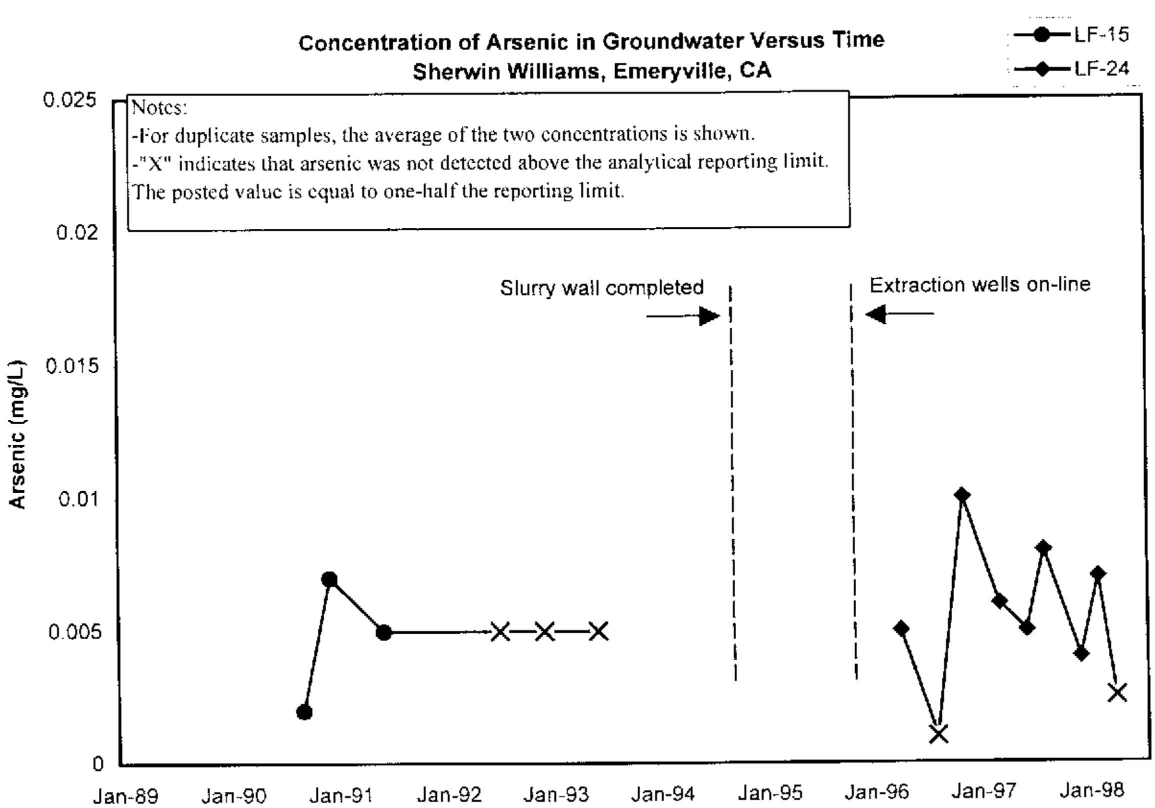
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-30
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.01
0.0075
0.005
0.0025
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



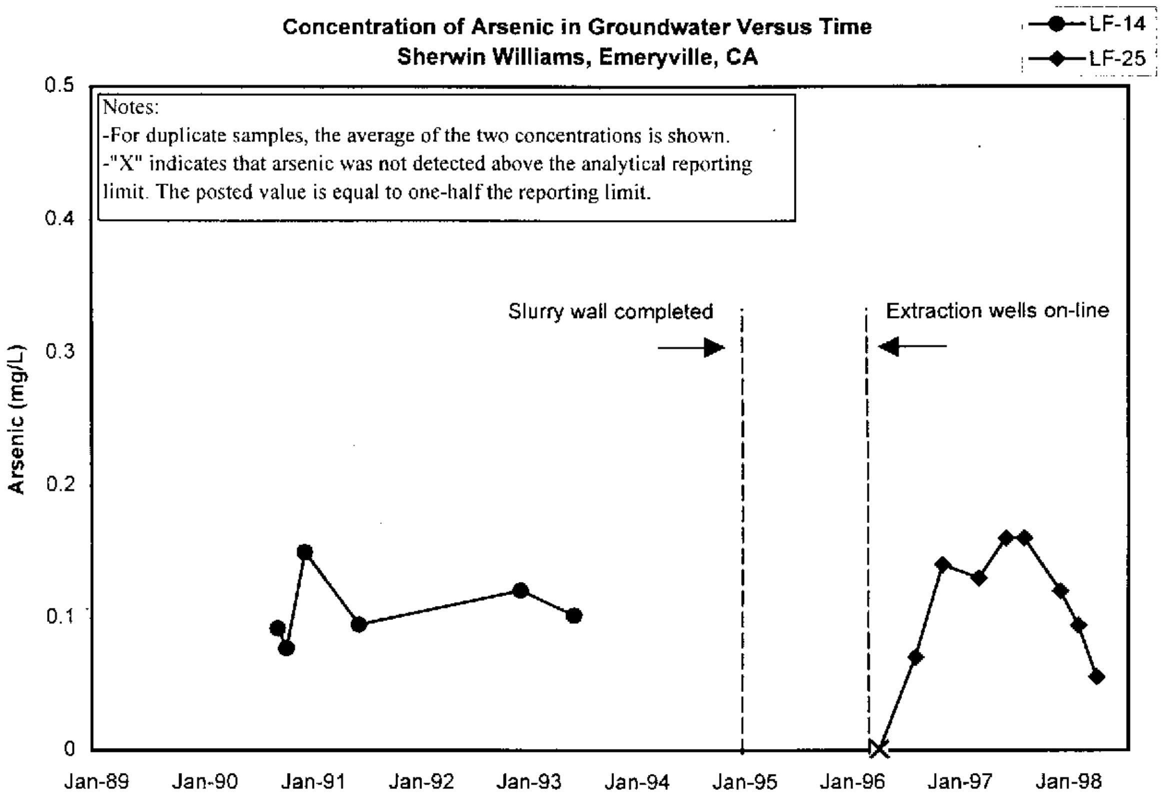
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-11
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
5
4
3
2
1
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



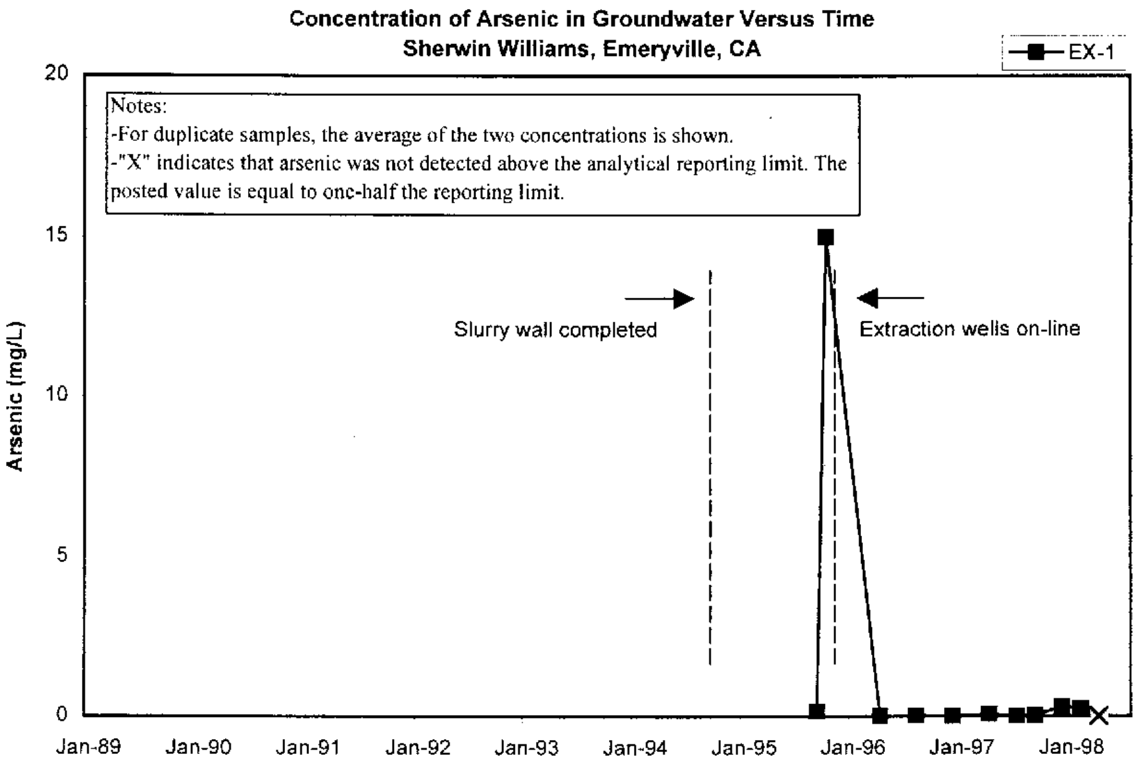
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-16
LF-23
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

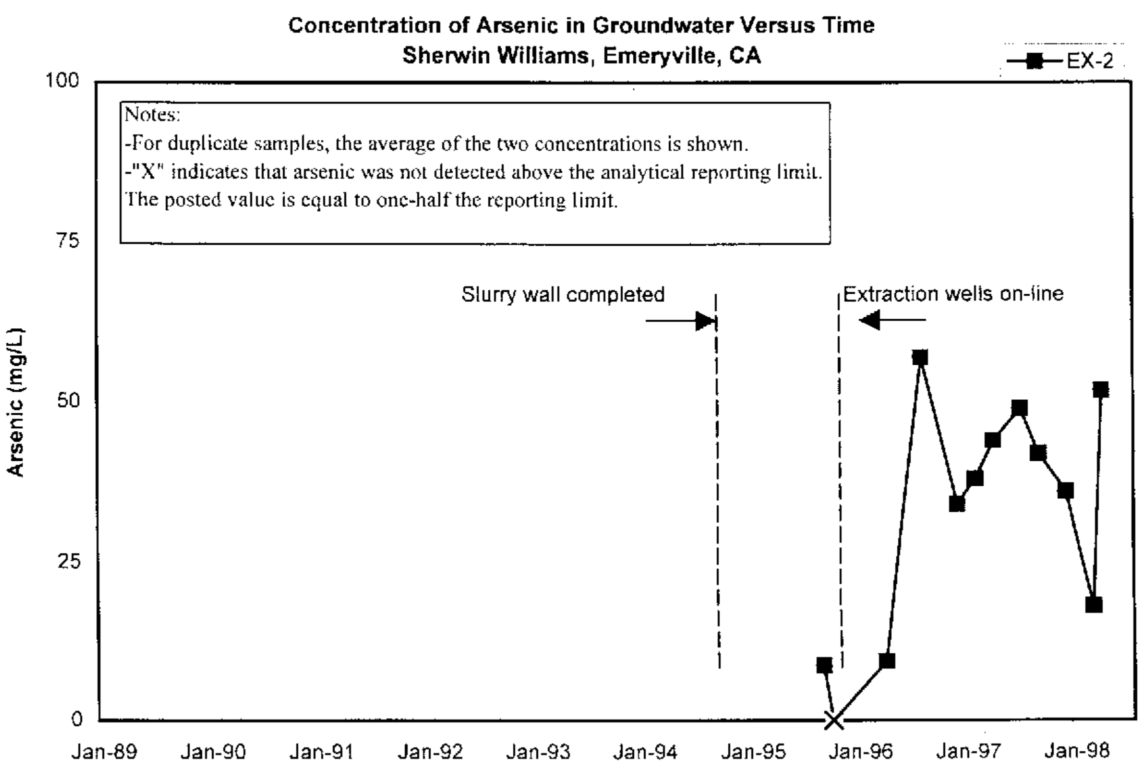


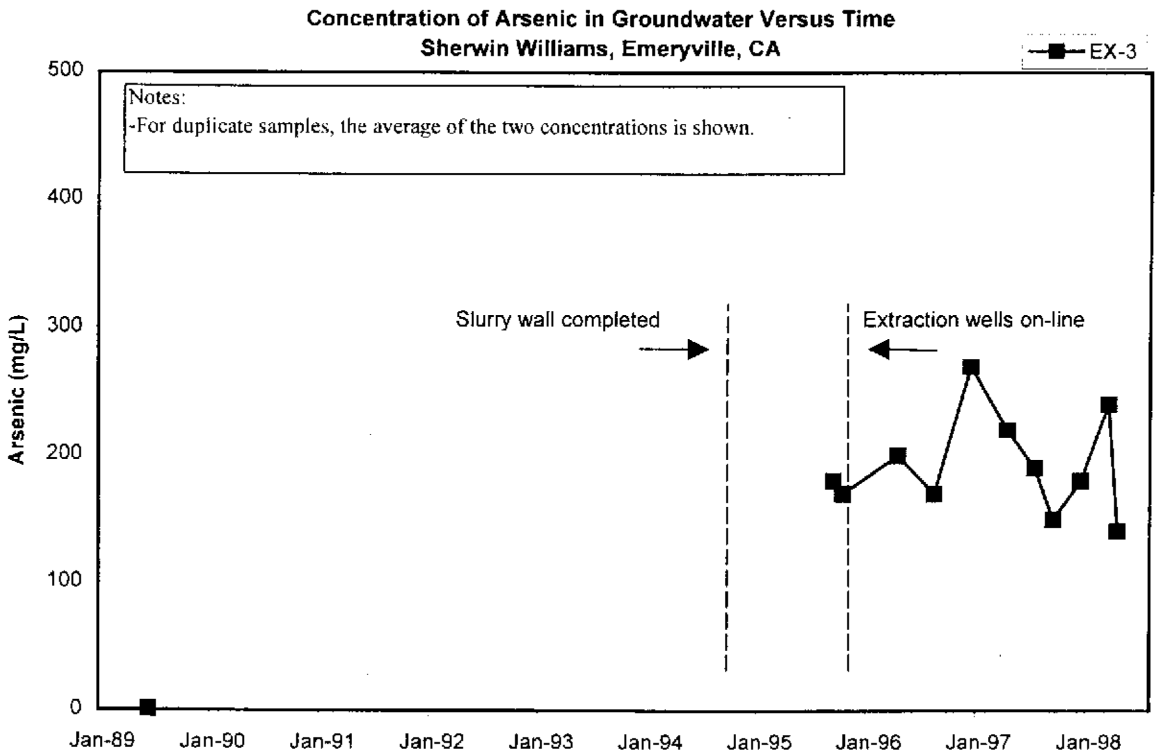
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-15
LF-24
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.025
0.02
0.015
0.01
0.005
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



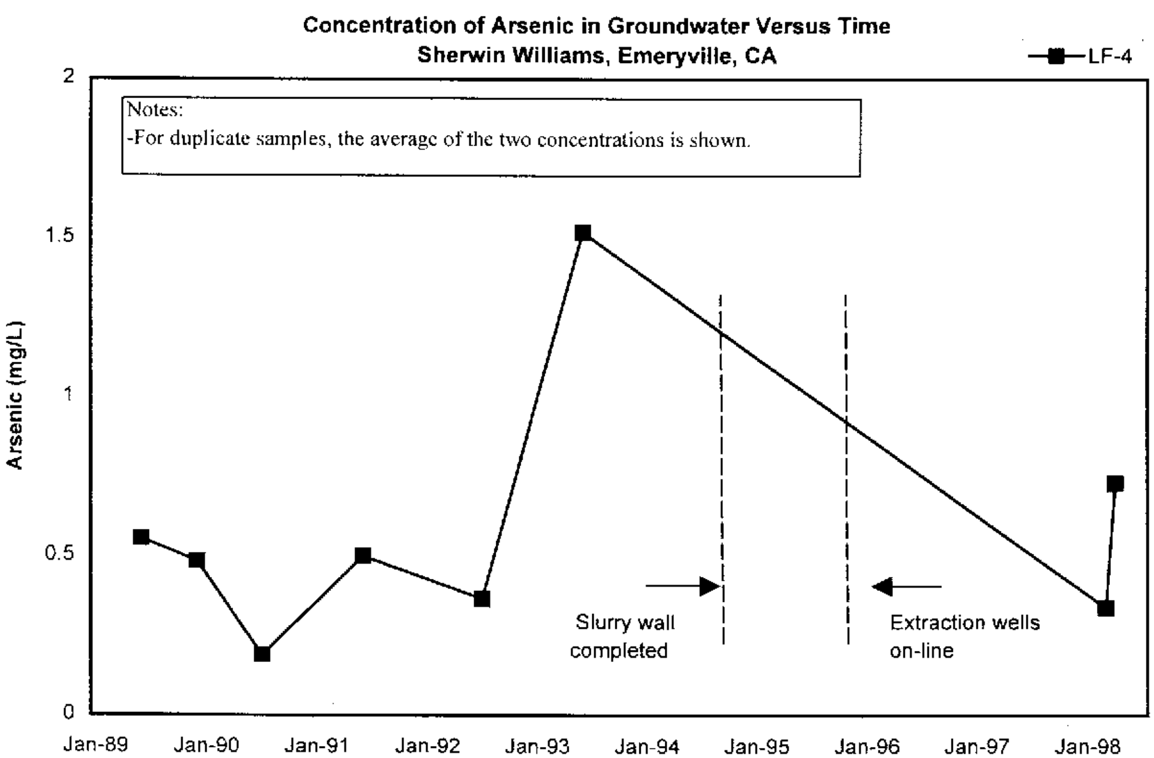
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-14
LF-25
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.5
0.4
0.3
0.2
0.1
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98


Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
EX-1
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
20
15
10
5
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

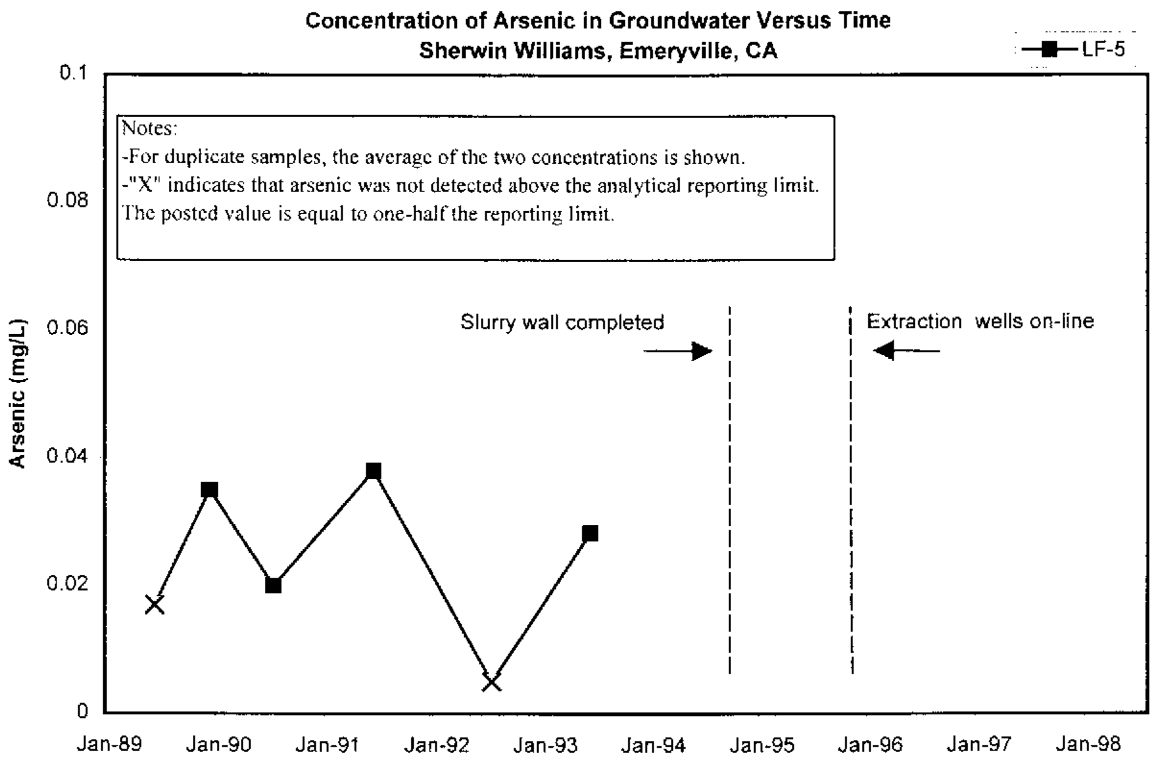

Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
EX-2
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
100
75
50
25
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



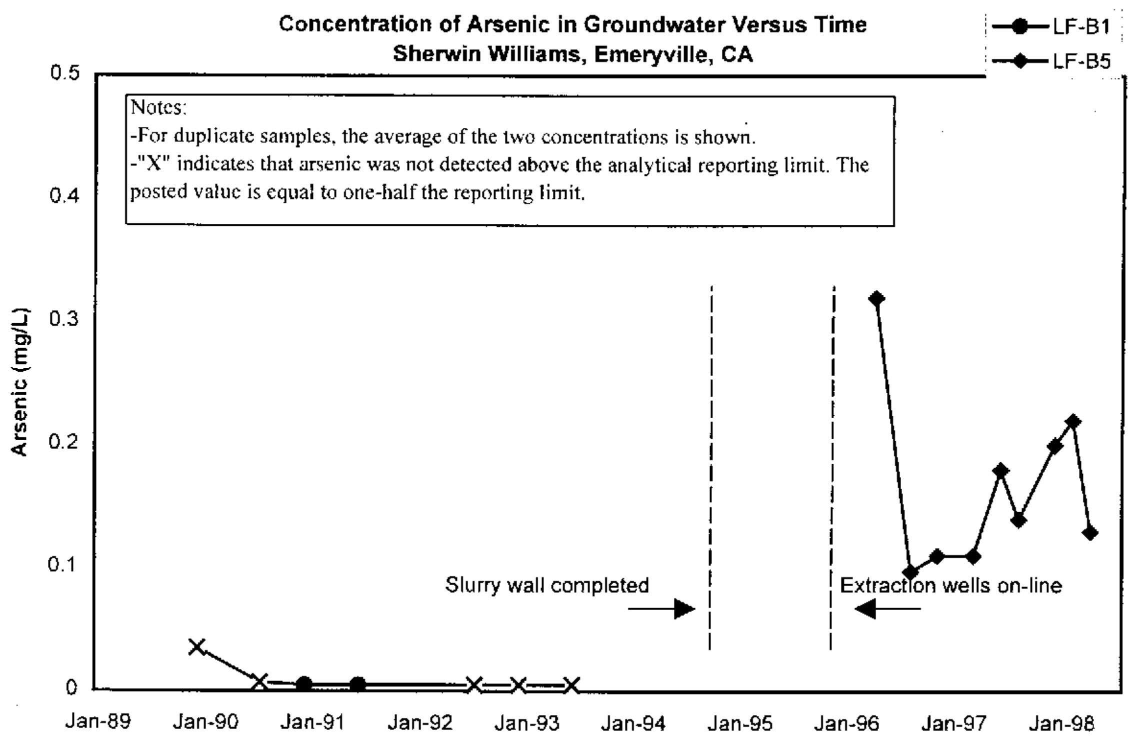
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
EX-3
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
500
400
300
200
100
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



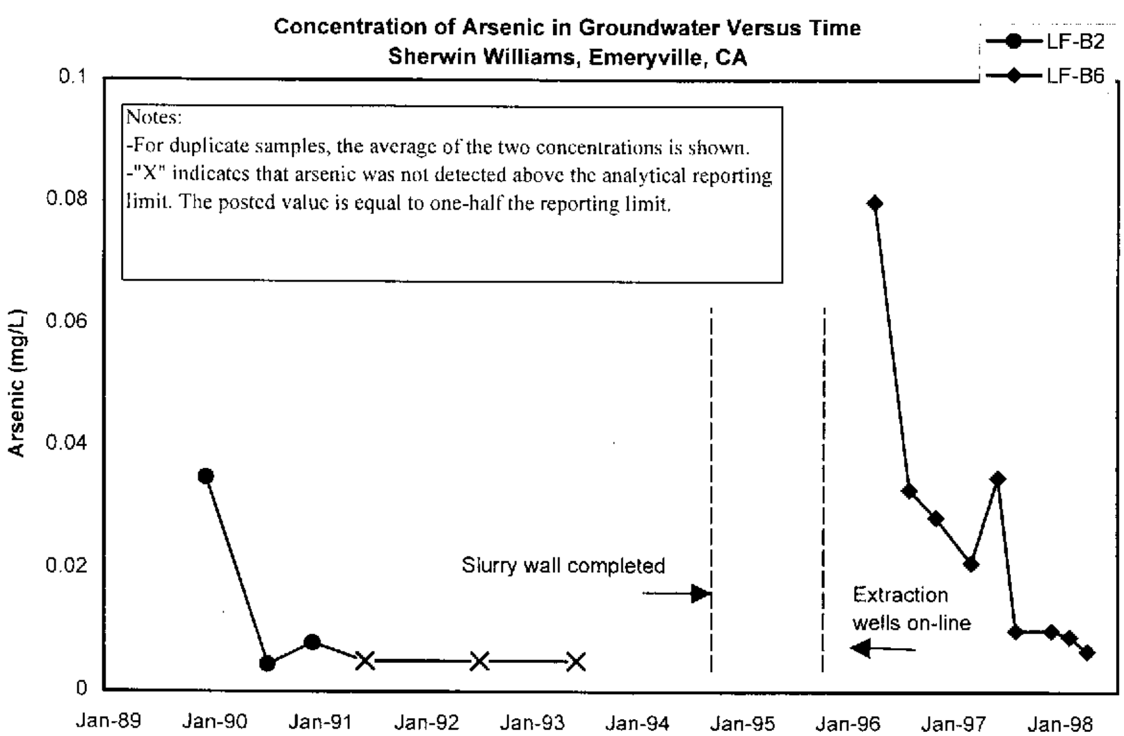
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-4
Notes:
-For duplicate samples, the average of the two concentrations is shown.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
2
1.5
1
0.5
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



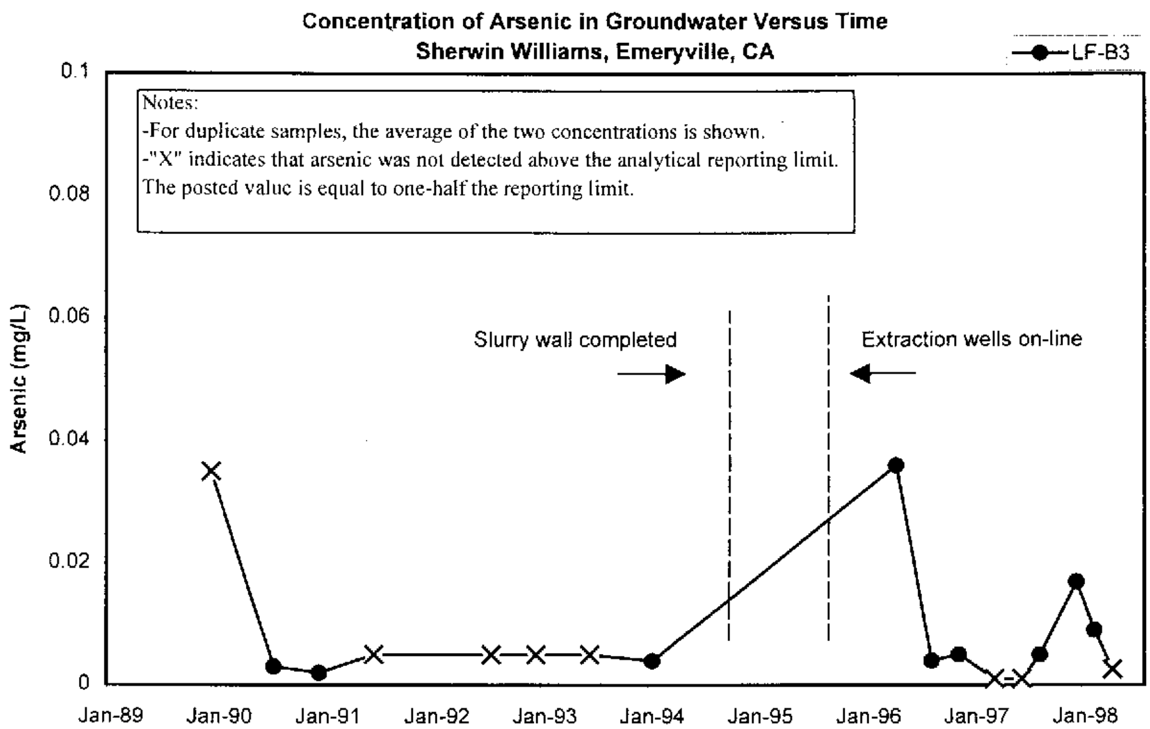
Levine·Fricke·Recon



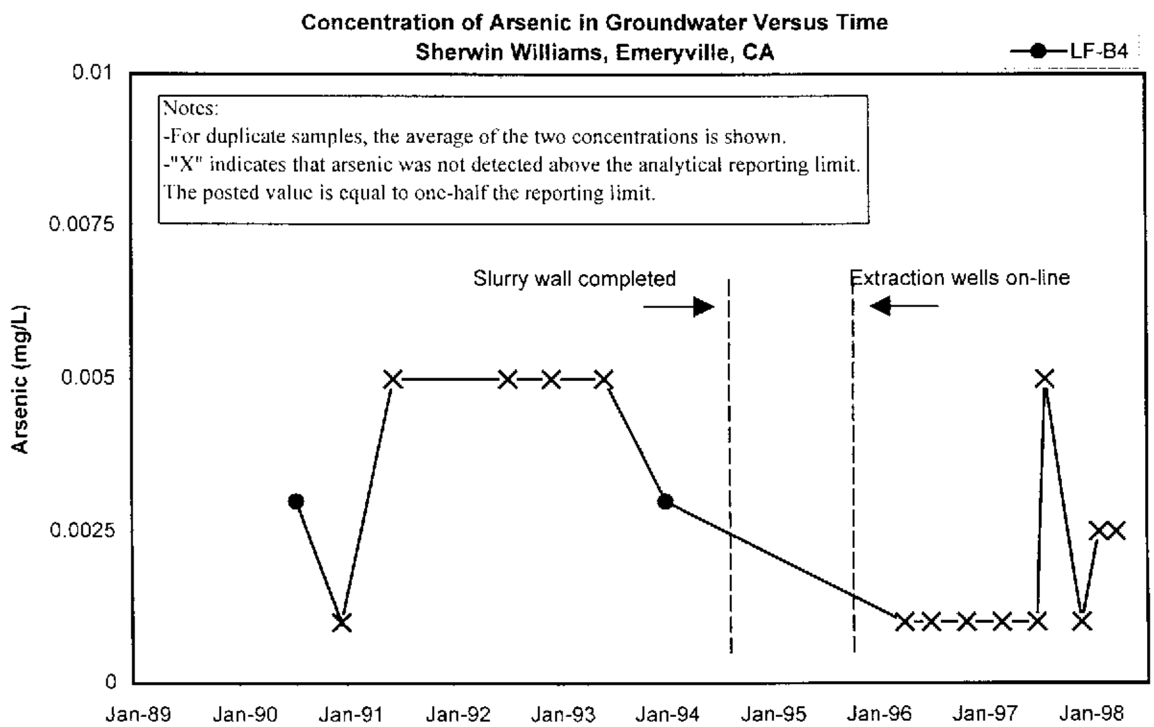
Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-B1
LF-B5
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Arsenic (mg/L)
0.5
0.4
0.3
0.2
0.1
0
Slurry wall completed
Extraction wells on-line
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-B2
LF-B6
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit. The posted value is equal to one-half the reporting limit.
Arsenic (mg/L)
0.1
0.08
0.06
0.04
0.02
0
Slurry wall completed
Extraction wells on-line
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-B3
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.1
0.08
0.06
0.04
0.02
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98



Concentration of Arsenic in Groundwater Versus Time
Sherwin Williams, Emeryville, CA
LF-B4
Notes:
-For duplicate samples, the average of the two concentrations is shown.
-"X" indicates that arsenic was not detected above the analytical reporting limit.
The posted value is equal to one-half the reporting limit.
Slurry wall completed
Extraction wells on-line
Arsenic (mg/L)
0.01
0.0075
0.005
0.0025
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

Appendix D

Evaluation of Alternative Arsenic Removal Treatment Technologies

EVALUATION OF ALTERNATIVE ARSENIC TREATMENT TECHNOLOGIES

In March 1997, LFR prepared a cost and feasibility analysis report to comply with requirements described in Provision E.4 of the general permit. The RWQCB issued the requirement for the feasibility and cost analysis report after three water samples collected from the groundwater treatment system's final effluent in July and September 1996 contained arsenic above the general NPDES discharge limit of 10 ppb. The report evaluated the feasibility and cost of adopting a single 25-ppb site-specific NPDES arsenic discharge limit, eliminating the 10-ppb general NPDES arsenic discharge limit for the Site. This limit is below the State of California's four-day average allowable concentration of 36 ppb of arsenic (III) in saline environments. Based on the information presented in the feasibility and cost analysis report, LFR recommended and the RWQCB concurred with this single site-specific NPDES arsenic discharge limit of 25 ppb.

The March 1997 cost and feasibility analysis report evaluated the technical feasibility of various arsenic treatment technologies to be used either in place of or in addition to the existing GWTS to achieve the general NPDES arsenic discharge limit of 10 μg/l. A number of technologies were reviewed and the arsenic treatment technologies that appeared to be viable alternatives to electrochemical co-precipitation or potential complimenting technologies were retained for further consideration based on their cost and technical effectiveness.

Under the cost and feasibility analysis report, LFR performed an evaluation of the following treatment technologies as alternatives to the Andco electrochemical co-precipitation system:

- ion exchange
- reverse osmosis
- hydroxide precipitation with lime
- sulfide precipitation

LFR investigated whether there had been significant advances in these technologies since the 1991 EIRM report. The results of this evaluation confirmed the conclusions of the 1991 EIRM report that the electrochemical co-precipitation treatment technology was the most feasible and cost effective and did not warrant replacement.

In addition, LFR evaluated the following technologies for use as additional treatment to the existing electrochemical and carbon treatment systems to cost-effectively and consistently meet the NPDES limit for arsenic:

- ion exchange
- reverse osmosis

- arsenic filter bags

The evaluation of these additional technologies indicated that there were significant space and technical constraints limiting the installation of another groundwater treatment system in addition to the Andco and carbon treatment systems currently operating.

In 1997 and early 1998, LFR evaluated potential present and future actions, as well as expansion options to improve the performance of the GWETS. LFR identified several equipment limitations (e.g., filter press, clarifier, and hydrogen peroxide controller unit) in the existing Andco system. As outlined in Section 2.4.2, the current GWTS system has difficulty in consistently meeting the NPDES discharge requirements of 25 ppb at flow rates between 7 and 9 gpm. In addition, normal operation and maintenance of the GWTS is labor intensive and the Andco system generates a large volume of sludge that is difficult to dewater using the existing filter press. Additionally, a significant capital expenditure will be required to upgrade the existing Andco system to handle a flow rate of 30 gpm.

In January 1998, LFR identified to Sherwin-Williams two companies that have recently developed new arsenic-removal technologies. The first company, Klean Earth Environmental Company (KEECO) developed a technology using a proprietary chemical (KB-1™) that chemically bonds to the dissolved metals, encapsulates the metals in a silica matrix, and facilitates their rapid precipitation. A bench-scale treatability study was performed on groundwater collected from the three on-site extraction wells using the KEECO process. Although the KEECO technology reduced arsenic concentrations from 39 milligrams per liter (mg/l; equivalent to parts per million [ppm]) to less than 25 ppb, the technology was eliminated from further consideration because of implementability limitations. The KEECO process requires a specialized silica sand that is highly abrasive to process equipment resulting in frequent changeouts of specially designed mixing blades. LFR concluded this technology would not be technically feasible for a 30-gpm treatment system.

The second company, MSE Technology Applications, Inc. (MSE), had developed two proprietary arsenic removal technologies in conjunction with the University of Montana at Butte ("Montana Tech"), with funding from the U.S. EPA Mine Waste Technology Program. A bench-scale treatability study was performed on a 10-gallon composite water sample collected from the three on-site extraction wells. The first proprietary MSE technology, mineral-like precipitation, was able to lower the arsenic concentration from 81 ppm to a concentration of 50 ppb. The second proprietary MSE technology, catalyzed cementation, was able to lower the arsenic concentration from 61.5 ppm to 9 ppb.

After favorable results were obtained from the bench-scale treatability study, LFR contracted MSE to perform a seven-day pilot-scale demonstration at the Sherwin-Williams Facility. On March 9, 1998, LFR submitted a work plan to the RWQCB outlining the objectives and sample schedule for the seven-day MSE pilot-scale demonstration. Results from the first demonstration, conducted during the second week of March 1998, indicated the mineral-like precipitation process reduced the arsenic concentration in the process water from 46 ppm to 160 ppb and the catalyzed cementation process reduced arsenic concentrations from 46 ppm to 70 ppb. Several factors limiting the effectiveness of the catalyzed cementation process were identified following completion of the first pilot-scale demonstration.

During the first week of April 1998, MSE performed a second pilot-scale demonstration using a modified catalyzed cementation process that addressed the limitation of the first pilot-scale demonstration. The overall objective for the second pilot-scale demonstration was achieved with arsenic concentrations in the process water consistently reduced from 53 ppm to less than 20 ppb.

MSE performed several bench-scale tests during the second pilot-scale demonstration to evaluate the effectiveness of using alternate proprietary reagents for the catalyzed cementation process. The results of the bench-scale tests indicated that the proprietary reagent used during the initial step of the catalyzed cementation process could be replaced by a more efficient and cost-effective proprietary reagent. In addition, the results indicated that the intermediate step of the catalyzed cementation process could potentially be eliminated and the process would still reduce arsenic concentrations to below 25 ppb.

Sherwin-Williams contracted MSE to perform a third pilot-scale demonstration using the revised treatment process (reductive precipitation) during the week of May 18 through 22, 1998. After several adjustments in chemistry were made to the system, the overall objective for the third pilot-scale demonstration was achieved with arsenic concentrations in the process water consistently reduced from 54 ppm to below the NPDES permit limit of 25 ppb. The reductive-precipitation process was performed and evaluated at flow rates between 1 and 5 gpm.

Based on the results of the third pilot-scale demonstration, MSE has started the initial engineering design of a 30-gpm GWTS. MSE personnel performed a walkthrough of the Andco GWTS on May 19 and 20, 1998, to inspect existing equipment used in the Andco GWTS (e.g., clarifier, filter press, multimedia filters, and metering pumps). The equipment was inspected to help determine if several pieces of existing equipment can be utilized in the MSE process or whether new equipment will need to be designed for the new GWTS. The MSE personnel also made initial assessments of the general layout of the treatment system area, piping and electrical requirements, and reviewed project issues with LFR staff.